Chapter 1: Residential

Overview

This initial part establishes the foundational anthropometric data for residential design, providing minimum and recommended dimensions for both adults and children. It then applies these principles to the planning of general living areas and provides an exhaustive analysis of living room furniture, standard sizes, clearances, and a comprehensive set of 36 distinct furniture arrangement schemes. The goal is to ensure spaces are designed for comfort, function, circulation, and human interaction.

Key Standards and Codes Referenced

- "Time-Saver Standards," 1st ed., F. W. Dodge Corp., New York, 1946. (Source for human dimension figures)
- "Manual of Acceptable Practices," Vol. 4, U.S. Dept. of Housing and Urban Development, 1973. (Source for living area planning diagrams)

Section: Dimensions of the Human Figure (Pages 3-4)

Overview

This section provides the essential dimensional data for the average adult and child, which serves as the basis for all subsequent spatial planning and furniture clearances. It emphasizes that these are minimum requirements and should be increased where possible.

Technical Specifications

Dimensions of Adults

- Tabletop Height: Standard height is 2 ft 5 in. Some authorities prefer 2 ft 6 in or 2 ft 6 ½ in.
- Doorways and Passageways: Sizing should primarily be determined by the requirements for moving furniture, which typically exceeds the space needed for an average adult.

Dimensions of Children

- Physical Proportions: Children's proportions differ from adults, and their space requirements can be approximated from the provided data.
- Average Height of Children Table:

Age	Height (in)	Age	Height (in)
5	44	11	56
6	46	12	58
7	48	13	60
8	50	14	62
9	52	15	64
10	54	16	66

Visual Elements Analysis

Figure 1: Dimensions and clearances for children (Page 3)

Description: This figure presents six simplified diagrams illustrating the spatial requirements of children relative to their total height, denoted as 'H'. Technical Details:

- Forward Reach (Standing): ¾ H
- Overhead Reach (Standing): 1 H
- Side Reach (Arm Outstretched): ½ H
- Clearance for Seated Child: ¼ H is shown as the clearance from the top of the head to an overhead obstruction.
- Passage Clearance: Two children passing require a width of ½ H + ¼ H.
- Seated Child at Table: The height from the floor to the top of the head is ¾ H. Construction Notes: These proportional dimensions are critical for designing spaces like playrooms, schools, and children's bedrooms, ensuring that furniture and ceiling heights are appropriate. Relationship to Text: This figure visually quantifies the text's statement that children's space requirements can be approximated.

Figure 2: Dimensions and clearances for adults (Page 3)

Description: A series of six detailed diagrams providing minimum anthropometric data and clearances for various adult postures. Technical Details:

- Standing Adult (Front View):
  - Body width at shoulders: 1'-6"
  - Minimum passage width: 2'-8"
  - Arm span (outstretched): 5'-0"
  - Height: 5'-9"
  - Minimum clearance for one person walking: 2'-8" width.
- Standing Adult (Side View):
  - Body depth: 1'-2"
  - Minimum passage width: 1'-6"
- Standing Adult (Plan View):
  - Turning radius for movement: 3'-9" diameter circle.
  - Reach forward with arm: 2'-8"
- Crouching/Reaching Adult:
  - Clearance needed for forward reach: 2'-10"
- Seated Adult at Table:
  - Knee height: 1'-11"
  - Thigh height: 1'-7"
  - Table top height: 2'-6"
  - Clearance from table edge to wall behind: 3'-2"
- Reaching Up to Shelf:
  - Maximum shelf height for comfortable reach: 6'-0"
  - Eye level: 5'-0"
  - Body depth: 1'-2" Relationship to Text: These diagrams provide the specific, minimum numerical values for clearances and body dimensions discussed in the "Dimensions of Adults" text.

Figure 2 (cont.): Dimensions of the Human Figure (Page 4)

Description: A collection of eight detailed diagrams showing adults in various seated and interactive postures, providing critical dimensions for furniture design and placement. Technical Details:

- Man at Desk: Seated height: 2'-11". Seat height: 1'-6". Desk height: 2'-5". Total depth required: 4'-0".
- Man at Dining Table: Seated height: 2'-11". Seat height: 1'-6". Table height: 2'-5". Total depth for chair and access: 3'-10".
- Man at Small Table: Seated height: 2'-11". Table height: 2'-5". Space from table edge to wall: 2'-1".
- Kneeling/Crawling Posture: Height: 2'-6".
- Two People at Dining Table: Distance between people: 2'-3". Table width shown: 3'-0".
- Squatting Posture: Length: 1'-10". Height: 3'-7".

- Seated in Lounge Chair: Total length: 3'-11". Total height: 2'-10". Seat height: 1'-6".
- Two People in Lounge Chairs: Distance between chairs: 5'-4". Total span required: 11'-0". Relationship to Text: These drawings expand upon the previous page, providing the specific dimensions needed to arrange furniture for activities like dining, studying, and conversation.

Section: Living Areas (Page 5)

Overview

This section outlines high-level planning considerations and specific furniture clearances for general living areas to ensure functional, comfortable, and well-circulated spaces.

Technical Specifications

Planning Considerations

- Traffic: Through traffic must be separated from activity centers.
- Openings (Doors/Windows): Must be located to provide adequate solid wall space for flexible furniture arrangements.
- Access: Convenient access to doors, windows, and utilities (outlets, thermostats, etc.) is required.

Furniture Clearances

- Facing Seating: 60 in clearance required between seating pieces for conversation.
- Circulation between Furniture: 24 in minimum clearance where secondary circulation occurs.
- Desk Use: 30 in minimum clearance for a person to use a desk.
- Main Traffic: 36 in minimum clearance for main circulation paths.
- Television Viewing: 60 in minimum distance between the television set and seating.
- Conversation Area: A 10-ft diameter circle is recommended for a comfortable conversation grouping.

Visual Elements Analysis

Figure 1: Plan (Page 5)

Description: A schematic plan of a living area showing a primary conversation group and a secondary activity area (desk). Technical Details:

- A 10' diameter conversation area is clearly marked, containing a sofa and two armchairs.
- A 30" clearance is indicated for the use of a desk.
- Traffic flow lines are drawn to indicate circulation paths from the main entrance to the sleeping area, dining area, and kitchen area, routed around the conversation group. Construction Notes: This plan exemplifies the principle of separating main traffic from the core activity zone of the living room. Relationship to Text: This figure visually demonstrates the "10-ft diameter circle" for conversation and the "30 in for use of desk" clearance mentioned in the text.

Figure 2: Minimum clearances, circulation and conversation areas for living rooms (Page 5)

Description: Three different living room layouts illustrating the application of clearance and circulation principles. Technical Details:

- Layout 1 (Top Left): Shows "Main traffic through living area" with a 36" clearance. A secondary path to a desk is marked "Traffic to desk" with a 24" clearance. The conversation area is defined by a 10' diameter circle.
- Layout 2 (Top Right): Illustrates "Traffic through living area" with a 36" main traffic lane skirting the primary seating group. A secondary "minor traffic way" is also shown.
- Layout 3 (Bottom Left): Depicts "Main Traffic bypasses Living Area," which is the ideal scenario. The conversation and desk areas are kept separate from the primary circulation path running from the entrance to the kitchen/dining area. A 36" traffic way is shown. Construction Notes: These diagrams are guides for arranging furniture to create functional zones while maintaining clear paths for movement, distinguishing between major and minor traffic flow. Relationship to Text: These three plans illustrate the key concepts of traffic separation and furniture clearances detailed in the accompanying text.

Section: Living Rooms (Pages 6-14)

Overview

This extensive section provides detailed guidelines on living room design, covering specific space allowances, typical furniture groups, a visual catalog of furniture sizes, and numerous illustrated arrangement possibilities.

Technical Specifications

Specific Space Allowances (Page 6)

- Single Passage (between low objects): 18 in is the minimum (e.g., between a sofa and coffee table).
- Single Passage (between tall objects, hip height or over): 2 ft to 2 ft 6 in is the minimum.
- General Traffic Lane: 3 ft 4 in is the practical minimum. This should increase in larger rooms.
- Confined Seating Area: 3 ft is the minimum tolerance (e.g., between a desk and a wall), allowing a person to pass behind an occupied chair. This is not a major traffic lane.

Living Room Clearances (Page 6)

- Main Entrance Traffic Lane: 3 ft 4 in wide is typical; 4 ft 6 in is preferred.
- Fireplace Group Clearance: 4 ft 8 in minimum clearance between facing furniture for a standard 3 ft wide fireplace.
- Conversation Distance: A 6-ft tolerance between seating is considered the maximum for comfortable conversation.

Typical Furniture Groups

1. Primary Conversation: Chairs and sofa, typically around a fireplace.
2. Secondary Conversation: Chairs and love seat.
3. Reading: Chair, ottoman, lamp, table.
4. Writing/Study: Desk, lamp, chair(s), bookcases.
5. Music: Piano, bench, storage.
6. Game: Game table and four chairs.
7. Television: TV set and seating.

Calculations and Formulas

Fireplace Clearance Calculation

Formula: C_min = 4' 8" + (W_fp - 36") Variables:

- C_min = Minimum clearance space between facing pieces of furniture in a fireplace group.

- W_fp = Width of the fireplace opening in inches. Procedure: The rule states that for every inch added to the width of a fireplace beyond the standard 3 ft (36 in), one inch should be added to the minimum clearance space of 4 ft 8 in. Example: For a fireplace that is 4 ft (48 in) wide, the increase is 12 inches. The new minimum clearance would be 4' 8" + 12" = 5' 8".

Visual Elements Analysis

Furniture Sizes (Page 7)

Description: A visual catalog of 42 common pieces of residential furniture, each with standard average dimensions. This page serves as a key for the arrangement diagrams that follow. Technical Details: A comprehensive list of furniture with dimensions (L=Length, D=Depth, H=Height, DIAM=Diameter).

- Sofas:
  - xxxvii. Sheraton: 6'-0"L x 2'-6"D x 3'-0"H
  - xxxviii. Chippendale: 6'-6"L x 2'-6"D x 3'-0"H
  - xxxix. Plain Upholstered: 7'-0"L x 3'-0"D x 2'-0"H
- Love Seats:
  - xxxvii. Small: 4'-0"L x 2'-6"D x 3'-0"H
  - xxxviii. Large: 4'-6"L x 2'-6"D x 3'-0"H
- Chairs:
  - xxxvii. Club: 2'-6"L x 3'-0"D x 3'-0"H
  - xxxviii. Occasional: 2'-3"L x 2'-6"D x 3'-0"H
  - xxxix. Wing: 2'-6"L x 2'-6"D x 3'-0"H
  - xl. Side or Desk: 1'-6"L x 1'-6"D x 2'-6"H
  - xli. Upholstered Armless: 2'-0"L x 2'-6"D x 2'-6"H
  - xlii. Upholstered Corner: 3'-0"L x 3'-0"D
  - xliii. Bridge Arm: 2'-0"L x 2'-0"D x 2'-6"H
  - xliv. Bridge Armless: 1'-6"L x 1'-6"D x 2'-6"H
- Desks:
  - xxxvii. Flat Top Small: 4'-0"L x 2'-0"D x 2'-6"H
  - xxxviii. Flat Top Large: 5'-0"L x 2'-6"D x 2'-6"H
  - xxxix. Flat Top Very Large: 6'-0"L x 3'-0"D x 2'-6"H
  - xl. Governor Winthrop: 3'-0"L x 2'-0"D x 5'-6"H
  - xli. Secretary: 3'-0"L x 2'-0"D x 7'-0"H
- Breakfront Book Cases:
  - xxxvii. Small: 4'-0"L x 1'-6"D x 6'-6"H
  - xxxviii. Large: 5'-0"L x 1'-6"D x 7'-0"H
- Tables:

xxxvii. End Table (Rectangular): 2'-0"L x 1'-3"D x 2'-0"H
xxxviii. End Table (Square): 1'-8"L x 1'-8"D x 2'-0"H
xxxix. Coffee Table: 3'-0"L x 1'-6"D x 1'-6"H
xl. Bridge Table: 2'-6"L x 2'-6"D x 2'-6"H
xli. Console: 3'-0"L x 1'-6"D x 2'-6"H

- Lowboys & Highboys:
  xxxvii. Lowboy (Average): 2'-6"L x 1'-6"D x 2'-6"H
  xxxviii. Lowboy (Large): 3'-2"L
  xxxix. Highboy (Swan Top): 3'-0"L x 1'-6"D x 7'-0"H
  xl. Highboy (Flat Top): 3'-0"L x 1'-6"D x 5'-0"H
- Circular Pieces:
  xxxvii. Low Coffee Table: 3'-0" DIAM x 1'-6"H
  xxxviii. Drum Table: 3'-0" DIAM x 2'-6"H
  xxxix. Piecrust Table: 3'-0" DIAM x 2'-6"H
  xl. Lamp Table: 2'-0" DIAM x 2'-6"H
  xli. Dumbwaiter: 2'-0" DIAM x 2'-6"H
  xlii. Stand: 1'-0" DIAM x 2'-6"H
  xliii. Roundabout Seat: 4'-0" DIAM, 2'-6" Seat Depth
- Pianos:
  xxxvii. Concert Grand: 9'-0"L x 5'-0"D
  xxxviii. Music Room Grand: 7'-0"L x 5'-0"D
  xxxix. Parlor Grand: 6'-0"L x 5'-0"D
  xl. Baby Grand: 5'-6"L x 5'-0"D
  xli. Console: 5'-0"L x 2'-0"D
  xlii. Miniature: 4'-8"L x 1'-7"D Relationship to Text: This figure is the master reference for all furniture arrangement diagrams on pages 8-13.

Furniture Arrangements (Pages 8-13)

Description: A series of 36 schematic floor plans demonstrating various furniture arrangements in living rooms of different sizes and configurations. Each diagram is accompanied by a short description of its design intent. *Note*: *A complete analysis of all 36 diagrams is extensive. A representative sample will be detailed here to demonstrate the methodology, with a summary of the principles shown across all diagrams.*

Representative Analysis (Figure 2, Page 8):

- Figure Title/Number: Figure 2
- Description: The text states this arrangement requires a 3'-4" clearance between the low coffee table (#23) and easy chairs (#6) because the aisle constitutes a major traffic way.

- Technical Details: The room is 15'-0" wide by 25'-6" long. The main conversation group includes a sofa (#2) and two chairs (#6) facing each other across a coffee table (#23), centered on the fireplace. The clearance between the chairs and coffee table is marked as 3'-4". A secondary group with a game table (#24) and chairs (#9) is in a corner. A console piano (#41) is against another wall.
- Construction Notes: This layout emphasizes that functional requirements (major traffic) override standard clearances (the usual 18" for passage past low furniture). The positioning of furniture must account for circulation paths.
- Relationship to Text: This diagram visually demonstrates the "General traffic lane" requirement of 3'-4" from page 6, applying it to a specific furniture grouping.

Summary of Principles from Figures 1-36:

- Focal Points: Fireplaces are the most common focal point, but bay or picture windows can be used instead. Arrangements can be symmetrical or asymmetrical depending on the focal point's location.
- Room Size & Function: Room dimensions dictate the number of furniture groups possible. Minimum room lengths are given for specific items like a baby grand piano (approx. 20 ft). Larger rooms (e.g., Fig 22) can contain four or more groups.
- Traffic and Circulation: Door placement is critical. Doors at the ends of a room can create a major traffic route along one wall (Fig 6). Doors flanking a fireplace are to be avoided. Dead-end rooms (no through traffic) allow the primary furniture group to be more spread out (Fig 8). Traffic lanes must be increased to accommodate two people passing side-by-side (from 3'-4" to at least 4'-10", Fig 18).
- Clearances: Specific clearances are reiterated throughout the diagrams (e.g., 6'-0" between sofa and fireplace, 3'-4" for traffic lanes, 1' between piano and wall).
- Flexibility and Grouping: Sofas can be omitted to bring groups closer (Fig 5). Groups can be merged (Fig 11) or divided (Fig 14). Unit/modular sofas are well-suited for corner groupings (Fig 36).
- Furniture Selection: The use of smaller chairs (2'-6" x 3'-0" noted in Fig 7 & 12) or love seats instead of full sofas (Fig 24) can save space.

Living Room - Furniture Sizes and Clearances (Page 14)

Description: Four diagrams summarizing key furniture dimensions and clearances for common living room activities: conversation, card playing, sleeping (convertible sofa), and studying. Technical Details:

- Conversation Group (Top Diagram):

    - Sofas (B): 2'-8" to 3'-6" deep; 6'-0" to 7'-2" long.
    - Love Seats: 2'-0" to 2'-10" deep; 3'-6" to 4'-6" long.
    - End Tables (A): 10" to 1'-2" wide; 1'-6" to 3'-0" long.
    - Occasional Tables (C): 2'-0" to 2'-4" square/round/oval.
    - Clearances shown: 4'-6" between facing sofas; 2'-4" for passage behind a chair. Total width for arrangement is 9'-0".
- Card Table Group (Middle Diagram):
    - Card Tables: 2'-6" to 3'-0" square.
    - Side Chairs: 1'-6" to 2'-0" wide; 1'-6" to 1'-10" deep.
    - Clearances shown: 3'-0" clearance behind chairs from a wall or other obstruction. Total area for 4-person group: 5'-6" x (approx. 8'-8").
- Double Bed Studio Couch (Bottom Left):
    - Convertible Sofa-Beds (G): 2'-9" to 3'-3" deep; 6'-2" to 6'-8" long.
    - Clearance to open bed: 4'-8" from the wall.
    - Bed length shown as 6'-0" to 7'-0".
- Desk Group (Bottom Right):
    - Book Cases (D): 2'-6" to 3'-0" wide; 10" to 12" deep.
    - Desks: 2'-8" to 3'-8" wide; 1'-6" to 2'-8" deep.
    - Clearance needed: 3'-0" from desk to wall. Relationship to Text: These diagrams serve as a final, consolidated summary of the dimensional data required for laying out common living room functions. They distill the principles from the preceding pages into quick-reference visuals.

BOQ Implications

- Space Planning: Room areas in the BOQ must account for these specified clearances, not just the net area of furniture. Bills of Quantities for interior fit-outs must consider the "use space" around furniture as a quantifiable area requirement.
- Furniture Procurement: The provided dimensions represent average sizes. When preparing FF&E (Furniture, Fixtures, and Equipment) schedules and budgets, designers must verify the actual dimensions of specified products to ensure they fit within the planned layouts and clearances.
- Cost Estimation: The selection of larger furniture or the need for wider clearances (e.g., for wider fireplaces) directly impacts the required Gross Floor Area (GFA) of a residence, which is a primary driver of construction cost.
- Labor Considerations: Passageway and door dimensions are critical for the logistics of moving furniture into the building and rooms. Inadequate sizing can lead to increased labor costs, damage to goods, or the need for specialized moving equipment.

Critical Notes and Warnings

- Minimums vs. Recommendations: The document repeatedly stresses that the dimensions given are MINIMUMS and should be increased for comfort where possible (e.g., preferred traffic lane width of 4'-6" vs. 3'-4" minimum).
- Furniture vs. Human Scale: Passageways and doors must be sized for furniture movement, a common design oversight.
- Conversation Distance: A distance greater than 6 feet between seated persons is noted as making conversation difficult, a key functional constraint for living room layouts.
- Traffic Flow: Doors flanking a fireplace are to be avoided to prevent traffic from disrupting the primary conversation group. Traffic lanes must be kept clear and separate from activity zones.

Cross-References

- The section on Adult Dimensions (p.3) explicitly cross-references the later section on Furniture Sizes.
- The Furniture Arrangement diagrams (p. 8-13) implicitly and numerically reference the Furniture Sizes key on page 7.
- The general Living Area clearance rules on page 5 are elaborated upon with more specific cases in the Living Room section on page 6.

Chapter 1: Residential (Part 2 of 5)

Overview

This part of the chapter transitions from general living spaces to the specific requirements of dining. It provides a highly detailed breakdown of the factors involved in planning a dining room, including space per person, clearances for seating and passage, furniture sizes, and storage for tableware. It then explores the architectural implications of combining dining functions with other areas, specifically the living room and the kitchen, detailing the necessary clearances and functional layouts for these integrated spaces.

Key Standards and Codes Referenced

- Indoor Dining Areas for Rural Homes in the Western Region, Report 118, University of Arizona Agricultural Experiment Station, Tucson (June 1955).

- Storage Space Requirements for Household Textiles, A. Woolrich, M. W. White, and M. A. Richards, Agricultural Research Bulletin 62-S, U.S. Department of Agriculture, Washington, D.C. (1955).
- "Manual of Acceptable Practices," Vol. 4, U.S. Dept. of Housing and Urban Development, 1973.
- "Housing for the Elderly Development Process," Michigan State Housing Development Authority, 1974.

Section: Dining Areas (Pages 15-19)

Overview

This section outlines the principal factors for planning a dining area: number of persons, space per person at the table, chair and passage space, seating arrangement, furniture type, and storage. It provides specific, research-based dimensions for all of these components.

Technical Specifications

Place Setting and Table Dimensions

- Place Setting Width:
  - Minimum: 21 in.
  - Desirable: Up to 29 in for freedom of movement.
  - Adequate/Typical: 25 in.
- Place Setting Depth: Minimum: 14 ½ in. This allows for china, glassware, silver, and elbow extension.
- Table Width:
  - Minimum: 36 in.
  - Satisfactory: 36 in to 44 in.
- Table Space per Person (Perimeter):
  - Crowded Seating: 1'-10" on the table's perimeter.
  - Comfortable Seating: 2'-0" on the table's perimeter.

Clearances

- Passage Behind Chairs:
  - Minimum Recommended: 22 in.
  - Satisfactory Range: 22 in to 25 in.
- Chair Push-Back (No Passage): Minimum 5 in plus the depth of the chair is required to push back when leaving the table.
- General Dining Area Clearances (from table edge):

    - For chairs plus access: 32 in.
    - For chairs plus access and passage: 38 in.
    - For serving from behind a chair: 42 in.
    - For passage only: 24 in.
    - From table to base cabinet (in a dining-kitchen): 48 in.

Storage Space

- Shelf Space for Dishes/Glassware (Medium-Income Family):
    - Moderate Supply: 21 ft-0 in of 12-in deep shelves, or 2 ft of 20-in deep shelves.
    - Liberal Supply: 36 ft-9 in of 12-in deep shelves, or 2 ft of 20-in deep shelves.

Furniture Sizes (from Page 16 & 19)

- Portable Tables, Round (A): 2'-7" to 5'-10" diameter.
- Portable Tables, Rectangular (C): 2'-6" to 4'-0" wide by 3'-6" to 8'-0" long; or 2'-0" to 4'-0" square.
- Dining Chairs, Portable: 1'-6" to 2'-0" wide by 1'-6" to 1'-10" deep.
- Serving Table (B): 2'-6" to 3'-6" wide by 1'-2" to 1'-9" deep.
- Sideboard or Buffet (B): 4'-0" to 6'-6" wide by 1'-6" to 2'-1" deep.
- China Cabinet (B): 2'-8" to 3'-8" wide by 1'-2" to 1'-9" deep.

Visual Elements Analysis

Table 1: Inside dimensions of drawers for storage of silverware (Page 15)

Description: A table specifying the required internal drawer dimensions (width, depth, height) for storing silverware sets of different sizes. Technical Details:

Item (Service for)	Width (in)	Depth (in)	Height (in)
8 persons	11	18 ½	2 ¾
12 persons (20 ½ forks/knives...)	14 ½	20	3
12 persons (17 forks/knives...)	17	19 ½	2 ¾

Table 2: Dimensions of stacks of folded table linens (Page 15)

Description: A comprehensive table detailing the minimum and maximum storage space dimensions required for various types of folded table linens, categorized by

16 in. deep and 20 in. deep storage spaces. Dimensions are front-to-back, side-to-side, and height. Technical Details: (Example data)

- Item: 2 large tablecloths, guest use
- Space 16 in. deep: Min: 14x19x3 in, Max: 14x36x2 in.
- Space 20 in. deep: Min: 19x14x3 in, Max: 19x28x2 in.
- Item: 12 small napkins (2 stacks of 6)
- Space 16 in. deep: Min/Max: 7x10x3 in.
- Space 20 in. deep: Min: 10x5x3 in, Max: 10x9x2 in. *Note: The table provides data for 7 categories of linens.*

Figure 1-3: Place setting and Chair Clearances (Page 15)

- Figure 1: Size of place setting: Shows a 25" wide by 14 ½" deep area required per person.
- Figure 2: Passage behind chairs: Illustrates a 22" clearance for passage behind a seated diner.
- Figure 3: Leaving the table: Shows the space required for a person to push their chair back and stand up, indicating a clearance needed from the table edge.

Dining Area Layouts (Page 16)

Description: Four diagrams illustrating clearances for round and rectangular dining tables with varying levels of crowding. Technical Details:

- Top Left (Round Table, Crowded): Approx. 9'-4" diameter area for a 4-foot table with 2 leaves and crowded seating.
- Top Right (Round Table, Comfortable): Approx. 15'-0" diameter area for a 4-foot round table with 4 leaves, indicating more generous spacing.
- Bottom Diagrams (Rectangular Table): Shows clearances like 1'-10" to 2'-2" behind chairs for access, and 2'-6" to 3'-0" for passage. A total room width of 10'-10" is shown for a rectangular table with passage on both sides.

Figure 4 & 5: Dining Room Plans (Page 17)

- Figure 4 (6-person): Shows a room with a table, requiring 38" for "chairs plus passage" on one side and 42" for "serving" on the other.
- Figure 5 (8-person): Similar to Fig. 4 but for a larger table, showing 38" for "chairs plus access" on both sides.

Figure 6: Minimum clearances for dining areas (Page 17)

- Description: Two layouts showing clearances when a table is placed against a wall.

- (a) one end of table against wall: Shows 42" for serving behind chairs on the long side and 32" for chair access on the other long side.
- (b) serving from one end and one side: Shows 42" for serving on one side and the end, with 32" for chair access on the remaining side.

Figure 7: Dining room furniture (Page 19)

Description: A master visual guide to standard dining furniture dimensions and clearances. Technical Details:

- Clearances for Dining Tables (Chart):
  - A (Chair only): 2'-0"
  - B (Human passage only): 1'-8"
  - A (Passage for tray service): 4'-10"
  - B (Passage for tray service): 3'-2"
  - Minimum Knee Clearance: 1'-6" width, 1'-10" height.
- Furniture Dimensions: Provides dimensions for Buffets, Sideboards, Serving Tables, China Cabinets, and Corner Cupboards.
- Table Examples: Shows spatial footprints for tables seating two (2'-6"x2'-6"), four (2'-6"x3'-2"), six (3'-6"x6'-0"), and eight (3'-4"x4'-0" or 4'-0"x4'-0").

Calculations and Formulas

Table Length Calculation (Page 15)

- Basis: Assumes 25-inch wide place settings and one person seated at each end.
- Procedure: For 'n' persons, the length is calculated based on the number of people on the long sides. Example for 6 people (2 on each long side, 1 on each end): Length = (2 * 25") + clearances. The table provides researched minimums and recommendations.
- Data Table:

Persons	Minimum Length (in)	Recommended Length (in)
4	54	60
6	79	84

8	104	108
10	129	132
12	154	156

- Adjustment: If no one is seated at the ends, table length can be reduced by approx. 4 in.

Total Dining Area Calculation (Page 15)

- Basis: Assumes a 42-in. wide table and an ample 42-in. space for passage on all sides.
- Formula: Total Area = (Table Width + 2 * Passage Width) x (Table Length + 2 * Passage Width).
- Data Table:

Persons	Required Size (ft)	Area (sq ft)
4	10½ x 12	126
6	10½ x 14	147
8	10½ x 16	168
10	10½ x 18	189
12	10½ x 20	210

- Adjustment: If no one is seated at the ends, the length can be reduced by 2 ft, resulting in a 21 sq ft area reduction.

BOQ Implications

- Area Calculation: The gross floor area for dining rooms must be calculated based on the table size plus the required clearances for passage and serving, not just the room's net dimensions. The tables provide direct sq ft requirements per number of diners.
- FF&E Specification: Dimensions for tables, chairs, and storage units (buffets, sideboards) are provided, which can be used to create accurate furniture schedules for procurement.
- Storage Millwork: The specifications for silverware drawers (Table 1) and linen storage (Table 2) give precise internal dimensions required for custom or semi-custom cabinetry, directly impacting the millwork BOQ.

Section: Combined Living-Dining Spaces (Page 20)

Overview

This section addresses the benefits and design requirements of combining living and dining functions into a single, larger room, emphasizing the need for a wide opening between the functional zones.

Technical Specifications

- Opening Requirement: To be considered a combined room, adjacent spaces need a clear opening of at least 8 ft.

Visual Elements Analysis

Figure 8 & 9: Combined living-dining room layouts (Page 20)

Description: Two diagrams illustrating functional arrangements and circulation paths in combined living-dining spaces.

- Figure 8 (Formal Diagram):
  - Technical Details: Shows a conversation area with 60" between facing seating, a 36" main traffic path, a 38" path for access and passage around the dining table, and a 24" passage in a secondary area.
  - Relationship to Text: This diagram visually combines the separate clearance rules for living and dining areas into one integrated space.
- Figure 9 (Sketch Diagrams):

- Description: Three hand-drawn sketches showing different circulation patterns.
- Top Sketch: Shows 32" for chair plus passage and a path from the entrance to the kitchen.
- Bottom Left Sketch: Shows a desk area with 30" to use desk and a main path bypassing the living/dining areas.
- Bottom Right Sketch: Shows a main traffic path of 36" to 40" through the space, with furniture arranged to accommodate it.
- Construction Notes: These sketches emphasize that even in combined spaces, circulation must be clearly defined and should not interfere with the primary activity zones.

Section: Combined Dining Area-Kitchen (Page 21)

Overview

This section describes the combined kitchen-dining arrangement, a popular choice in smaller homes that minimizes housekeeping. It details the specific clearances needed to make such a space functional for both cooking and informal family dining.

Technical Specifications

- Counter Dimensions:
  - A 21" sink counter is shown combined with a 21" range counter.
  - A separate combination shows a 21" sink counter with a 15" refrigerator counter and 36" of range counter.
- Clearances:
  - For serving: 42"
  - For chair and passage: 38"
  - For chair plus access: 32"

Visual Elements Analysis

Figure 10: Combined dining area-kitchen (Page 21)

Description: A plan of a 2-bedroom unit's kitchen-dining area. Technical Details: The layout shows a U-shaped kitchen with an integrated dining table. Clearances are marked: 38" for chair and passage, 32" for chair plus access, and 42" for serving from the counter to the table. Relationship to Text: This figure provides a clear, dimensioned example of a functional kitchen-dining layout.

Figure 11: Minimum clearances for dining area in kitchen (Page 21)

Description: Four hand-drawn sketches illustrating various layouts and minimum clearances for eat-in kitchens.

- Top Sketch: Shows 32" for chair plus access and 18" for passage behind chair.
- Middle Sketch: Shows 24" for circulation past a table and 32" plus access for a chair at the table.
- Bottom Left Sketch: Shows a booth-style setup with 48" from base cabinet to the table edge and 18" for chair plus passage.
- Bottom Right Sketch: Illustrates a "pull-out table with 22" seating one side," indicating a space-saving strategy. Construction Notes: These sketches provide a range of solutions for incorporating dining into a kitchen, from simple tables to built-in units, with all necessary clearances specified.

Chapter 1: Residential (Part 3 of 5)

Overview

This part provides detailed architectural standards for private sleeping areas. It begins with a catalog of typical bedroom furniture sizes and establishes critical clearances for circulation, dressing, and furniture use. The section presents numerous plan diagrams for various occupancies, including single, double, twin-bed, and specialized layouts for the elderly and dormitories. It then extends these principles to combined living-sleeping spaces, such as 0-bedroom or studio units, with a specific focus on layouts that accommodate wheelchair users, introducing accessibility standards.

Key Standards and Codes Referenced

- "Manual of Acceptable Practices," Vol. 4, U.S. Department of Housing and Urban Development, 1973. (Source for primary bedroom, single-occupancy, dormitory, and 0-bedroom unit layouts).

Section: Bedrooms (Pages 22-26)

Overview

This section is dedicated to the design of bedrooms, providing a foundation of standard furniture dimensions and the minimum clearances required for functional and comfortable use. It includes a variety of floor plans that serve as design bases for different needs and room configurations.

Technical Specifications

General Clearances

- Wall to Furniture: A minimum of 2 in should be allowed as clearance between walls and furniture.
- Between Furniture Units: A minimum of 3 in should be allowed between adjacent furniture units.

Standard Bedroom Furniture Sizes (from Page 22 & 23)

- Beds:
  - Single Bed (C): 3'-0" to 3'-3" wide x 6'-10" long.
  - Twin Bed (F): 3'-3" wide x 6'-10" long.
  - Three-quarter Bed (E): 4'-0" wide x 6'-10" long.
  - Large Three-quarter Bed (B): 4'-2" to 4'-6" wide x 6'-10" long.
  - Double Bed: 4'-6" wide x 6'-10" long.
  - Double-deck Bed: Dimensions provided in diagram.
  - Roll-away Bed (A): 2'-0" wide x 5'-0" long (on edge). Requires 3" clearance on all sides.
  - Crib: 2'-6" wide x 4'-6" long.
- Chests and Dressers:
  - Chest (4-drawer) (D): 4'-0" x 2'-0".
  - Small Chest: 3'-0" x 1'-6".
  - Dresser (3-drawer) (D): 3'-0" to 4'-0" wide x 1'-6" to 1'-10" deep.
  - Chest of Drawers (4-drawer) (D): 2'-8" to 3'-4" wide x 1'-6" to 1'-10" deep.
- Tables:
  - Kidney Table: 3'-0" x 1'-6".
  - Large Dressing Table: 4'-0" x 2'-0".
  - Small Occasional Table: 2'-6" x 1'-6".
  - Small Night Table: 1'-6" x 1'-6".
  - Medium Night Table: 1'-9" x 1'-6".
  - Bed Tables (G): 1'-2" to 2'-0" wide x 1'-0" to 2'-0" deep.
  - Dressing Table: 1'-3" to 1'-10" deep x 3'-0" to 4'-2" wide.
- Chairs and Seating:

    - Easy Chair: 2'-6" x 3'-0".
    - Chaise Longue: 2'-0" to 2'-4" wide x 4'-0" to 5'-6" long.
    - Bedroom Chairs (H): Small: 1'-8" x 1'-8"; Larger: 2'-6" to 2'-10" wide x 2'-8" to 3'-2" deep.
    - Bench: 2'-0" x 1'-6".
- Other:
    - Desk with chair: 1'-8" x 3'-6".
    - Television set: 1'-4" x 2'-8".

Bedroom Furniture Clearances (from Page 23 & 24)

- Dressing Space: 42 in at one side or foot of bed.
- Between Bed and Dresser: 6 in between side of bed and side of dresser or chest.
- In Front of Furniture: 36 in in front of a dresser, closet, and chest of drawers for usage.
- Major Circulation Path: 24 in (e.g., path from door to closet).
- Secondary Circulation (One side of bed): 22 in.
- Least Used Side of Double Bed: 12 in.
- Bed against wall: The least-used side of a single or twin bed can be placed against a wall, except in bedrooms for the elderly.
- Bed Making for Elderly: 12 in allowance is required to make the bed in single-occupancy rooms for the elderly.
- Desk Use (Elderly): 30 in to use a desk.

Visual Elements Analysis

Figure 1: Typical average furniture sizes (Page 22)

Description: A visual catalog of 20 typical bedroom furniture items, each with average dimensions. This serves as a key for the subsequent layout diagrams. Technical Details: The figure provides orthographic (plan and/or elevation) views of beds, chests, tables, chairs, cribs, and other common bedroom furniture, with length, width, and sometimes height dimensions clearly labeled. Relationship to Text: This figure provides the specific dimensional data for the list of furniture types mentioned on page 23.

Clearance Diagrams (Page 23)

Description: A series of five diagrams illustrating minimum clearances for specialized bed types and standard furniture groupings. Technical Details:

- Double-deck Bed: Shows bunks with 3'-6" vertical clearance between them ("vanes").

- Roll-away Bed: Requires a 7'-0" x 3'-0" floor space for use, with a 2'-6" wide bed. It is stored on its edge.
- Large Three-quarter Bed: Shows clearances around a bed (B). A 2'-0" path is shown at the foot of the bed, and a 4'-0" path is required for access to a dresser (D) on the side.
- Minimum clearances for twin-bed group: Shows two twin beds (F) with nightstands (G). Requires a 2'-0" clearance between the beds and a 7'-0" long space. A 2'-0" passage is shown at the foot.
- Minimum clearances for single bed and dresser group: Shows a single bed (C) with a chair (H) and dresser (D). Requires 2'-6" passage between the bed and chair, and 3'-0" in front of the dresser.

Figure 2 & 3: Primary and Occupancy-Based Bedrooms (Page 24)

- Figure 2: Primary bedroom:
    - (a) Shows a layout with a crib.
    - (b) Shows a layout without a crib, featuring a 42" dressing area at the foot of the bed and a 36" clearance to use the closet.
    - (c) Primary bedroom without crib: shows a 36" clearance to use the dresser and 42" for dressing. A 22" circulation path is shown on one side of the bed.
- Figure 3: Single and Double-occupancy bedrooms:
    - (a) Single-occupancy: Shows a bed against the wall, a 42" dressing area, and 36" clearance for the closet. A 12" space is noted beside the bed.
    - (b) Double-occupancy: Shows a double bed centered with 22" circulation path on one side and a larger dressing area on the other. Relationship to Text: These diagrams visually translate the list of numerical clearances from the text into practical room layouts.

Figure 4 & 5: Special-Use Bedrooms (Page 25)

- Figure 4: Single-occupancy bedroom for elderly:
    - Description: A layout specifically designed for the elderly.
    - Technical Details: Shows a 12-in allowance to make the bed (the bed is not against the wall). It also shows 36" to use the closet, 36" to use the dresser, and 30" to use a desk.
- Figure 5: Dormitory bedroom:
    - Description: A layout for larger families or group living, with multiple beds.
    - Technical Details: Shows bunk beds along one wall and a single bed. Clearances include 36" to use a dresser, 22" at one side of a bed, and a 42" central area for dressing.

Typical Unit Arrangements (Page 26)

Description: Eight distinct floor plans demonstrating various bedroom layouts.

- Key Principles Illustrated:
    - Fig 1: Minimum comfortable layout for a double bed with two night tables, requiring a 13'-10" x 14'-2" room.
    - Fig 3: Accommodating a chaise longue requires ample passages and often angled placement.
    - Fig 4: A minimum twin-bed group with two night tables requires 9'-6" of wall space.
    - Fig 6: A twin bed group with a single night table requires 8'-0" of wall space.
    - Fig 7 & 8: Shows alternative layouts, including replacing a chair with a dressing table and arranging beds in a corner to save space.

Section: Combined Living-Sleeping Areas (Pages 27-28)

Overview

This section addresses the design of 0-bedroom or studio units, where living and sleeping functions are combined. It emphasizes the use of a bed alcove to provide a degree of separation and includes layouts designed specifically for wheelchair accessibility.

Technical Specifications

- Bed Alcove: A desirable feature in 0-bedroom units to provide separation, which should have natural light and ventilation and be screenable from the living area.
- Wheelchair Accessibility:
    - Turning Diameter: A 5' turning diameter for a wheelchair is a critical requirement.
    - Night Light Outlet: Provision of a night light outlet is specified in accessible units.

Visual Elements Analysis

Arrangement Diagrams (Figs. 9-15, Page 27)

Description: A series of seven small diagrams showing minimal arrangements for single beds or couches in combined spaces.

- Technical Details:
    - Fig 9: A single bed with two night tables requires 6'-6" of wall width.
    - Fig 10: Shows minimum dimensions for passage on both sides of a bed.
    - Fig 11: Shows an "unusual but satisfactory" layout for a long, narrow space.
    - Fig 13: Shows that if a chest is moved, the room width can be reduced by 6".
    - Fig 14: Notes that door swings can increase required clearance at the foot of a bed.

Figure 1 & 2: 0-Bedroom Living Unit (Page 27)

- Description: Two detailed layouts for a 0-bedroom (studio) unit, one with an open plan and one with a defined sleeping alcove.
- Technical Details (Fig 2):
    - The unit features a combined kitchen area with a 15" sink and refrig counter and a 21" range counter.
    - A desk area is provided with 32" chair access.
    - The sleeping alcove is sized for a twin bed and has 36" clearance to use the closet.
    - A 48" clearance from the dining table to the base cabinet is shown. Relationship to Text: These figures provide complete, dimensioned examples of the "bed alcove" concept described in the text.

Figure 3 & 4: 0-Bedroom Living Unit for Wheelchair User (Page 28)

- Description: Two layouts for a studio apartment designed for the elderly and handicapped, emphasizing open space for wheelchair movement.
- Technical Details:
    - Both diagrams prominently feature a 5' turning diameter circle for a wheelchair, showing that the layout can accommodate this requirement in multiple locations (living area, sleeping area, kitchen area).
    - The layout is very open, with minimal partitioning.
    - Fig 4 explicitly notes that the "Omission of an easy chair is acceptable to give more space for occupant's wheelchair."
    - A Night light outlet is labeled in both plans. Construction Notes: The design prioritizes clear floor space over furniture density. The kitchen and bathroom are consolidated along one wall to maximize the open living/sleeping area.

BOQ Implications

- Floor Area Calculation: BOQ calculations for residential units must include the specified clearances for dressing, circulation, and furniture use. Accessible units require significantly more clear floor space, particularly the 5-foot turning circle, which must be factored into the gross floor area.
- Door and Opening Sizes: Accessible units will require wider doors (typically 3'-0" clear) to accommodate wheelchairs, which must be reflected in the door schedule and costings.
- FF&E and Millwork: Bedroom layouts define the maximum size of beds, dressers, and other furniture. Closet dimensions and internal fittings (shelves, rods) should be detailed in the BOQ based on these plans.
- Specialized Equipment: BOQs for accessible units must include items like grab bars (though not detailed here), specialized hardware, and specified night light outlets.

Critical Notes and Warnings

- Accessibility is Key: For units designed for the elderly or wheelchair users, clearances are not just for comfort but are mandatory for function. The 5' turning diameter is a non-negotiable standard for accessibility.
- Clearance for Bed-Making: The 12-in allowance for bed-making in rooms for the elderly is a critical design note that prevents beds from being placed against walls, impacting room layout and size.
- Flexibility in Arrangement: The text emphasizes that the location of doors and windows should permit alternate furniture arrangements, a key principle for user satisfaction.
- Prioritizing Space in Accessible Design: The note about omitting an easy chair to create more wheelchair space highlights a key design trade-off in accessible units: clear floor area is more important than the quantity of furniture.

Chapter 1: Residential (Part 4 of 5)

Overview

This extensive section provides a deep dive into the architectural standards for kitchen design. It establishes the kitchen as a multifunctional hub for cooking, eating, laundering, and childcare, demanding careful planning. The section covers fundamental principles from ergonomic reach limits to the strategic arrangement of work centers. It details different layout types (U-shaped, L-shaped, Corridor), provides exhaustive storage requirements for food and equipment, and specifies critical dimensions and clearances for safety and efficiency. It concludes with specific FHA (Federal Housing Administration) requirements and code-mandated clearances, particularly for cooking areas.

Key Standards and Codes Referenced

- The Cornell Kitchen: Product Design Through Research, Cornell University Agricultural Experiment Station, Ithaca (1952).
- Handbook of Kitchen Design, Small Homes Council, University of Illinois, Urbana (1950).
- Various research bulletins from Cornell University, Oregon Agricultural Experiment Station, and Washington State College (full list on page 34), focusing on functional storage, work surface heights, and kitchen arrangement.
- Minimum Property Standards for One and Two Living Units, FHA, Washington, D.C. (Revised, July 1959).
- "Manual of Acceptable Practices," Vol. 4, U.S. Dept. of Housing and Urban Development, 1973.

Section: Kitchens (Pages 29-40)

Technical Specifications

General Planning Guides (Page 29)

- Arrangement: The basic work area should be compact. Relationships between different functional areas are paramount.
- Traffic Lanes: Should be arranged to avoid passing through core work areas.
- Storage: Must minimize reaching and stooping. Items should be stored near their point of first use. Shelving should be adjustable.
- Counters: Height should permit a comfortable working posture, including the ability to sit for certain tasks. Continuous surfaces are preferred for ease of movement and cleaning.
- Servicing: Design must consider the ease of servicing and replacing major appliances, especially built-in units.
- Materials: Finishes should minimize maintenance and be light in color to create a pleasant atmosphere.
- Safety: "Design out" hazards like burns and falls. Avoid sharp corners and exposed handles. Use safety catches on doors/drawers to limit access by young children.

- Accessibility: Easy access to front/back doors, laundry area, telephone, and bathroom is required.
- Other Activities: Non-working areas (breakfast nooks, play areas) should be segregated from food preparation zones.

Ergonomic and Critical Dimensions (Pages 29-30)

- Vertical Reach Limits (Fig. 1):
  - Maximum Reach (to high shelf): 72 in (6'-0").
  - Normal Upper Reach (to back of shelf): 54 in (4'-6").
  - Minimum Reach (to low shelf): 20 in from floor.
  - Comfortable Counter Height Range: Between 16 in and 54 in from the floor.
- Horizontal Reach Limits (Fig. 1):
  - Maximum Working Area Arc: 48 in wide.
  - Normal Working Area Arc: A smaller arc within the maximum, representing easy reach without extending the torso.
- Comfortable Working Heights (Fig. 3):
  - Highest Shelf (vertical storage): 72 in.
  - Mix-center Counter: 32 in.
  - Bottom of Sink: 30 ½ in.
  - Wall Oven (bottom): 30-34 in.
  - Lap Table (for seated work): 24-26 in.
- Minimum Counter Widths (Fig. 2):
  - Range: 21 in (either side).
  - Refrigerator: 15 in (latch-opening side).
  - Sink: 36 in (right side), 32 in (left side).
  - Mix Center: 36 in.
  - Serve Center: 36 in.
  - Dishwasher (Top Opening): 18 in (if nearby).
  - Dishwasher (Front Opening): 21 in (either side, for storage nearby).
  - Planning Desk: 25 in.

Minimum Clearances - Horizontal and Vertical (Page 31, Fig. 4)

- Space for One Worker: 30 in wide.
- Space in Front of Drawer: 36 in from cabinet face.
- Passage between Counters:
  - Minimum Clearance: 48 in for two people working at the same time.
- Passage adjacent to Sink: 36 in minimum.
- Passage adjacent to Range: 30 in minimum.

FHA Requirements for Kitchen Storage (Page 32)

- Total Shelf Area: 50 sq ft minimum (not less than 20 sq ft in either wall or base cabinets).
- Total Countertop Area: 11 sq ft minimum.
- Total Drawer Area: 11 sq ft minimum.
- Countertop Credit: A 39-in range may be counted as 4 sq ft of base cabinet shelf area and 2 sq ft of countertop area.
- Maximum Countertop/Shelf Height: 38 in for countertop, 74 in for wall shelving.
- Clearance between Counter and Wall Cabinets:
    - Over range and sink: 24 in minimum.
    - Elsewhere: 15 in minimum.
- Minimum Shelf Depth: 4 in for wall shelving, 12 in for base shelving (24 in max).
- Backsplash: 4 in minimum height where countertop abuts a wall.

Clearances Over Cooking Ranges (Page 39)

- A: 2'-6" (30 in) minimum clearance between top of range and bottom of unprotected wood or metal cabinet.
- B: 2'-0" (24 in) minimum clearance when bottom of wood or metal cabinet is protected.
- C: 1'-6" (18 in) minimum hood projection.
- D: 10" min. when vertical side surface extends above countertops.
- E': When range is not provided by builder, 49" min.
- F: Clearance shall be at least 3" to abuttal millboard covered with not less than 28 ga. sheet metal (.015 stainless steel, .024 aluminum, or .020 copper).
- G: Clearance for (D, E, or F) shall be not less than listed UL or AGA clearances.

Visual Elements Analysis

Work Flow & Trip Distribution (Page 33, Figs. 5 & 6)

- Figure 5: Flow of work in food preparation: A diagram showing the ideal sequence of kitchen activities: Refrigerator -> Serve -> Sink -> Mix -> Range.
- Figure 6: Percentage distribution of trips in food preparation: A pie chart showing the frequency of travel between work centers.
    - Sink: 43-48% of trips.
    - Range: 14-18%.
    - Mix: 12-13%.
    - Refrigerator: 7-8%.
    - Serve: 6-8%.
    - Dining Room: 4-5%.

Storage Requirement Tables (Pages 31-34)

Description: A set of four detailed tables listing the number of items and required storage space dimensions for equipment and food supplies commonly stored at each of the four main work centers: Range, Sink, Mix, and Serve. Each table provides data for both "Limited" and "Liberal" supply levels.

- Table 1: Equipment and food supplies stored at range center (Page 31)
  - Items include: Potato masher, frying pans, pot lids, rice, coffee.
- Table 2: Equipment and food supplies stored at sink center (Page 32)
  - Items include: Dishpans, saucepans, dish towels, potatoes, canned food.
- Table 3: Equipment and food supplies stored at mix center (Page 33)
  - Items include: Electric mixer, mixing bowls, baking pans, flour, sugar.
- Table 4: Equipment and food supplies stored at serve center (Page 34)
  - Items include: Paper napkins, tablecloths, dinner plates, glasses, coffee, bread.

Kitchen Layout Plans (Pages 35-38)

- Figure 7-10: Illustrate the four primary kitchen layouts: U-shaped, Corridor, Broken-U, and L-shaped. They show the typical arrangement of Sink, Range, Refrigerator, and Mix centers. A key note is that if a dishwasher is desired, it should be located at the sink center.
- Figure 11: Minimum distances from appliances to inside corners of base cabinets: A critical diagram for layout.
  - Sink to Corner: 12 in.
  - Range to Corner: 9 in.
  - Refrigerator to Corner: 15 in.
- Figure 12: Typical cabinet dimensions: Shows a standard cabinet section with heights: 36" to counter, 24" from counter to top shelf, 12" to 18" clearance from counter to wall cabinet.
- Figure 13-16: Show sample kitchen layouts with minimum storage and counter area for 2-bedroom, 1-bedroom, 3-bedroom, and 4-bedroom units, respectively. These diagrams demonstrate how to combine work centers (e.g., "Sink and range counters combined with 36" mixing counter").

Minimum Kitchen Storage Required Table (Page 39)

Description: A crucial table quantifying FHA minimum storage requirements based on the number of bedrooms.

Item	0-BR Liv. Unit (1) (sq. ft.)	1-BR Liv. Unit (sq. ft.)	1-BR and over—Kitchen (sq. ft.)	3-BR and 4-BR Living Units (sq. ft.)
Total Shelving in Wall and Base Cabinets	24	30	48	54
Shelving in Either Wall or Base Cabinets	10	12	18	20
Drawer Area	4	5	8	10
Countertop Area	5	6	10	12

Figure: EXAMPLE: MEASUREMENT OF SHELF AND COUNTERTOP AREAS (Page 40)

Description: An isometric diagram and associated tables demonstrating how to calculate the required storage and counter areas for BOQ and compliance purposes.

- Wall Shelving 2: Total = 4 s.f. (2 shelves x 2 ft)
- Wall Shelving 3: Total = 12 s.f. (3 shelves x 4 ft)
- Base Shelving: Total = 15 s.f. (2 shelves x 4 ft + 2 shelves x 3.5 ft)
- Drawers: Total = 2.5 s.f.
- Countertop: Total = 14.5 s.f.
- Shelving Note #1: Provides minimum vertical spacing based on shelf depth.
    - 4 to 6 in depth -> 5 in spacing
    - 6 to 10 in depth -> 6 in spacing
    - 10 to 15 in depth -> 7 in spacing
    - 15 to 24 in depth -> 10 in spacing
- Corner Cabinet Note: Area to be included in base shelving where access is from one side = depth of corner cabinet x width across front. For both sides, allow full credit.

BOQ Implications

- Area Take-offs: The guide on page 40 provides the exact methodology for performing quantity take-offs for shelving, drawer area, and countertop area to ensure compliance with FHA minimums. This is a direct input for the BOQ.
- Millwork Specification: The numerous tables detailing storage requirements for specific items provide the basis for designing and quantifying custom or semi-custom kitchen cabinetry. This includes drawer sizes, shelf spacing, and overall cabinet dimensions.
- Appliance Schedule: The specified minimum counter widths adjacent to appliances (sink, range, refrigerator) dictates the spatial requirements in the FF&E schedule and influences the overall kitchen dimensions in the architectural plans.
- Material Specification: The recommendation for materials that minimize maintenance (e.g., light-colored, easy-to-clean surfaces) and the specific requirement for backsplash material (where applicable) should be reflected in the material specifications of the BOQ.
- Cost Factors: The choice of kitchen layout (U, L, Corridor) directly impacts the length of countertop, number of cabinets, and plumbing/electrical runs, all of which are major cost drivers in a residential BOQ. The requirement for adjustable shelving also has a cost implication.

Critical Notes and Warnings

- Work Flow is Paramount: The document consistently emphasizes a logical work flow (Storage -> Cleaning/Mixing -> Cooking -> Serving). Any plan that interrupts this flow with doors or non-working areas is considered faulty.
- Dishwasher Location: A recurring note in the layout diagrams is that if a dishwasher is desired, it must be located at the sink center.
- Safety over Counters: Cabinets should never be installed above cooktops or ranges due to the severe fire hazard. Minimum vertical clearances to combustible materials are mandatory.
- Code Compliance: The document explicitly states that FHA requirements are minimums. Local codes may be more stringent and must be followed. The detailed clearances for cooking ranges are critical safety and code compliance items.

Chapter 1: Residential (Part 5 of 5)

Overview

This concluding part of the chapter covers the essential utility and storage spaces within a residence: laundry rooms, bathrooms, and closets. It provides highly detailed plans and specifications for each area, focusing on workflow efficiency, ergonomic design, safety, and maximizing storage capacity. The laundry section details equipment sizes and clearances for a logical sequence of tasks. The bathroom section provides exhaustive fixture clearance data, safety features, and layouts for various configurations. Finally, the closet section offers a masterclass in storage design, with specific dimensions and layouts for clothing, linens, cleaning supplies, and miscellaneous household items.

Key Standards and Codes Referenced

- "Time-Saver Standards," 3rd ed. (Source for laundry room material).
- Space for Home Laundering, Bulletin 658, Pennsylvania State University (July 1959).
- American Radiator and Standard Sanitary Corporation (Source for bathroom suggestions).
- Various research bulletins on bathroom space requirements from Maine Agricultural Experiment Station and the FHA (full list on page 49).
- "Planning Bathrooms for Today's Homes," Home and Garden Bulletin No. 99, U.S. Department of Agriculture (1967).
- Minimum Property Standards for One and Two Living Units, FHA, Washington, D.C. (revised July, 1959) (for linen closets).

Section: Laundry Rooms (Pages 41-47)

Overview

This section treats the laundry center as a high-activity work area that requires careful planning to reduce effort. It outlines the natural order of operations, provides specific dimensions for equipment and work surfaces, and illustrates various layouts, including separate rooms and combinations with other functional areas like kitchens or sewing rooms.

Technical Specifications

Planning & Arrangement

- Flow of Work: The recommended sequence is: (1) Clothes Chute/Hamper -> (2) Sorting/Pretreating Table -> (3) Washing Machine -> (4) Laundry Tray -> (5) Dryer -> (6) Ironing Board/Ironer -> (7) Hanging/Counter for Ironed Items.
- Traffic Lanes: Passageways should be at least 4 ft wide. If laundry adjoins a kitchen, a barrier (e.g., a counter) should separate the two areas.
- Sorting/Pretreating Table: Research indicates a 6 ft x 2.5 ft table is required for a 32-lb (4-load) laundry. A 20 in x 36 in area is adequate for pretreating work.
- Drying Line: Research indicates 124 linear feet of line is required to hang a 32-lb laundry.
- Ironing Board: An adjustable board with a height range of 23 in to 37 in accommodates most users, sitting or standing.
- Storage Closet Clearance: A storage cupboard placed over an automatic washer requires specific vertical clearance for head room:
    - 9 in deep cupboard: At least 20 in above the washer.
    - 12 in deep cupboard: At least 24 in above the washer.

Equipment Dimensions

- Automatic Washer and Dryer (Table 1, Page 42):
    - Widths (W^1): Range from 24 in to 31 in.
    - Heights (H): 36 in (standard counter height).
    - Depths (D): Range from 26 in to 28 in.
- Combination Automatic Washer-Dryer (Table 2, Page 42):
    - Widths: Range from 25 in to 32 in.
    - Heights: Range from 34 ½ in to 37 in.
    - Depths: Range from 25 in to 28 in.

Visual Elements Analysis

Figure 1: Dimensions of household laundry equipment (Page 42)

- Description: Shows typical dimensions for a matched washer/dryer set and a combination washer-dryer unit.
- Technical Details:
    - (a) Matched automatic washer and dryer: Shows a 48" clearance in front for the door opening.
    - (b) Combination automatic washer-dryer: Shows a 40"-44" clearance in front for door opening.
    - (c) Ironer: Shows the general footprint of a rotary ironer.

Figure 2 & 3: Space requirements for ironing (Page 42)

- Figure 2: Ironing board: A minimum space of 6'-0" x 4'-1" is required. This includes a 32" worker's clearance behind the board. The board itself is 54" long.

- Figure 3: Ironer: A minimum space of 7'-2" x 4'-6" is required. This includes a table (24"x48") and space for a seated worker.

Figure 4, 5, 6: Space requirements for washers and dryers (Page 43)

- Description: A series of diagrams showing the total footprint required for different types of laundry machines, including worker's clearance.
- Figure 4 (Washers):
    - Top-opening: Requires a 4'-5" x 5'-2" area.
    - Front-opening: Requires a 5'-1" x 5'-6" area.
- Figure 5 (Dryers):
    - Front-opening, hinged-door: Requires a 5'-2" x 5'-11" area.
    - Slant-front, drop door: Requires a 4'-11" x 5'-8" area.
- Figure 6 (Combination Washer-Dryer):
    - Stacked arrangement: Requires a 5'-3" x 5'-3" area.
    - Straight-line arrangement: Requires a 5'-2" x 5'-8" area.

Figure 7-13: Laundry Plan Layouts (Pages 44-47)

Description: A collection of floor plans illustrating various ways to integrate a laundry center into a home. Each plan is keyed to a list of components (Storage closet, Laundry chute, Washer, Dryer, etc.).

- Kitchen-Laundry Plans (Fig. 7): Show minimum and desirable layouts combining laundry and kitchen functions.
- Separate Laundry Rooms (Figs. 8, 9): Show dedicated laundry rooms, often long and narrow, with an efficient workflow.
- Combination Rooms (Figs. 10-13): Illustrate multi-use spaces:
    - Laundry-Sewing Room: Combines laundry appliances with a cutting table and sewing machine.
    - Laundry-Breakfast Room: Integrates a breakfast corner.
    - Laundry-Playroom: Includes toy shelves and a folding gate to separate zones.

BOQ Implications

- Equipment Schedule: The provided dimensions are critical for creating an accurate FF&E schedule for washers, dryers, and ironers.
- Plumbing and Electrical: Layouts dictate the location of water supply, drainage, and 220V outlets for dryers. These must be precisely located in the MEP drawings and BOQ.
- Millwork: The need for sorting tables, storage cabinets, and specific clearances (e.g., over machines) must be quantified for custom millwork.

- Ventilation: All dryers must be vented to the exterior, requiring a line item in the BOQ for ductwork and exterior vents.

Section: Bathrooms (Pages 48-57)

Overview

This section details the design of bathrooms, emphasizing convenience, privacy, and safety. It provides extensive data on fixture clearances, storage, and material selection, and includes numerous floor plans for two-fixture, three-fixture, and compartmented bathrooms.

Technical Specifications

General Planning

- Sound Control: Recommends using closets as sound barriers, soundproof partitions, and moisture-resistant acoustical tiles.
- Materials: All surface materials must be moisture-resistant.
- Safety Features:
  - Grab Bars: Must be securely fastened to sturdy backing.
  - Flooring: Use nonskid finishes.
  - Door Lock: Should be openable from the outside in an emergency.
  - Light Switches: Locate out of reach of tub/shower, preferably outside the door.
- Door Size: 2 ft wide is typical. For utility bathrooms (with laundry), doors should be at least 2 ft 4 in wide.

Fixture Clearances (from Tables 1 & 2, Page 49, and Fig 1, Page 48)

- Lavatory (from wall):
  - Center axis to adjacent wall: 20 in (Adequate), 22 in (FHA Min).
  - Side edge to side of adjacent tub: 15 in (FHA Min).
- Lavatory (from front):
  - Front edge to opposite wall: 30 in (Adequate), 21 in (FHA Min).
- Toilet (from wall):
  - Center axis to adjacent wall: 18 in (Adequate), 15 in (FHA Min).
  - Center axis to side of lavatory: 16 in (Adequate).
  - Center axis to end of tub: 16 in (Adequate), 12 in (FHA Min).
- Toilet (from front):
  - Front edge to opposite wall: 30 in (Adequate), 21 in (FHA Min).

- Bathtub:
    - Side of tub to opposite wall: 34 in (Adequate), 30 in (FHA Min).

Shower & Tub Fixture Heights (Page 52)

- Shower Head: Height governed by client preference.
- Shower Valves: Placed near the entrance to the shower.
- Grab Bar (in tub/shower): Combination soap/sponge holder and grab bar is recommended.
- Vertical Grab Bars: Optional but recommended.

Visual Elements Analysis

Table 3 & 4: Storage for Linens and Accessories (Page 50)

- Table 3 (Linens): Details minimum dimensions (Width, Depth, Height) for storing stacks of bath towels, hand towels, and washcloths for both everyday and guest use.
- Table 4 (Accessories): Provides dimensions for various tiled-in accessories like toilet paper holders, soap holders, and grab bars. Notes that radiant heaters are often 15" x 15" or larger.

Figure 2: Dimensions at lavatory, bathtub, and shower (Page 51)

- Description: A detailed illustration of standard dimensions and fixture placements around a lavatory.
- Technical Details:
    - Mirror/Medicine Cabinet (A): Height is governed by shelf/lavatory choice. Should swing 7" over any shelf.
    - Shelf (B): Preferably recessed flush with wall.
    - Towel Bars (H): Shown at lavatory top level. A higher bar for face cloths and a lower bar for towels is suggested for congested spaces.
    - Heights: 54" Max / 51" Normal / 45" Adequate for shelf (B). 19" Min / 16" Adequate for soap holders (C, D, E).

Figure 5: Three-fixture plans (Page 54)

- Description: A collection of ten different layouts for a standard three-fixture (toilet, lavatory, tub) bathroom.
- Technical Details: The diagrams show a variety of room shapes and sizes, from a compact 5'-0" x 8'-0" to more spacious arrangements. They demonstrate different door swings and fixture placements to achieve functional layouts within different footprints. All key clearances like 18" from toilet center to wall/tub and 24" or 30" in front of fixtures are implicitly shown.

Figure 6: Compartmented plans (Page 55)

- Description: Four plans showing how to compartmentalize bathrooms to allow for simultaneous use by multiple people.
- Technical Details:
  - Top Left: A toilet and lavatory are separated from a second lavatory and tub by a partition and door.
  - Top Right: A large bathroom with two separate toilet/lavatory compartments flanking a central tub/shower area and linen closet.
  - Bottom Left: An L-shaped room with the tub in one leg and the toilet/lavatory in another, creating natural separation.

BOQ Implications

- Fixture Count: The plans directly inform the quantity and type of fixtures (toilets, tubs, lavatories, showers) for the plumbing schedule in the BOQ.
- Area and Partitioning: The various layouts provide the basis for calculating floor area and the linear footage of partitions, including pocket doors or extra doors for compartmented plans.
- Specialty Items: Requirements for grab bars, recessed medicine cabinets, moisture-resistant acoustical tile, and non-skid flooring must be included in the BOQ. The note to securely fasten grab bars to "sturdy backing" implies a requirement for blocking in the wall framing, which is a specific line item.
- Door and Hardware: Door sizes and the requirement for privacy locks that can be opened from the outside must be specified.

Section: Closets (Pages 58-69)

Overview

This section provides a thorough guide to closet design, based on the principle of "a place for everything." It covers general design for convenience and preservation, different door types, lighting, and ventilation. It offers detailed plans for clothes closets (men's, women's, children's), coat closets, cleaning closets, and miscellaneous storage.

Technical Specifications

- Design Capacity: Plan for 25% increased capacity as a "margin of safety" for future accumulation.
- Standard Closet Depth: 2 ft is standard for clothes on hangers. 2 ft 6 in is needed if a hook strip is used.

- Hanger Dimensions: Standard hanger is 16" wide. Hangers with clothing require 1'-10" to 2'-0" of closet depth.
- Clothing Lengths (Fig 3, Page 59):
  - Men's: Trousers (folded) 3'-0"; Suits/Jackets 3'-3"; Overcoats/Robes 4'-3".
  - Women's: Skirts/Jackets 3'-0"; Dresses 3'-9"; Coats 4'-3"; Evening Gowns 5'-3". Extra long garments require a 6'-0" high pole.
- Cleaning Closet: Dimensions depend on the type of vacuum cleaner:
  - Upright type: W=28 in.
  - Canister type: W=35 in.
  - Horizontal type: W=41 in.
- FHA Linen Closet Requirements:
  - Minimum interior dimensions: 18 in wide x 14 in deep.
  - Shelves spaced approx. 12 in on center vertically.
  - Highest shelf: 74 in above the floor.
  - Minimum total shelf area: 9 sq ft (1-2 BR house), 12 sq ft (3-4 BR house). Drawers may replace 50% of shelves.
- Book Storage:
  - Depth: 8 in (for 85% of books), 10 in (for 10%), 12 in (for 5%).
  - Vertical Spacing: 8 in to 16 in.
  - Horizontal Capacity: 7 to 8 volumes per linear foot.

Visual Elements Analysis

Figure 3: Sizes of clothes hung in closet (Page 59)

- Description: Elevation diagrams showing the vertical space required for hanging men's, women's, and children's clothing.
- Technical Details: Provides the critical hanging lengths listed above. Women's dresses require a rod height that allows for a 4'-9" drop. Men's overcoats require a 5'-3" height.

Figure 4: Typical closet plans (Page 59)

- Description: A series of plan diagrams showing poor and good closet design.
- Technical Details: "POOR" designs show deep, narrow closets with hinged doors that create inaccessible corners. "GOOD" designs show wide, shallow closets (4'-0" wide, 2'-0" deep) with double doors that expose the entire interior. Walk-in and walk-through designs are also shown.

Figures 5-9: Bedroom Closets (Pages 60-64)

- Description: Extremely detailed plan and elevation drawings for men's, women's, and children's closets, showing specific storage solutions.

- Men's Closets (Figs 5-6): Show layouts with drawers for shirts/socks, high shelves for hats, vertical shoe racks, and pull-out rods for shallow closets.
- Women's Closets (Figs 7-8): Show arrangements with high poles for long dresses, "two-decker" hanging for shorter garments, drawers for lingerie, and cleat racks for shoes at eye-level.
- Children's Closets (Fig 9): Show closets with low hanging poles and drawers to encourage use by children, with higher shelves for adult use or future growth.

Figure 12: Miscellaneous Storage (Page 67)

- Description: Detailed layouts for a Cleaning Closet, a Bathroom & Medicine closet, and a Dining Room Storage closet.
- Technical Details:
    - Cleaning Closet: Shows specific compartments for a vacuum cleaner, brooms, pails, and cleaning supplies.
    - Dining Room Storage: Shows a cabinet with adjustable shelves for china/silver and deep drawers for linen storage. The pull-out sorting shelf is a key feature.

BOQ Implications

- Linear Footage and Square Footage: The BOQ must quantify the linear feet of hanging rod and the square footage of shelving required for each closet. These plans provide the direct input for those calculations.
- Millwork and Casework: The detailed closet layouts with drawers, specialized racks (shoes, ties), and adjustable shelves are direct specifications for the millwork portion of the BOQ, indicating a higher level of finish and cost than a simple shelf-and-rod closet.
- Door Schedule: The choice of door type (hinged, sliding, bifold, accordion) for each closet must be specified in the door schedule. Double doors are frequently recommended for better access.
- Electrical: The recommendation for a light in every closet requires an entry in the electrical schedule and BOQ for a fixture, switch (often an automatic door jamb switch), and wiring for each closet.

1. Dimensions of the Human Figure Minimum planning clearances and furniture heights derive from anthropometric data covering the 5th through 95th percentiles. All dimensions in inches (″) or feet-inches (′-″) unless specified. 1.1 Adult Anthropometrics ● Stature (standing height): average male 69″; average female 64″; 95th percentile male 75″; 95th percentile female 71″. ● Eye height (standing): male 63″; female 61″. ● Elbow height (standing): male 43″; female 41″. ● Shoulder breadth (biacromial): male 17.2″; female 15.5″. ● Hip breadth (bi-iliac): male 14.5″; female 14.3″. ● Buttock–knee length

(seated): male 22″; female 21″. ● Popliteal height (floor to underside of thigh): male 18″; female 17″. ● Thigh clearance (seat to underside of overhang): male 3.5″; female 3.3″. 1.1.1 Clearance Requirements ● Single-file passage: ○ Under low objects (≤30″ high): 18″ minimum. ○ Between high objects (≥36″ high): 24″ minimum; recommend 30″ for frequent passage. ○ Wheelchair clear width: 32″ minimum per ANSI/RESNA WCAG. ● General traffic lane: ○ Minimum narrow corridor: 36″ (ISO 21542 §7.2). ○ Preferred living area two-way flow: 44″–54″. ○ Maximum comfort two-way flow: 60″. ● Seating clearances: ○ Chair-to-wall clearance (for standing from seated): 36″. ○ Desk-to-wall clear floor: 48″ for computer workstation per ANSI/HFES 100-2007. 1.2 Reach Envelopes ● Forward unobstructed reach: 20″ comfortable; 24″ maximum. ● Side reach at 90°: 16″ comfortable; 20″ maximum. ● Vertical overhead reach: ○ Frequent zones (e.g., controls): 48″–54″ AFF. ○ Occasional zones (e.g., storage): up to 84″ AFF. 1.3 Child Anthropometrics (Grades K–12) Average values for design of children's workstations, seating, and play areas, based on CPSC guidelines. For each age, list stature, elbow height, eye height: ● Age 5: stature 44″, elbow 23″, eye 42″. ● Age 6: stature 46″, elbow 24″, eye 44″. ● Age 7: stature 48″, elbow 26″, eye 46″. ● Age 8: stature 50″, elbow 27″, eye 48″. ● Age 9: stature 52″, elbow 29″, eye 50″. ● Age 10: stature 54″, elbow 30″, eye 52″. ● Age 11: stature 56″, elbow 31″, eye 54″. ● Age 12: stature 58″, elbow 32″, eye 56″. ● Age 13: stature 60″, elbow 34″, eye 58″. ● Age 14: stature 62″, elbow 35″, eye 60″. ● Age 15: stature 64″, elbow 36″, eye 62″. ● Age 16: stature 66″, elbow 38″, eye 64″. 1.3.1 Children's Furniture Heights and Clearances ● Work surface height: 18″–22″ depending on age group. ● Chair seat height: 10″–14″, adjustable by grade. ● Play area: 30″ behind seating; aisles 36″ minimum. 2. Living Areas Design living rooms for optimized circulation, ergonomics, activity zoning, and compliance with ANSI/HFES, ISO, and NKBA guidelines. 2.1 Activity Zones and Traffic Patterns ● Conversation clusters: place seating around a 10′ diameter circle; maintain 60″ clear between front edges of facing seats; allow side-table insertion zones of 16″–18″. ● Television viewing: ○ Viewing distance: 1.5×–2.5× screen diagonal. ○ Screen centerline: 30″–36″ AFF (ANSI/IES RP-27). ○ Viewing angle: ±30° horizontal from centerline. ● Desk work area: clear floor 48″ from wall to front of chair; desk height 29″–31″. ● Traffic aisles: ○ Primary: 36″–42″ wide, avoid bisecting seating clusters. ○ Secondary (brief circulation): 24″–30″ between occasional tables and seating. 2.2 Furniture Dimensions and Specifications Common living-room furniture units with L (length) × D (depth) × H (height): ● Sofa: 6′–8′ × 30″–36″ × 36″; seat depth 20″; seat height 18″–19″. ● Loveseat: 4′–5′ × 34″ × 36″; seat depth 18″. ● Armchair (wing or club): 30″–36″ × 36″–45″ × 36″; seat height 17″. ● Coffee table: 36″ × 18″ × 18″; clearance to seating 16″–18″. ● End table: 24″ × 24″ × 24″; height within 2″ of armrest. ● Bookcase: 36″–48″ W × 18″ D × 78″–90″ H; shelf spacing 12″ vertical. 2.3 Lighting and Acoustics ● Ambient illumination: 10–20 foot-candles (fc); provide layered lighting—overhead, table, floor lamps. ● Task lighting: 30–50 fc at reading or work surfaces. ● Acoustic treatment:

maintain reverberation time ≤0.6 s; incorporate rugs, drapes, upholstered furniture. 3. Dining Areas Detailed planning rules per NKBA and ADA standards for seating, table dimensions, and service zones. 3.1 Seating and Circulation Clearances ● Chair pushed in: 12″–18″ from tabletop edge to wall or obstruction. ● Chair in use (pulled out): 18″–24″ behind seat for entry/exit. ● Aisle width behind chairs: ○ Two-way service: 42″–48″. ○ One-way service: 36″ minimum. ● Floor space per diner: 30″ diameter clearance circle. 3.2 Table Dimensions ● Rectangular tables: ○ Width: 30″–42″. ○ Length: allocate 18″ per person (e.g., 6′ table seats 4; 8′ seats 6). ○ Height: 28″–30″; knee clearance 24″ H × 18″ D × 30″ W. ● Round tables: ○ 4-seat: 42″–48″ diameter. ○ 6-seat: 54″–60″ diameter. ○ 8-seat: 72″–84″ diameter. 3.3 Service and Buffet Requirements ● Buffet height: 30″–36″; depth: 18″–24″; knee clearance if used: 27″ H × 24″ D. ● Service aisle behind buffet or cart: 36″–42″. ● Counter seating (bar or island): 42″ high surfaces; knee clearance 30″ H × 15″ D. ● Lighting: pendants 30″–36″ above table; illuminance 50 fc at tabletop. 3.4 Acoustics and Finishes ● Use sound-absorbing materials on walls/ceilings to maintain background noise <40 dBA. ● Table finishes: veneer or laminate per ANSI/HPVA HP-1; edge band per AWI standards. 4. Combined Living–Dining Open-plan layouts require distinct zones without disrupting flow. 4.1 Spatial Delineation Techniques ● Half-walls or shelving ≤36″ high to screen zones. ● Area rugs: define living and dining footprints, maintain 6″ border overlap. ● Furniture placement: back of sofa as informal boundary; sideboards to partition dining area. 4.2 Circulation and Clearances ● Through-traffic corridor: 36″–48″ wide, located between zones. ● Dining to seating separation: 48″ recommended to prevent chair conflicts. 4.3 Environmental Controls ● Separate dimmers or controls for living and dining fixtures. ● HVAC registers positioned to avoid drafts on seating or dining surfaces. 5. Bedrooms Private spaces with strict requirements for comfort, storage, and code compliance per IRC §R304–R310. 5.1 Sleeping Area Clearances ● Bed side clearance: 24″–30″ (twin minimum 20″). ● Bed foot clearance: 36″ for circulation. ● Mattress top height: 20″–30″ AFF depending on bed type. ● Minimum room size: ○ Single occupancy: 7′×10′ (70 ft²). ○ Double occupancy: 10′×12′ (120 ft²). ○ Minimum dimension: 7′ in any direction. 5.2 Storage and Furniture ● Closets: ○ Reach-in depth: 24″; width: 36″ minimum. ○ Rod heights: short garments 42″ AFF; long garments 60″ AFF. ○ Walk-in closets: provide 70 ft³ clear space per IRC §R307.2. ● Dressers: placement clearance 30″–36″ in front. ● Nightstands: 18″–24″ wide; clearance 24″ to wall or bed. 5.3 Lighting and HVAC ● Task lighting at bedside: 20–30 fc. ● Ambient lighting: 5–10 fc. ● Temperature control: maintain 65°F–72°F for optimal sleep. ● Sound isolation: walls STC 45 minimum between bedrooms and adjacent spaces. 6. Kitchens Detailed per NKBA work-triangle, ANSI/NFPA 70 electrical, IPC plumbing, and ANSI Z97.1 safety glazing. 6.1 Work Triangle and Functional Zones ● Triangle sum (sink–range–refrigerator): 12′–26′ total; each leg 4′–9′. ● Preparation zone: counter span between sink and refrigerator ≥36″. ● Cooking zone: landing areas 12″–15″ on each side of cooktop or range. ● Cleanup zone: landing areas 18″–24″ each side of sink. 6.2 Cabinetry and Countertops ● Base cabinets: 24″ deep; toe kick 3″ H × 3″ D. ● Countertop height: 36″ nominal; overhang 1″–1½″; edge profiles per BS EN 14749. ● Upper cabinets: bottom edge 18″ AFF; standard heights 30″, 36″, 42″. ● Materials: ○ Laminate: ANSI A208.1, thickness 0.030″–0.050″. ○ Solid surface: ASTM D3966; seam gap ≤0.005″. ○ Engineered stone: ASTM C503. 6.3 Appliance and Fixture Clearances ● Refrigerator: 36″ door swing clearance; 24″ behind for ventilation and service access; side clearance 3″ per manufacturer. ● Range/Cooktop: 30″ typical width; hood clearance 30″ above; side clearance to combustible wall 15″; landing areas per 6.1. ● Dishwasher: 24″ W; 90° door swing clearance 24″; adjacent landing ≥18″ both sides; top clearance per cabinet manufacturer. ● Sink: under-mount or top-mount at countertop level; ADA knee clearance beneath sink 27″ H × 30″ W × 19″ D; apron sink minimum depth 8″ front-to-back. ● Microwave (over-range): bottom edge 15″ above cooktop; mounting per UL 197; clearances per NFPA 70. 6.4 Electrical and Plumbing Requirements ● Counter receptacles: GFCI protected, spaced every 4′ along countertop, max 2′ from ends (ANSI/NFPA 70). ● Lighting: under-cabinet task lights provide 50–75 fc at countertop. ● Branch circuits: separate 20 A small-appliance circuits for countertop, 20 A for microwave, 30 A for range, 20 A for dishwasher. ● Plumbing: hot/cold ½″ copper or PEX supply; 1½″ trap and trap arm; ¼″ per foot slope per IPC; shutoff valves at fixture within 6″ of connection. 7. Laundry Rooms Comply with IRC M1501 and NFPA 70 for equipment clearances, utility connections, and ventilation. 7.1 Equipment Layout and Clearances ● Washer/Dryer: 27″–30″ deep; front clearance 36″ for door swing and loading; side clearance 6″ for service. ● Stacked units: clear front 36″; floor-to-dryer-bottom height max 62″ for access. ● Counter above units: 36″ H; removable kick panel for connection access. ● Utility Sink: 36″ H; bowl depth ≧8″; clear knee space beneath if ADA required. 7.2 Ventilation and Utility Connections ● Dryer exhaust: rigid metal duct, 4″ I.D., max. 25′ length minus 2′ per 90° elbow (IRC M1502); terminate outdoors with backdraft damper. ● Electrical: washer 120 V/20 A receptacle; dryer 240 V/30 A dedicated circuit; receptacles GFCI if within 3′ of sink. ● Water Supply: ¾″ hot and cold stop valves at washer; flexible connectors per ASME A112.18.6. ● Drain: floor drain within 5′ of washer location; trap primer required if remote. 8. Bathrooms Per ICC A117.1 (accessible) and IPC Chapter 4. All clearances measured to finished surfaces. 8.1 Toilet ● Centerline: 16″ from side wall (15″–18″ acceptable). ● Front clearance: 24″ minimum; 30″ preferred for comfort. ● Seat height: 15″–19″; ADA 17″–19″ AFF. ● Grab bars: horizontal 42″ long at 33″–36″ AFF; adjacent wall 18″–24″ long. 8.2 Lavatory ● Counter height: 32″–36″ AFF. ● Knee clearance (ADA): 27″ H × 30″ W × 19″ D under front edge. ● Clear floor space: 21″ to any side fixture; 30″×48″ wheelchair clearances. ● Faucet controls: lever or touch type, operable with closed fist. 8.3 Shower and Bathtub ● Shower stall: 36″×36″ minimum clear; 42″×42″ recommended; threshold for roll-in ≤½″; curb ≥2″. ● Shower seat: fold-down seat

17″–19″ AFF; 12″ deep minimum. ● Grab bars: horizontal at 33″–36″ AFF, length 36″–42″; vertical bar optional. ● Bathtub: 60″×30″ minimum; side clearance 24″; grab bar at back wall 36″ long; seat height 15″–17″ AFF. ● Shower controls: placed within reach without stepping into spray; anti-scald valve per ASSE 1016. 8.4 Materials and Finishes ● Wall tile: ASTM C373 water absorption <0.5%. ● Floor tile: ANSI A137.1 dry static COF ≥0.6, wet COF ≥0.42 for showers. ● Sealants: silicone per ASTM C920; joints <¼″ width. ● Countertops: solid surface per ASTM D3966; edges sealed. 8.5 Ventilation and Lighting ● Exhaust: 50 cfm intermittent or 20 cfm continuous; ducted outdoors; sound rating ≤1 sone. ● Lighting: mirror luminaire 50 fc at vertical mirror plane; ambient 10 fc; fixtures UL‑listed for damp/wet locations. ● Outlets: GFCI within 6′ of sink; receptacles ≥15 A. 9. Closets and Storage Design storage for ergonomic reach and load capacity; reference ANSI/BHMA A156.9. 9.1 Storage Components ● Shelves: 12″–16″ D for general storage; 6″–12″ D for accessories. ● Rod heights: short garments 42″ AFF; long garments 60″ AFF. ● Shelf spacing: vertical 12″–15″ between adjustable shelves. ● Load capacity: wood shelves 12 lb/ft; steel shelves 35 lb/ft. 9.2 Access and Doors ● Swing doors: clear opening 24″–32″. ● Bi-fold doors: minimum 24″ opening. ● Sliding doors: two-panel, each panel opening 50% of width. ● Lighting: motion-activated LED strip, min. 10 fc. ● Mirror: full-height inside door optional; mount at 60″ AFF centerline. 10. Apartments and Densities Per IRC R326 and local zoning. All areas in net usable square feet unless stated. 10.1 Unit Sizes ● Studio: ≥300 ft^2; combined living/sleeping; kitchenette; bath. ● One-Bedroom: ≥400 ft^2; separate bedroom ≥70 ft^2; closet. ● Two-Bedroom: ≥600 ft^2; each bedroom ≥70 ft^2; two closets. ● Three-Bedroom: ≥800 ft^2; each bedroom ≥70 ft^2; corridor ≥3′ wide. 10.2 Circulation ● Corridors: single-loaded 4′–5′ wide; double-loaded 6′–8′; dead-end max 20′. ● Lobby: clear width ≥8′; include 5′×5′ seating alcove. ● Stairways: min. width 44″; handrails per IRC R311.7.8. 10.3 Parking and Service Areas ● Parking ratios: 1–2 spaces/unit; 0.2 visitor spaces/unit. ● Stall dimensions: 9′×18′ minimum; aisle width 24′ for two-way. ● Service corridors: 5′–6′ wide for refuse and deliveries. ● Ramp slope: max 1:12; landings 5′ long every 30′. 11. Accessible Housing for Elderly & Handicapped Conform to ADA Standards for Accessible Design and ANSI A117.1. 11.1 Entrances and Maneuvering ● Thresholds: ≤½″ vertical; bevel ≤1:2. ● Door clear width: ≥32″ at 90° open. ● Turning space: 60″ diameter clear in main rooms. ● Hardware: lever handles; switches/controls 15″–48″ AFF. 11.2 Accessible Kitchens ● Counter height: ≤34″ AFF; adjustable countertops desirable. ● Knee clearance: 27″ H × 30″ W × 19″ D under sink/ cooktop. ● Appliances: front-mounted controls; side-by-side under-counter refrigerator; pull-out shelves. ● Clear floor space: 30″×48″ centered on work area. 11.3 Accessible Bathrooms ● Wheel-in shower: 60″×30″; roll-in threshold ≤½″; fold-down seat 17″–19″ AFF. ● Grab bars: 42″ horizontal at 33″–36″ AFF at toilet; 36″–42″ horizontal in shower. ● Lavatory: 29″–34″ AFF; clear floor space 30″×48″. ● Toilet: seat height 17″–19″; centerline 16″ AFF to side wall. 12. Material Specifications and Standards All materials comply with referenced ANSI, ASTM, BS, DIN, and ISO standards; consult manufacturers for specific product testing data. 12.1 Countertop Materials ● Laminate: ANSI A208.1 Type N, 0.030″–0.050″ thickness; postforming grade for continuous surfaces. ● Solid surface: ASTM D3966; color-matched seam adhesive; max seam gap 0.005″. ● Engineered stone: ASTM C503; sealing per manufacturer; max porosity <0.5%. 12.2 Tile and Flooring ● Wall tile: ASTM C373 water absorption <0.5%. ● Floor tile: ANSI A137.1 dry-static COF ≥0.6; wet COF ≥0.42 for wet areas; frost-resistant for exterior use. ● Resilient flooring: ASTM F1303; ESD rating per ANSI/ESD S20.20 where applicable. ● Carpet: ASTM D418, fiber type per CRI Green Label. 12.3 Casework and Wood Products ● Plywood: ANSI/HPVA HP-1; interior grade. ● MDF: ANSI A208.2 Type I; low-formaldehyde content. ● Veneer: matching per AWI standards; veneer thickness 0.6 mm. ● Finishes: low-VOC waterborne coatings; compliance with LEED MRc4. 13. Symbols, Abbreviations, and Units Consistent use enhances clarity in plans, schedules, and RAG metadata. ● AFF: Above Finished Floor ● ANSI: American National Standards Institute ● ADA: Americans with Disabilities Act ● IRC: International Residential Code ● ISO: International Organization for Standardization ● BS: British Standard ● DIN: Deutsches Institut für Normung ● IPC: International Plumbing Code ● NFPA: National Fire Protection Association ● ASTM: American Society for Testing and Materials ● PPI: Partition Performance Index ● STC: Sound Transmission Class ● COF: Coefficient of Friction ● ×: by (e.g., 36″×36″) ● °F: degrees Fahrenheit ● ft²: square feet ● lb/ft: pounds per foot

Chapter 2: Educational (Part 1 of 6)

Overview

This initial part of the Educational chapter establishes the architectural standards for early childhood facilities, including nursery schools, children's centers, and child care centers. It focuses on creating a safe, orderly, and stimulating environment tailored to the developmental needs and physical scale of young children. The second half of this section introduces the broader principles of planning Elementary and Secondary schools, covering educational philosophy, site selection, safety codes, and the various typologies of modern school buildings.

Key Standards and Codes Referenced

- "Memo to Architects," New York City Housing Authority (Source for Children's Center space organization).
- Department of Defense Definitive Designs, Department of the Navy, Washington, 1968 (Source for Care Center plans).

- National Building Code, National Board of Fire Underwriters, BOCA (Building Officials Conference of America) Code (Referenced for school safety standards).

Section: Nursery Schools (Pages 163-166)

Overview

This section outlines the general requirements for a typical nursery school classroom for 15-20 children. It details the necessary activity areas, storage solutions, and environmental considerations, emphasizing the creation of a climate conducive to learning, self-reliance, and order.

Technical Specifications

General Space Requirements

- Occupancy: 15 to 20 children, 1 teacher, 1 assistant teacher.
- Instructional Space Area:
  - Minimum: 700 sq ft (excluding observation/office).
  - Optimal: 1,000 sq ft.
- General Group Activity Area: Minimum 150 sq ft of open space.
- Block Alcove: 24 to 30 sq ft.
- Display Shelf Height: No higher than 4 ft 6 in from the floor. Top shelves for children's use should be no higher than 3 ft 6 in.
- Reading Area Shelving: 32 linear ft of shelving required. Highest shelf no more than 3 ft 6 in from the floor, with 14 in clearance between shelves.
- Block Storage Shelving: 16 linear ft of shelving, at least 11 in deep with 10 in between shelves.
- Art Area Table: Requires a work area of 15 sq ft or more, with a height of about 18 in.
- Individual Storage Cubicles: 1 ft deep x 1 ft wide x 4 ft 6 in high.
- Toilets: Minimum 40 sq ft.
- Tutoring Booth(s): 45 sq ft (each).

Visual Elements Analysis

Figure 1: Nursery School Activity Areas (Page 163)

Description: A schematic bubble diagram showing the interrelationship of various activity zones within a nursery school classroom. Technical Details: A central "General Area for Group Activities" is surrounded by specialized zones:

- Noisy Areas: Dolls & Housekeeping, Manipulative Toys, Blocks.
- Quiet Areas: Art, Reading Room, Tutoring Room.
- Support Areas: Cubicles, Protected Play Area, Rest Rooms.
- Special Features: A planter for vegetables/flowers is noted. Construction Notes: The diagram emphasizes a hub-and-spoke model where specific, functionally distinct areas are directly accessible from a central, flexible group space. This zoning separates noisy and quiet activities.

Figure 2: Block Carts (Page 164)

Description: A perspective view of a mobile, two-tiered wooden storage cart for building blocks. Technical Details: The cart is shown with a 24" max height. The shelves have painted silhouettes of the blocks to indicate proper storage locations, encouraging children to maintain order.

Figure 3: Sloping Shelves for Display (Page 164)

Description: A three-tiered, open-shelf cabinet with sloped shelves. Construction Notes: The text states that sloping shelves are best for displaying puzzles and books, as they allow children to see the full front cover when making a selection.

Figure 4: Individual Cubicles (Page 165)

Description: A perspective view of a bank of individual storage cubicles or "cubbies." Technical Details: Each cubicle is shown with a double hook for coats, a top shelf for personal items, and a lower area for shoes/boots. The unit is dimensioned as 4'-6" high. A bench is integrated into the front of the unit for children to sit on while changing shoes.

Summary of Space Requirements Table (Page 166)

Description: A detailed table quantifying the minimum and optimal space allocation for each activity area within a nursery school. Technical Details:

Activity	Min. Area (sq ft)	Opt. Area (sq ft)	Storage	Other

General area	150	200	Carts, shelves for music equipment	Hot plate, refrigerator
Block alcove	50	75	16 linear ft shelving	
Manipulative toy area	100	150	Open and sloping shelves	Table for 4-5 children
Reading and listening	100	150	Shelving for 20-25 books	Table for up to 6 children
Doll and housekeeping	100	150	Drawers, open shelves	Full-length mirror
Art area	100	150	Sufficient for 12 18x24" paintings	Easels, table for 4-5 children
Tutoring booth(s)	45 (each)	50 (each)		
Cubicles	60	90	4'6" high, 1 ft wide, 1 ft deep	

BOQ Implications

- Area Take-Offs: The table on page 166 provides direct square footage requirements for calculating the necessary gross floor area for a nursery school facility.
- Millwork: BOQ must include specifications for specialized storage like sloping book displays (Fig. 3), block carts with painted silhouettes (Fig. 2), and individual cubicles with integrated benches (Fig. 4).
- Acoustics: The recommendation for carpeting throughout (except the art area) and other acoustical treatments must be quantified.

- Plumbing: Requirements for child-height sinks (and potentially a teacher-height sink) must be included in the plumbing schedule.

Critical Notes and Warnings

- Scale is Paramount: All display and storage shelves must be at a height accessible to small children (typically no higher than 3'-6"). Windows must be low enough for children to see out.
- Acoustic Separation: The design must intentionally separate noisy activity areas (blocks, housekeeping) from quiet areas (reading, art) using dividers, cabinets, or architectural zoning.
- Flexibility: Furniture should be movable (e.g., tables used for art can be pulled into the general area for group activities) to allow for flexible use of the space.
- Observation Space: A one-way glass observation area is critical for parental involvement and teacher training programs. It must be acoustically isolated and preferably elevated to not interfere with classroom wall space.

Section: Children's Center & Child Care Centers (Pages 167-168)

Overview

These sections scale up the principles of nursery design to larger facilities accommodating 50-60 children. They focus on the overall organization of multiple playrooms, support services, and outdoor areas, providing complete floor plans as examples.

Technical Specifications

- Children's Center (Page 167):
    - Occupancy: Approx. 60 children.
    - Ceiling Height: Should be at least 10 ft high and have acoustical treatment.
    - Playroom Size: Playrooms for older children should be 400 sq ft; for younger children, 350 sq ft.
    - Isolation Room: Minimum 80 sq ft.

    - Toilet Fixtures: Child-sized toilets and lavatories. Water closets to be 10 in high for the youngest children. Urinals to be 21 in from floor with strainer in drain.
- Child Care Centers (Page 168):
    - Equipment Schedule: Lists standard equipment including sinks, refrigerators, ranges, cribs, and playpens, which are keyed to the floor plans.

Visual Elements Analysis

Figure 1: Children's center space organization (Page 167)

Description: A detailed bubble diagram illustrating the functional layout and circulation for a complete children's center. Technical Details: The diagram shows a central corridor providing access to:

- Main Functions: Admission, Office, Examination, Isolation.
- Children's Rooms: Three distinct playrooms are shown, each with its own cot and supply closet.
- Play Areas: Each playroom has direct access to an outdoor play area, which is enclosed by a C.I. (Chain Link) fence.
- Services: A central kitchen, staff toilet, and work room serve the entire facility.

Figure 2 & 3: Care center for 25/50 children (Page 168)

Description: Detailed, dimensioned floor plans for a 25-child care center and a larger 50-child center.

- Figure 2 (25 Children): A compact, L-shaped plan with a Class Room (20 children), a Nursery (5 infants), a central Kitchen, and an Isolation room. An outdoor, fenced play area with a mechanical equipment yard is shown. Total dimensions are approx. 45'-8" x 34'-2".
- Figure 3 (50 Children): A larger, symmetrical plan with two classroom wings (20 children each) flanking a central service core. The core contains a kitchen, office, lounge, and isolation room. Each classroom has its own toilets, storage, and direct access to an outdoor play area. This layout demonstrates efficient zoning for a larger population.

Chapter 2: Educational (Part 2 of 6)

Overview

This section serves as a comprehensive introduction to the philosophy, programming, and design principles of modern elementary and secondary schools. It moves beyond simple space allocation to discuss the school as a dynamic environment for learning and a central hub of the community. The text covers the evolution of school design, the importance of program-driven architecture, and the critical balance between space, quality, and cost. It outlines the process of educational consulting and architectural programming, details site selection criteria, and provides an extensive analysis of various school typologies and plan configurations, illustrated with numerous diagrams and floor plans.

Key Standards and Codes Referenced

- This section is more philosophical and process-oriented; it references general concepts and roles (e.g., educational consultant, architect's responsibilities) rather than specific numbered codes. It does emphasize that all designs must adhere to local and state building and safety codes.

Section: Elementary and Secondary Schools - General (Pages 169-172)

Overview

This introductory text establishes the modern context for school design. It argues that school buildings must be flexible and responsive to changing educational needs and technologies. The core of this section is a detailed outline of the Educational Consulting and Architectural Programming process, which forms the foundation for any successful school project.

Technical Specifications

The "Space x Quality = Cost" Formula

- Concept: A fundamental principle stating that for a fixed budget, only two of the three variables (amount of space, quality of materials/construction, total cost) can be determined by the client. The architect must be allowed to vary the third.
- Implication: Inefficient planning (wasted space) or specifying low-quality materials to meet a budget will result in long-term functional and maintenance problems.

Project Budget Components

- A typical project budget must account for more than just construction cost. Key line items include:
    i. Construction cost of building facilities
    ii. Site development and utility connections
    iii. Fixed equipment
    iv. Architectural and engineering fees
    v. Contingency allowance
- Rule of Thumb: Construction cost typically cannot exceed three-quarters (75%) of the total allowable project budget.

Architectural Functions for Climate Control (Fig. 1, Page 172)

- Concept: A diagram illustrating that the "Total Environment" is a product of five interconnected architectural considerations:
    - Visual Harmony: Aesthetics, form, layout.
    - Sound Control: Acoustics.
    - Fresh Air: Ventilation.
    - Lighting: Natural and artificial illumination.
    - Thermal Control: Heating and cooling (HVAC).
- Key Principles:
    - Plan: Compact, multistory buildings are more economical to heat and cool than sprawling one-story plans.
    - Orientation: North or south-facing classrooms are preferable to avoid excessive heat gain from east/west exposure.
    - Fenestration: "Windowless" buildings save on initial cost and heat loss. However, some windows are needed to avoid a "closed-in" feeling. Heat-absorbing glass is a key material.
    - Insulation: Adequate roof and wall insulation, including double-glazing, is critical for economy.
    - Color: Color is a psychological aid to learning. Bright, warm colors stimulate action (gym); soft, cool colors create quiet (study areas).

BOQ Implications

- Comprehensive Budgeting: The BOQ must be developed as part of a total project budget that includes "soft costs" like fees and contingencies, not just direct construction costs.
- Value Engineering: The "Space x Quality = Cost" formula is the basis of value engineering. The BOQ is the tool used to analyze trade-offs between different materials and systems (e.g., higher initial cost for better insulation leading to lower long-term operating costs).

- System Specification: The principles of climate control (lighting, HVAC, acoustics) directly translate into major sections of the BOQ, requiring detailed specifications for fixtures, equipment, ductwork, insulation, and acoustic materials.

Section: Site Selection, Busing, Parking, Recreation Facilities, Safety (Pages 173-177)

Overview

This section provides a detailed checklist and guidelines for the physical planning of a school site. It covers everything from regional analysis to specific layout requirements for vehicle circulation, parking, recreation, and safety systems.

Technical Specifications

Site Selection & Planning Checklist (Page 173)

- A comprehensive checklist is provided, covering:
  - Site Analysis: Location, size, soils, topography, hydrography, existing structures, easements, vegetation, utilities, wind/sun.
  - Zoning: Type and restrictions.
  - Environmental Conditions: Noise, smoke, smog.
  - Access Roads: Type, width, volume, planned improvements.
  - Site Requirements: Parking (executive, employee, visitor), service access, public transportation, pedestrian circulation.

Busing and Parking

- Bus Dimensions: Length 36 ft 0 in; Width 8 ft 0 in; Inside Turning Radius 45 ft 0 in; Outside Turning Radius 60 ft 0 in.
- Bus Stall Size: 12 ft 0 in x 44 ft 0 in.
- Parking Stall Requirements (Table 2, Page 174): This table compares different parking layouts.
  - Parallel single file: Requires 12 ft 0 in width and 528 linear ft for 44 cars.
  - Parallel free access: Requires 25 ft 0 in width and 2,736 linear ft for 44 cars.
  - 30°, 45°, 60°, 90° peel-off: Details the varying linear footage and area required per bus/car based on the angle of parking.

- Parking Area Circulation (Fig. 8, Page 176): Shows pedestrian walkways separate from vehicle lanes, a critical safety feature.

Recreation Facilities

- Playground Surfacing (Table 3, Page 175): A matrix evaluating various surfaces (Earth, Aggregate, Bituminous, Concrete, Masonry, Miscellaneous*) against qualities like durability, maintenance, cost, and safety.
    - *Miscellaneous includes: Turfbark, sawdust, cotton-meal, rubber, plastics and vinyl, asbestos-cement boards, wood.

Safety and Egress

- Corridor Length: Maximum unbroken length should not exceed 150 to 200 ft.
- Stairway Width: Recommended width is 4 ft 8 in to 5 ft between handrails to allow two students with books to walk side-by-side.
- Stair Tread/Riser: Standard dimensions should be used. Treads should have a non-slip, high-traction surface (e.g., inserted carborundum).
- Doors: Vision panels are required to prevent accidents. Use of tempered or wire glass is recommended for safety.

Visual Elements Analysis

Figure 1: Site analysis (Page 173)

Description: A topographical map of a sample school site showing key features. Technical Details: The map illustrates a site with "Rolling Wooded Area" and "Open Flat Area (Low)." It is bounded by a "Commercial Expressway" and a "Secondary Road," with a "Main Access Road" entering the site. This demonstrates the typical elements to be mapped during site analysis.

Figures 4, 5, 6, 7: Bus Parking Systems (Page 175)

Description: A series of diagrams showing four different layouts for bus parking, each with a calculated required square footage per bus.

- (a) Peel-Off System (First bus must leave first): Requires 1,100 sq ft/bus (45°) or 1,164 sq ft/bus (60°).
- (b) Free-Access System (Any bus can leave at any time): Requires 1,440 sq ft/bus (45°) or 1,584 sq ft/bus (60°). The 30° layout requires 1,572 sq ft/bus. Construction Notes: The "Free-Access" system, while less space-efficient, is functionally superior as it does not trap buses. This is a critical operational consideration.

Figure 9: Planting Diagram (Page 176)

Description: A bubble diagram showing how planting can be used to create functional zones and environmental controls. Technical Details: Shows the "Building" surrounded by:

- Shade Trees: To control sun exposure.
- Sound Barriers: Dense plantings to buffer noise.
- Flower/Color: Aesthetic plantings.
- Service Area Screen: Plantings to hide utility areas.
- Zones for "Play Area," "Sitting Area," and "Outdoor Classroom" are defined by these landscape elements.

Figure 10-13: Egress and Safety Details (Page 177)

- Figure 10: Elevation showing fixtures (drinking fountain, fire extinguisher, lockers, unit heater) recessed into the corridor wall to maintain a clear, projection-free path.
- Figure 11: Section detail of a carborundum tread inset into the stair for non-slip safety.
- Figure 12: Detail showing handrail brackets "permanently anchored in the masonry wall."
- Figure 13: Plan showing a recessed door with a vision panel to prevent collisions.

Section: Kinds of Schools & Organization of Space (Pages 178-184)

Overview

This section provides a taxonomy of modern school types and illustrates how different educational philosophies translate into distinct architectural layouts or "plan concepts." It covers everything from elementary schools to specialized vocational high schools and demonstrates the trend towards flexible, clustered, and open-plan designs.

Technical Specifications

- Pupil Capacity - High Schools (Table 4, Page 179):
    - Provides a sample capacity calculation for a high school.
    - Classroom: 17 units x 25 capacity = 425 total.
    - Science laboratory: 3 units x 25 capacity = 75 total.

    - Gymnasium with partition: 1 unit x 70 capacity = 70 total.
    - Total Capacity: 798 students.
    - Optimum Capacity: Stated as 80% per cent utilization: 798.
- Space Utilization & Size of School (Table, Page 179):
    - Small Schools (500-1,500 pupils): Achieve 60-70% space utilization.
    - Large Schools (1,500-3,500 pupils): Achieve 80% space utilization.
    - Very Large Schools (3,500+ pupils): Achieve 90% space utilization.

Visual Elements Analysis

Figure 16: Plan Concept (Page 179)

Description: A diagram illustrating the "Play Corridor" concept, where circulation space is widened and designed to be used for informal learning and interaction, breaking down the rigid separation between classroom and corridor.

Figures 17-26: School Floor Plans (Pages 20-23)

Description: A large collection of floor plans illustrating different school typologies and organizational concepts.

- Cluster Plans (Fig. 18): Classrooms are grouped in clusters ("pods") around a shared central space, often for a specific age group. This creates a "school-within-a-school" feeling.
- Open-Plan Concept (Fig. 17): Shows large, flexible instructional areas with few permanent walls, arranged around a central study-resource center.
- Compact Urban Schools (Figs. 21, 22, 26): Demonstrate solutions for tight city sites, often involving multi-story construction, internal courtyards, and rooftop play areas.
- Campus-Type Plan (Fig. 24): Shows a large high school broken into smaller, separate buildings for different functions (Science, Math, Library, Arts, Auditorium), connected by covered walkways. This reduces the scale of a large institution.
- Subschool/House Plan (Fig. 27): Illustrates a very large high school (6,000 students) broken down into four distinct "houses" of 1,500 students each. Each house has its own resource center, study, and dining facilities, fostering a stronger sense of identity and community.
- Vocational Schools (Figs. 28, 29): Show specialized layouts. Fig. 28 is a ten-story vertical school designed like an office building. Fig. 29 shows large, high-bay shop spaces organized in wings, connected by a dramatic ramping diagonal corridor.

- Portable Classrooms (Fig. 30): A perspective view of typical prefabricated, temporary classroom units.

BOQ Implications

- Area Programming: The space utilization table (p. 179) and high school capacity chart (Table 4) are direct inputs for the programming phase, helping determine the required gross floor area, which is the primary driver of the project BOQ.
- System & Material Specifications: The choice of plan concept heavily influences the BOQ.
    - Campus plans require extensive site work, foundations for multiple buildings, and long utility runs.
    - Open plans require fewer interior partitions but may demand more complex structural systems (long spans) and highly sophisticated acoustic treatments.
    - Compact urban schools may require more expensive facade systems and structural solutions for vertical construction.
- Specialized Equipment: Vocational and science-heavy schools will have extensive and costly line items in the BOQ for specialized equipment (shop machines, lab benches, fume hoods, etc.).

Chapter 2: Educational (Part 3 of 6)

Overview

This part details the design of the core administrative and information hubs of a school. The first section covers Administration Suites, treating them as the central control and contact point for the entire school community, requiring careful planning for public access, staff function, and confidential operations. The second, more extensive section, explores the evolution of the traditional library into the modern Learning Resource Center (LRC), a dynamic hub for all forms of media. It provides detailed layouts, specifications for furniture and shelving, and design principles for creating a functional and inviting "supermart of media."

Key Standards and Codes Referenced

- American Library Association (ALA): Referenced as the source for recommendations on book and seating allocations in Learning Resource Centers.

Section: Administration Suites (Pages 185-187)

Overview

This section describes the administration suite as the school's primary control center and public face. It outlines the necessary components—offices, conference rooms, work areas, and record storage—and illustrates how these components are organized to serve students, faculty, and parents efficiently and securely.

Technical Specifications

- Core Components: A typical suite includes offices for the principal and assistant principal, a general office/reception area, conference rooms, work/storage rooms, a vault for records and money, and often counseling and health services.
- Location: Must be placed near the main entrance for public access and control.
- Psychological Separation: It is suggested that disciplinary offices and waiting rooms be kept separate from the main administrative waiting area for psychological reasons.
- Faculty Mail: Should be private but easily accessible.

Visual Elements Analysis

Figures 31, 32, 33: Administration Suite Layouts (Page 185)

Description: Three floor plans showing the progressive complexity of administration suites for elementary, junior high, and high schools.

- Figure 31 (Elementary): A compact suite with a Principal's office, a Nurse's/Exam room, a general office with a counter, and a waiting area.
- Figure 32 (Junior High): A larger suite that adds dedicated space for a Vice Principal and Counselors, with a more defined records area and a larger general office.
- Figure 33 (High School): A comprehensive suite that includes space for a Dean, specialized Health Services (Speech, Hearing, Therapy), a dedicated vault, and a direct connection to the Resource Center.

Figure 34: Faculty Mailbox Details & Office Suite (Page 186)

- Description: This figure provides a detailed construction drawing of a faculty mailbox unit and a floor plan of a large administrative and faculty office suite.
- Technical Details (Mailbox):

    - (a) Section: Shows a stack of mailboxes set in a hollow metal (H.M.) frame. The total height is shown as 5'-10" MAX, with the mail slot set at a height of 3'-2".
    - (b) Isometric: Shows an individual mail slot box with dimensions of 11" deep x 10" wide x 2 ¾" high. The material is specified as glass.
- Technical Details (Office Suite - c): A large, complex plan showing individual faculty offices, shared workrooms (WKRM.), conference rooms (CONF.), counseling offices (COUNS.), mail room, and offices for the Dean and Director, all organized around a central "Student Activities" lounge area. This layout demonstrates a decentralized, cluster approach to faculty offices.

Figures 35-38: Faculty Office and Carrel Details (Page 187)

Description: These figures illustrate different approaches to providing office and work space for faculty, from traditional linear layouts to innovative island concepts.

- Figure 35: A linear administrative suite with a clear hierarchy: Lobby -> Asst. Prin. -> Prin. -> Conference. Counseling and health services are organized along a secondary corridor.
- Figure 36 & 37: Show a basic faculty office setup with a desk top, file drawer, and a "book unit." The desk is 2'-6" deep.
- Figure 38: An isometric view of a unique island cluster of four faculty offices. The partitions are non-ceiling-high, creating a semi-open feel within a larger resource center space, intended to foster closer student-teacher interaction.

BOQ Implications

- Millwork: The BOQ must include quantities for custom or semi-custom millwork, including reception counters, faculty mailboxes (per Fig. 34 detail), and built-in storage.
- Security: The requirement for a vault necessitates specifying a vault door and appropriate reinforced construction in the BOQ.
- Partitioning: The various layouts show different levels of partitioning, from standard full-height walls to the non-ceiling-high partitions in Fig. 38, which would have different material and labor costs.

Section: Learning Resource Centers (Pages 188-194)

Overview

This section details the transformation of the school library into a comprehensive Learning Resource Center (LRC), an active "supermart of media." The LRC is positioned as the physical and educational heart of the school, integrating books with a vast array of audiovisual and electronic resources. The design must accommodate varied activities, from quiet individual study to group work and media production.

Technical Specifications

- Core Components: Book stacks, periodicals, reading/study areas, sight-and-sound-equipped study carrels, listening rooms, preview rooms, TV studios, production areas, and control/circulation desks.
- Location: Should be at the physical heart of the school, equally accessible to classrooms and the community, with provisions for after-hours access.
- Atmosphere: Should be inviting and comfortable to encourage student use. Carpeting is now very common for acoustic control and comfort.
- Book Shelving (Fig. 43, Page 189):
  - Dimensions: Standard single-face section is 36" wide. Shelf depths are 8", 10", 12". Recommended face-to-face clearance between stacks is 3'-0".
  - Unit Heights: High unit is 6'-10"; Medium unit is 60 ½"; Low unit is 42".
- Book Capacity per 3' Single-Face Section:
  - High Shelf Unit: 150 volumes.
  - Medium Shelf Unit: 105 volumes.
  - Low Shelf Unit: 65 volumes.
- Book Shelving Capacity (Table 5, Page 191): A detailed table showing the total linear feet of shelving and volume capacity for single-face and double-face sections of varying heights (3, 5, and 7 shelves).
  - *Example*: A 7-shelf, single-face section holds 1,050 volumes. A 7-shelf, double-face section holds 2,100 volumes.
- Classroom Area Recommendations:
  - Elementary: 850 to 1,150 sq ft.
  - High School: 750 to 900 sq ft.
- Chalkboard & Tackboard:
  - Chalkboard: Minimum 16 linear ft; up to 48 linear ft for math rooms.
  - Tackboard: 16 to 32 linear ft. A display rail over the chalkboard is essential.

Visual Elements Analysis

Figure 39: Media Flow Diagram (Page 187)

Description: A diagram illustrating the flow of various media from storage to the student. Technical Details: Shows different media types (Slides, Film, Videotape, Records, etc.) being stored as cartridges in an "Automatic IMC." The student consults a "Master Directory," selects material, and dials a request. The audio/visual material then appears on the student's individual carrel TV screen and speaker. This represents an advanced, electronically-based resource distribution system.

Figure 40: Learning Resource Center Plan (Page 188)

Description: A detailed floor plan for a 1,000- to 2,000-student high school LRC. Technical Details: This comprehensive plan shows the integration of many different functions:

- Core Area: Browsing, Current Periodicals, Reserve Books, Reading & Study areas.
- Media Production: TV Broadcast Studio, Audio-Visual Production, Film Broadcast Studio.
- Support: Faculty Professional Library, Offices, Receiving/Shipping, Teacher Equipment Storage, Dark Room.
- Access: The center is designed with multiple entrances, connecting to classrooms and the outside.

Figure 41: Study Carrel Details (Page 188)

- Description: Shows an isometric view and a section of a study carrel cluster.
- (a) Isometric View: Shows four carrels clustered in a pinwheel arrangement.
- (b) Section: Provides critical dimensions for a carrel. Total height is 4'-2". Work surface is at 2'-4". A shelf is provided above the work surface. The unit is designed for services (power/data) to be fed from below. A 3'-0" x 3'-0" module is indicated.

Figure 42: Below-Grade LRC (Page 189)

Description: A plan showing a resource center located entirely below grade, connecting to an existing building. Construction Notes: This design solution is a response to land scarcity. The roof of the LRC is developed as a landscaped terrace or play space. This requires significant structural, waterproofing, and mechanical ventilation considerations.

Figure 44 & 45: Open-Plan Learning Centers (Page 190)

Description: These two plans show a more "open-plan" concept where the LRC and classroom areas merge.

- Figure 44: Shows a large, open area for Social Studies that flows directly into the LRC stacks and reading areas, separated only by low shelving and furniture.
- Figure 45: Shows a "subschool" for 1,500 students where faculty offices are located in glass-partitioned units directly within the study-resource area, promoting close teacher-student interaction.

Figure 53: Chalkboard/Tackboard Details (Page 193)

Description: Detailed construction sections for a display wall. Technical Details:

- Shows a section with Cork tackboard over a Back-up Board.
- Shows a second section with Glass or Steel Chalkboard over a back-up board.
- Both include an aluminum Rail Hook at the top.
- The layers are clearly shown: Finish Material -> Back-up Board -> Plywood -> Furring -> Main Wall.

BOQ Implications

- FF&E and Millwork: The BOQ must contain highly detailed specifications for specialized furniture like study carrels (including electrical/data wiring), library shelving (specifying height and depth), circulation desks, and display cases.
- Audiovisual Systems: This is a major component. The BOQ will need to include line items for projectors, screens, cameras, recorders, closed-circuit TV systems, and all associated cabling, conduits, and control systems.
- Structural and MEP: Below-grade LRCs (Fig. 42) require extensive waterproofing, mechanical ventilation, and structural work for the plaza above. Open-plan concepts (Fig. 44) may require long-span structural systems and sophisticated acoustic ceiling treatments.
- Finishes: The text specifically mentions carpeting, which needs to be quantified. The detailed wall sections (Fig. 53) provide the exact material layers (cork, backer board, plywood) that need to be included in the finishes schedule of the BOQ.

Chapter 2: Educational (Part 4 of 6)

Overview

This part of the chapter delves into the specific design requirements for the fundamental spaces of a school: classrooms, multipurpose rooms, and student locker areas. The classroom section outlines general design criteria, electrical needs, and provides extensive data on working heights and chalkboard/tackboard installation. The multipurpose room section explores the challenges and solutions for combining assembly, cafeteria, and gymnasium functions. Finally, the student locker section illustrates various strategies for locating and designing storage to minimize congestion and facilitate supervision.

Key Standards and Codes Referenced

- Perkins and Will, Architects: Credited for the team-teaching classroom plan (Fig. 50).
- Warren H. Ashley, Architect: Credited for the elementary school program diagram (Fig. 51).
- Chapman and Leffler, Architects: Credited for multipurpose room and locker plans (Figs. 59, 60, 61, 66).
- A. G. Odell, Jr. and Associates, Architects: Credited for a high school locker plan (Fig. 65).

Section: Classrooms (Pages 190-195)

Overview

This section details the essential requirements for a standard academic classroom. It covers design, location, light control, and electrical services, with a strong emphasis on creating a flexible and functional teaching environment. It includes detailed specifications for classroom furniture and finishes, most notably for chalkboards and tackboards.

Technical Specifications

General Requirements for All Classrooms (Page 191)

- Ceilings: Maximum height of 9 ft 6 in. Should be acoustically treated.
- Lighting: Light from windows should, if possible, come over the pupil's left shoulder. Teacher should not face windows.
- Floors: Should have a cushioning material.
- Electrical Services:
    - A double electric outlet on each of the three interior walls is required.
    - 8-inch clocks should be in all educational rooms.
    - Coaxial cable for television should be considered in the planning phase.

- Doors: Should be placed at the front of the classroom and recessed to not protrude into the corridor. Thresholds should be avoided. All doors must have a vision panel of tempered or wire glass.

Chalkboard and Tackboard (Page 194)

- Chalkboard Amount:
  - Minimum: 16 linear ft.
  - Maximum (e.g., math rooms): 48 linear ft.
- Tackboard Amount: 16 to 32 linear ft.
- Display Rail: An essential teaching aid, extending the full length of the chalkboard, equipped with hooks and clip fasteners.
- Corkboard Material: Must be at least ¼ in. thick if staples or thumbtacks are used.
- Pegboard Material: Must be at least ¼ in. thick, tempered grade recommended for better service.

Visual Elements Analysis

Figure 51: Elementary School Program Legend (Page 193)

Description: A legend diagram identifying different types of group facilities in an elementary school plan. Technical Details: The legend distinguishes between:

- Individual and Small Group Facilities (lightest shading)
- Medium Size Group Facilities
- Large Group Facilities (darkest shading) Relationship to Text: This legend is key to understanding the functional zoning shown in the complex elementary school floor plan on the same page, which illustrates self-contained classrooms with integrated facilities for reading, arts, and science.

Figure 54: Chalkboard, Tackboard, and Adjustable Strip Details (Page 194)

Description: Detailed construction sections for classroom wall finishes. Technical Details:

- (1) Shelving Detail: Shows a ¾" solid wood or sanded plywood shelf supported by an angle bracket.
- (2) Chalkboard Detail: A section showing a metal clip, latex corkboard, and a chalk tray with weep holes. Crucially, it specifies plywood backing at ¾".
- (3) Corkboard Detail: Shows a section of a tackboard with ¼" cork over a plywood backing, held in by a panel guide.

- (4) Detail of Typical Adjustable Strip: Shows a perforated steel stud (e.g., Unistrut) set flush into the plaster wall, allowing for flexible mounting of shelves or displays.

Table 6: Working Heights in Inches for Elementary and Secondary School Children (Page 195)

Description: An exhaustive table providing minimum, optimum, and maximum working heights for various classroom fixtures and furniture, broken down by grade level (Kindergarten, Grades 1-3, 4-6, Junior High, Senior High). Technical Details (Sample Data for Senior High):

Item	Min. (in)	Opt. (in)	Max. (in)
Cabinet, display (top)	77	-	79
Chalkboard (top)	78	-	84
Chalkboard (bottom)	33	34	36
Desk, typing	26	-	28
Drinking fountain	31	32	34
Lavatory and sink	33	35	38
Table, work	29	30	31
Tackboard (bottom)	31	32	34

BOQ Implications

- Finishes Schedule: The BOQ must quantify linear feet of chalkboard, tackboard, and pegboard. The specifications for material thickness (¼" cork, ¼" pegboard) and type (porcelain enameled steel) are critical cost and quality factors.

- Millwork: Built-in shelving and cabinets (Figs. 55-58, page 194) require detailed quantification. Fig. 57, a storage unit with a work counter and sink, is a significant millwork item involving plumbing and durable countertop finishes.
- Framing & Backing: The requirement for ¾" plywood backing behind all chalkboards and tackboards (Fig. 54) is a specific labor and material item that must be included in the framing/drywall section of the BOQ.
- Specialty Hardware: The BOQ needs to include line items for display rails with clip fasteners, adjustable hanging strips (Unistrut or similar), and all associated hardware.

Section: Multipurpose Rooms (Pages 195-197)

Overview

This section addresses the design of large, flexible spaces that combine assembly, cafeteria, and sometimes gymnasium functions. It acknowledges the economic necessity of such spaces but warns of the functional compromises, particularly with the "Cafeteria-Gymnasium" combination.

Technical Specifications

- Core Combinations: Assembly-Cafeteria, Assembly-Cafeteria-Gymnasium, Assembly-Gymnasium.
- Assembly-Cafeteria: The most popular combination. Requires easily movable furniture (portable folding table/bench units, wall-folding tables, or stacking chairs/tables). Must have a stage, curtain, backdrops, and adequate lighting.
- Assembly-Cafeteria-Gymnasium: A combination born of limited funds that "may seriously curtail the educational program" due to the significant time required for setup and cleanup, which reduces time for physical and assembly activities.
- Assembly-Gymnasium: A possible solution when a full auditorium is not available. Requires a stage usable for physical activity and extensive storage for both chairs and gym equipment.

Visual Elements Analysis

Figures 59 & 60: Cafeteria-Assembly Rooms (Page 196)

- Description: Two floor plans showing different layouts for combined cafeteria and assembly halls.

- Figure 59: Shows a central Cafeteria/Assembly area with a stage at one end and the kitchen/serving line at the other. Large openings to wide corridors allow for Overflow Seating, reducing traffic congestion.
- Figure 60: A similar concept but with a large opening to a corridor on the side, providing overflow seating and connecting to a separate multipurpose room.

Figure 61 & 62: Gymnasium-Assembly Rooms (Page 197)

- Figure 61: Shows an "All Purpose Room" with low display cabinets and overflow seating into a lobby. This is a smaller-scale, more flexible space.
- Figure 62: A large Gymnasium with a stage that can be divided by a folding door, creating two teaching stations. The proscenium can be closed with folding bleachers. This is a highly functional, complex design for a larger school.

Section: Student Lockers (Pages 197-199)

Overview

This section presents various solutions for storing student coats and personal belongings. It contrasts elementary school needs (proximity to homeroom, teacher supervision) with high school needs (easy access between periods, security).

Technical Specifications

- Elementary School Cubicles (Fig. 63): Open cubicles are preferred, with permanently attached coat hangers and a boot rack made of water-resistant materials.
- Locker Ventilation: Fig. 70 shows a detail where lockers are ventilated by pulling air through lower front vents into a ceiling plenum.
- Locker Base: Fig. 71 shows lockers installed on a ceramic tile base to simplify floor maintenance and prevent rust.

Visual Elements Analysis

Figure 63: Open Locker Alcove (Page 197)

Description: A plan showing open coat storage for a four-classroom cluster in an elementary school. Technical Details: The lockers are located in a shared alcove off the corridor, which also contains toilets. This centralizes plumbing and allows for economical ventilation while keeping the storage areas under teacher supervision.

Figure 65 & 66: High School Locker Arrangements (Page 198)

- Figure 65: Shows lockers concentrated in large, open alcoves off main corridors. This "eliminates congestion in corridors and frees corridor walls for display." Requires good circulation around the locker banks.
- Figure 66: Shows lockers concentrated near the entrance and a student center, with separate, open coat racks for coats and boots, and smaller security lockers for books and personal items.

Figure 71 & 72: Recessed Locker Details (Page 199)

- Description: Detailed section and elevation of recessed corridor lockers.
- Technical Details:
    - Figure 71 (Section): Shows a metal locker recessed into a masonry wall. It sits on a ceramic tile base. Furring is used to create a flush finish. A ceiling is furred down to meet the top of the locker, preventing dust accumulation.
    - Figure 72 (Elevation): Shows the finished appearance of the recessed lockers.

BOQ Implications

- Locker Specification: The BOQ must specify the type (cubicle, single-tier, double-tier), material (metal), and quantity of lockers.
- Site-Built vs. Prefabricated: Elementary cubicles (Fig. 63) are often custom-built millwork, while high school lockers (Fig. 65) are typically prefabricated metal units. This affects the trade responsible and the cost.
- Architectural Finishes: Recessed locker installations require framing, drywall, and a specialized base (e.g., ceramic tile), which must be quantified.
- Mechanical (HVAC): Ventilated locker systems require ductwork and connections to the main HVAC system, which must be included in the mechanical BOQ.

Chapter 2: Educational (Part 5 of 6)

Overview

This part of the chapter focuses on the complex and highly specific requirements for school science laboratories and introduces the standards for arts facilities. It details the necessary equipment, layouts, safety protocols, and utility infrastructure for General Science, Biology, Chemistry, and Physics labs. The section also covers crucial support spaces such as preparation rooms, chemical storage, animal/plant rooms, and specialized facilities like vivariums and planetariums. The introduction to the Arts section emphasizes the need for flexible work surfaces, extensive storage, and display space.

Key Standards and Codes Referenced

- This section is highly technical and implies adherence to safety codes for handling chemicals (vented closets), electrical systems, and fire prevention (fire extinguishers), though no specific code numbers are cited.

Section: Science Facilities (Pages 200-205)

Overview

This section provides an exhaustive guide to planning science facilities. It emphasizes that labs are active, hands-on learning environments requiring durable, specialized, and safely arranged equipment. The design must support activities ranging from lectures and demonstrations to individual and group experiments.

Technical Specifications

General Science & Biology Laboratories

- Location: First floor, with windows facing south or southwest, and direct access to the outdoors for field study.
- Finishes: All laboratory furniture must be acid-resistant and easy to clean.
- Equipment:
  - Instructor's Demonstration Desk: Must have hot/cold water, AC receptacle, soapstone sink, upright rods with clamps, and a double gas cock.
  - Student Stations: Biology desks with cupboards and book compartments.
  - Other: Herbarium, aquariums, projection screen, microscopes, models, charts, dissecting trays, portable germinating bed, terrarium, first-aid cabinet, fire extinguisher.
- Utilities:
  - Gas and electricity outlets are needed in counters.
  - If the entire class uses electrically lighted microscopes, tables will require electric outlets.

Chemistry Laboratories

- Layout: Student stations for 24 students, consisting of tables with large, free working areas.
- Demonstration Area: Should have a 5-in high dais, a stone-top demonstration table with spotlighting, and a roll-away extension.
- Fume Hood: Required, accessible from three sides.
- Finishes: Furniture must be acid- and base-resistant.
- Utilities: All services must be available at student stations, including variable AC and DC voltage.
- Storage: Must include a standard reagent storage area and locked cupboards for dangerous chemicals and delicate instruments.

Physics Laboratories

- Layout: Workstations on three sides of the room with a large free working area. Tablet armchairs are placed in front of a demonstration area.
- Ceiling: An open-joist ceiling is advantageous for permitting the hanging of apparatus. A ceiling hook capable of holding a ½-ton load should be provided.
- Utilities: All services, including variable voltage, must be provided to all stations.
- Darkening: Proper room darkening is critical for experiments in photometry and for projecting slides and movies.

Plant and Animal Room

- Location: Adjacent to the biology laboratory with easy access to the outdoors.
- Construction: Greenhouse-like arrangement with southern exposure, sanitary finishes, and a concrete floor with a drain for hosing down.
- HVAC: Requires special, thermostatically controlled heating and ventilation, separate from the main building system, to ensure even temperatures during weekends and holidays.
- Equipment: Tables/racks for plants, growing beds on wheeled tables, animal cages, feeding trays, storage for food/tools, sink, hose, and bins for loam, sand, and peat moss.

Preparation and Storage Rooms

- Function: Used for teacher preparation, storage of bulk supplies, conferences, and offices.
- Shelving: Must be lined with storage for various sizes of materials. All shelves should have lips to prevent slippage and be built to be floor-supported due to weight.
- Chemistry Prep: Requires special transite-lined volatile closets vented to the outside for acids and reagents. Must have a sink, gas/electric outlets, and a preparation table large enough for six analytical balances.

- Physics Prep: Requires a storage bin of many small drawers (approx. 4"x4") for small parts, a rugged workbench for repairs, and ladders with rails to reach high storage.

Science Shop and Darkroom

- Layout: Can be built as a single unit, back-to-back, between a corridor and an exterior wall.
- Science Shop: Used for making and repairing instruments. Requires a rugged workbench, tool storage, drill press, small lathe, and sink.
- Darkroom: Requires a two-door, light-lock entrance. A counter should run along three sides with a large chemical-resistant sink (24"x30"x18" deep) and a wet bench. Requires hot/cold water, safelights, and adequate ventilation.

Visual Elements Analysis

Figure 74: General Science Room (Page 200)

Description: A detailed floor plan of a general science lab. Technical Details: The layout features perimeter counters with sinks and utilities. Two-person student tables are arranged in the center. An instructor's table is at the front, facing the class. A large storage and display wall is shown, along with a dedicated area for books. The plan emphasizes a clear separation between the lecture/demonstration area at the front and the hands-on lab area.

Figure 76: Physics Lab (Page 201)

Description: A detailed floor plan of a combined physics lab and lecture room. Technical Details: Perimeter counters provide work stations. The center is filled with tiered seating (4-student chemistry tables) facing a large demonstration area. The demonstration area is on a raised dais and includes a fixed chalkboard and demonstration desk. A shared preparation room connects this lab to an adjacent chemistry lab.

Figures 79-88: Science Laboratory Layouts (Page 203)

Description: A series of ten schematic floor plans illustrating different arrangements of student lab tables.

- Types Shown:
  - Fixed Two-Student Tables (Fig. 79): A traditional layout.
  - Fixed Linear Tables (Fig. 80): Tables are arranged in long, in-line rows.

    - Peninsular Tables (Figs. 81, 82, 84, 86): Tables are arranged in peninsulas projecting from the wall or from a central utility spine. This is noted as being suitable for Chemistry, Physics, and Biology.
    - Free-Standing Pod Tables (Fig. 88): Island or "pod" workstations, noted as separate lecture and lab areas. Construction Notes: These diagrams showcase the evolution of lab design from simple rows to more flexible and collaborative pod/peninsular layouts that integrate services efficiently.

Figures 89 & 93: Science Suites (Page 204)

- Figure 89: A comprehensive science suite showing two chemistry labs and two physics labs organized around a central block of four shared prep/storage rooms. This "four-leaf-clover" plan is extremely efficient for sharing resources and facilitating inter-departmental collaboration.
- Figure 93: A biology-focused suite with two main biology labs, an intensive training lab, and a vivarium, all connected by a large, shared preparation area. This plan demonstrates how to integrate specialized facilities into a cohesive whole.

Figures 94, 95, 96, 98: Planetarium and Vivarium Details (Pages 204-205)

- Description: Detailed plans and sections for highly specialized science facilities.
- Planetarium (Figs. 94, 96):
    - Section (Fig. 96): Shows a projection dome with a control console and demonstration area below. A mechanical room is located behind the dome.
    - Plan (Fig. 94): Shows concentric rings of seating around a central instrument core, with a projection booth at the perimeter.
- Vivarium (Fig. 95): A plan showing a glass-walled, skylit space integrated between two biology labs. It contains planting beds, a sluice/fountain, and animal cases, bringing a natural environment directly into the school corridor.
- Planting Table (Fig. 98): A detailed construction section of a planting table. Shows a ½" pitch for drainage, a stainless steel tube frame, and redwood slats.

BOQ Implications

- Casework and FF&E: This is the largest cost driver. The BOQ must include extensive quantities of specialized, acid-resistant lab benches, student stations, instructor's desks, fume hoods, and storage cabinets (including vented volatile closets).
- MEP (Mechanical, Electrical, Plumbing): Extremely complex and costly. The BOQ must account for running multiple services (hot/cold water, gas, compressed air, vacuum, waste, variable voltage AC/DC power) to numerous locations. Fume

hoods require dedicated, powerful exhaust systems. Planetariums and animal rooms require specialized, independent HVAC systems.
- Special Construction: The BOQ must include items for unique construction such as planetarium projection domes, glass walls for vivariums, light-locks for darkrooms, and reinforced ceilings for physics apparatus.
- Safety Equipment: A separate line item in the BOQ should account for required safety equipment, including fire extinguishers, first-aid kits, emergency eyewash stations, and safety showers.

Section: Arts (Page 205)

Overview

This brief introductory section establishes the core needs of a school arts facility: ample working surfaces, versatile storage, and abundant wall space for display.

Technical Specifications

- Core Requirements: Counters, tables, display space, and storage cabinetry.
- Utilities: Sinks are a basic requirement.
- Flexibility: The space should be open and flexible, using storage units as dividers.

Visual Elements Analysis

(Note: More detailed Arts plans are on the next page, but page 205 introduces the concepts and one key figure.)

- Figure 99 (on page 206, but referenced contextually): Shows a general art room with sinks in perimeter counters and flexible table arrangements.
- Figure 102-106 (on subsequent pages): Referenced in the text as illustrating specific solutions for arts facilities, such as hanging wires for drying prints and special storage.

Chapter 2: Educational (Part 6 of 6)

Overview

This concluding part of the chapter details the architectural requirements for the creative, vocational, and service-oriented spaces within a school. It begins with an in-depth look at Arts and Music facilities, emphasizing the need for flexible, well-lit spaces with specific acoustic properties and extensive storage. The section then briefly covers the robust needs of Industrial and Home Arts laboratories before providing a highly detailed guide to Food Service design, including kitchen systems, serving line configurations, and dining room space planning.

Key Standards and Codes Referenced

- Chapman and Leffler, Architects: Credited for an assembly-cafeteria plan (Fig. 59).
- Perkins & Will, Architects: Credited for a team-teaching classroom plan (Fig. 50, from a previous section but relevant context).

Section: Arts & Music Facilities (Pages 206-209)

Overview

This section outlines the requirements for spaces dedicated to visual arts and music. For arts, the focus is on flexible work areas, specialized storage, and ample display surfaces. For music, the primary considerations are acoustic control, instrument storage, and efficient circulation for large groups like bands and choirs.

Technical Specifications

Arts and Crafts Rooms

- Location: Should be near the auditorium stage, stagecraft, homemaking, and industrial arts areas. Direct outside access is desirable.
- Finishes: Floors should be vinyl asbestos in the general area; terrazzo or hardened concrete in the ceramics area. Walls should accept thumbtacks.
- Utilities: Double sinks with hot/cold water, drinking fountain, gas outlets, and plentiful electric outlets are required.
- Lighting: Semi-indirect lighting with daylight bulbs is recommended for good color rendering.

Music Facilities

- Acoustics: A critical consideration. The architect should aim for optimum reverberation time, even sound distribution, and freedom from undesirable absorption. Nonparallel walls or splayed walls/ceilings are recommended. Soundproof walls and doors are desirable. A competent sound engineer should be consulted.
- Instrument Storage: Must be planned for easy collection and return of instruments. It should be convenient for moving large instruments to buses, the stage, or playing fields.
- Choral Room: Should have a flat floor and 6-ft wide doors to move a piano. Portable risers are recommended.
- Instrumental Music Room: Requires flat floor, 6-ft wide doors, and special soundproofing. Must have storage space for instruments, music, and records.

Visual Elements Analysis

Figure 103: Clay Wedging Board (Page 207)

- Description: A detailed section view of a clay wedging board.
- Technical Details: Shows a 1" soapstone surface over a 1" gypsum board & plaster base, supported by a G.I. wire mesh. This provides a durable, non-porous surface ideal for working with clay.

Figure 105: Sink Cabinet Detail (Page 207)

- Description: A front elevation and section of a sink cabinet for an art room.
- Technical Details: The elevation shows a double-basin sink with gooseneck faucets set in a counter. The section reveals the plumbing trap below and a total counter/cabinet depth of 2'-6". The cabinet has a height of 3'-0".

Figure 107: Music Suite Plan (Page 208)

- Description: A comprehensive floor plan for a music suite.
- Technical Details: Shows a large Choral Room and an even larger Band Room separated by a central block containing the Music Library, Office, Practice Rooms, and Storage. This layout acts as an acoustic buffer, preventing sound from the band room from interfering with the choral room. Instrument storage is located strategically for access from both rehearsal spaces and the corridor.

Figure 111 & 113: Practice Room & Storage Details (Page 209)

- Figure 111: A detailed section through a practice room/makeup counter. Shows Perforated Hardboard (Perf. HDBD.) over insulation for acoustic control. Includes a mirror with makeup lights and a foldout counter.

- Figure 113: An isometric view of Individual Small Instrument Storage Units. These are cubby-style metal lockers, sized specifically for instruments like violins, clarinets, and trumpets.

BOQ Implications

- Acoustic Treatment: This is a major cost driver for music facilities. The BOQ must specify soundproof doors, nonparallel wall construction, acoustic wall panels (like Perf. HDBD. over insulation), and specialized ceiling treatments.
- Specialty Millwork & Equipment: The BOQ will include instrument storage lockers (Fig. 113), portable risers, conductor's platforms, music stands, and specialized work surfaces like the clay wedging board (Fig. 103).
- Plumbing: Arts rooms require multiple sinks, often with clay traps to prevent plumbing blockages, which must be specified.

Section: Industrial and Vocational Facilities; Home Arts (Pages 210-213)

Overview

This section covers the design of workshops for industrial arts (wood, metal, auto) and laboratories for home arts (cooking, sewing, family living). The key design driver for these spaces is a logical workflow that reflects the sequence of operations, along with robust safety measures and specialized utility services.

Technical Specifications

Industrial Arts

- Location: Should be isolated from quieter areas of the building, with a service road nearby and an outdoor shop area if possible.
- Safety: Requires special consideration for sawdust collection systems, overhead hoists, exhaust ducts (especially for auto shops), and extra clearances around machines for joint teacher-learner use.
- Utilities: Electrical service is often fed down from the ceiling rather than up from the floor to allow for more flexibility in equipment layout.

Home Arts (Family-Life Education)

- Food Laboratories:

    - Unit Kitchens: Should accommodate about four students. Counter heights should be 33 to 34 in. Space between counters should be 6 to 8 ft.
    - Utilities: Requires two duplex electric outlets per cooking area and a 110/220-V outlet for a clothes dryer.
- Clothing Laboratory: Requires space for sewing, grooming, dressing (about 8 ft square), and fitting areas. Needs storage for portable machines, notions, and student projects.
- Family Living Laboratory: A flexible, apartment-like space with areas for dining, living, home nursing, and child care. Requires residential-style furniture and storage.

Visual Elements Analysis

Figure 117: Section B Through Roof (Page 210)

- Description: A detailed roof and wall section for a typical shop building.
- Technical Details: Shows a steel beam (STL. BEAM) supporting steel purlins (STL. PURLIN). The roof assembly consists of 2" fiber deck with insulation above. The wall is 8" concrete block (8" BLK. PT'D.) with no trim. This illustrates the simple, robust construction typical of shop areas.

Figure 118: Shop Suite Floor Plan (Page 210)

Description: A comprehensive layout for an industrial arts department. Technical Details: The plan organizes multiple shops (Graphic Arts, Electrical, Power Mechanics, Metal, Wood) around a central tool and project storage core. Classrooms (CR) and a lecture/layout room are integrated directly into the suite, allowing for a seamless transition from theory to practice.

Figure 122 & 123: Home Arts Kitchen Layouts (Page 212)

- Figure 122: Shows a grouping of five U-shaped unit kitchens, a common arrangement for teaching cooking skills.
- Figure 123: Shows perimeter kitchens arranged around a central open area with tables. This layout is better for sit-down class lectures and demonstrations, with the lab work occurring along the room's edges.

Section: Food Service (Pages 212-217)

Overview

This section provides a detailed guide to planning school cafeterias and kitchens. It stresses that food service is a complex operation requiring efficient workflow, from receiving raw goods to serving finished meals and managing waste. It covers different kitchen systems (conventional, central, satellite) and various serving line configurations.

Technical Specifications

Kitchen Systems

- Conventional: A standard kitchen with an adjacent cafeteria.
- Central to Site: A single kitchen serves multiple, remote serving stations within the same building or campus, using food carts.
- Central to Community (Satellite): A large central kitchen prepares food that is transported by truck to multiple schools.

Serving Counters

- Requirement: One counter (35-40 linear ft) is required for every 150 to 200 seats.
- Scramble System: For fast service, sections of counters for different food categories (beverages, cold foods) are arranged as separate islands. Requires 12 to 13 ft between parallel tray slides.

Dining Room Space Planning

- Space per Seat: A good guide is 12 to 15 sq ft per seat.
- Table Size: A table for four should be 30 in x 48 in. A standard 14"x18" tray will not fit four to a 36" square table.
- Ventilation: Food odors are best controlled by exhausting air from the dining room *through* the kitchen at a rate of 30 air changes per hour. The kitchen itself requires 30 to 60 air changes per hour.

Visual Elements Analysis

Table 8: Food Service Space Requirement Chart (Page 217)

Description: An essential data table that provides the required square footage for the kitchen and the number of serving counters based on the planned enrollment or number of patrons. Technical Details (Sample Data):

Planned Enrollment	Seats Required	Kitchen Area (sq ft)*	Number of Counters
500	210	1,650	1
1,000	420	2,400	3
2,000	835	3,900	5
3,000	1,250	5,400	7
**Formula-based: 3-4 sq ft/student for smaller schools, down to 1.5-1.75 sq ft/student for very large schools.*			

Figure 134: Serving and Seating Arrangements (Page 215)

Description: A floor plan illustrating an efficient serving and dish return system. Technical Details: Shows students moving past serving lines, through a cashier station, into the dining area. After eating, they deposit soiled trays onto a conveyor belt that passes through a baffle wall into the dishroom, minimizing noise and clutter in the dining area.

Figure 139: Serving and Seating Arrangement (Page 217)

Description: A plan of a "scramble" or "marketplace" serving area. Technical Details: Instead of a single line, this layout features multiple separate stations: a central beverage island, a hot food counter, a cold food/salad counter, etc. Patrons can move directly to the station they want, significantly speeding up service. A single bank of cashiers is located at the exit.

BOQ Implications

- Kitchen Equipment: This is a massive component of the BOQ, including ranges, ovens, mixers, freezers, refrigerators, dishwashers, counters, and serving lines. All must be specified by size, capacity, and utility requirements.

- MEP: The BOQ must account for extensive plumbing (multiple sinks, floor drains, grease traps), heavy-duty electrical service, and powerful ventilation systems with dedicated exhaust hoods for cooking equipment, as specified.
- Finishes: Kitchen areas require durable, sanitary, and grease-resistant flooring and wall surfaces (e.g., quarry tile, stainless steel panels), which must be accurately quantified.
- Specialty Construction: Walk-in refrigerators and freezers are essentially small, highly insulated rooms and represent a specific construction item in the BOQ.

Chapter 3: Cultural (Part 1 of 4)

Overview

This initial part of the chapter establishes the foundational principles for the design of cultural museums. It begins with general observations on the critical decision of site selection, advocating for accessible, park-like settings over congested central-city locations to ensure security, environmental stability, and room for future expansion. It emphasizes that museum design must be a close collaboration between the director and architect, subordinated to the function of displaying art rather than creating a monument. The section then focuses on the specific requirements for small museums, providing functional layouts and space programs. Finally, it delves into the specifics of gallery design, providing key anthropometric data on visitor eye-level and optimal viewing zones to ensure exhibits are displayed effectively and comfortably.

Key Standards and Codes Referenced

- Museums, The Organization of Museums, UNESCO, Place de Fontenoy, Paris, 1967.
- Technical Leaflet #52, Gallery and Case Exhibit Design, by Arminta Neal, American Association for State and Local History, Nashville, TN, 1969.
- "Mies van der Rohe," by P. C. Johnson, Museum of Modern Art, New York, 1947.

Section: General Observations (Pages 329-335)

Overview

This section covers the high-level philosophical and practical considerations in planning a museum. It discusses site selection, the role of the museum as a "cultural center," the collaborative design process, and the fundamental approaches to lighting and spatial division.

Technical Specifications

Site Selection Criteria

- Accessibility: Must be readily accessible by public transport and, if possible, within walking distance of schools, colleges, and libraries.
- Environment: A location in a park or garden is preferred over a city center site.
  - Advantages: Provides a natural filter for dust and chemical pollutants, helps stabilize humidity, reduces noise and vibration, and lowers the risk of fire from adjacent structures.
- Expansion: The site must provide space for future expansion, either through enlargement of the original building or the construction of connected annexes.
- Support Services: A park-like site allows for annexes to house services like heating/electrical plants, repair shops, and garages at a safe distance from the main building.
- Parking: The site must be able to accommodate a car park.

Lighting Systems

- Natural Lighting: Still considered the best means of lighting a museum, despite its variability.
  - Lighting from Above (Overhead/Skylight): Provides a freer and steadier supply of light, is less affected by lateral obstacles, saves wall space for exhibits, and facilitates security. However, it can create issues with heat, glare, and potential for leaks.
  - Lateral Lighting (Side Windows): Can render the window wall and the opposite wall useless for display due to reflections. However, it is effective for lighting exhibits on perpendicular walls and is preferred by some for bringing out the plastic qualities of paintings and sculpture. High-placed windows (clerestory) can provide more light and free up wall space but require lofty ceilings.

Space Division and Layout

- Modern Tendency: Create large, unbroken spaces that can be flexibly subdivided by movable partitions.
- Traditional System: A succession of rooms with permanent walls, either communicating directly or connected by passages/galleries.

- Intermediate System: A recommended approach for small museums, featuring a mix of fixed-size rooms for the permanent collection and one or more large, flexible spaces for temporary exhibitions.

Visual Elements Analysis

Figure 1: Different methods of admitting natural light from above (Page 331)

Description: A collection of 11 diagrams illustrating various cross-sections for museum roofs and ceilings designed to control natural light. Technical Details:

- (a) A simple flat skylight.
- (b) A splayed ceiling with a central skylight, designed to direct light onto the display walls.
- (c) An asymmetrical skylight providing focused light on one wall.
- (d) A saw-tooth roof with vertical glazing (a north-light configuration) to provide even, indirect light.
- (e) A monitor roof with clerestory windows.
- (f) A ceiling with baffles below a skylight to diffuse light.
- (g), (h) High-placed side windows (clerestory) in a flat-roofed gallery.
- (i), (j) Cross-sections showing how sculptural exhibits are lit by overhead sources. Construction Notes: The choice of lighting system has profound implications for the building's structure. Splayed ceilings, saw-tooth roofs, and monitors require complex roof framing compared to a simple flat roof with lateral windows.

Figure 2: Floor plans for the location of doors in relation to the use of space (Page 332)

Description: Four diagrams demonstrating different circulation patterns based on door placement.

- (a) 1 (Traditional): Shows an "enfilade" arrangement where doors are aligned on a single axis, creating a long, "telescopic" view through multiple galleries.
- (a) 2-8, (b), (c), (d): Show alternative layouts using staggered doors, side doors, and polygonal rooms. Construction Notes: These plans illustrate a key design principle: staggering the doors between galleries prevents the visitor from seeing the entire route ahead, which can reduce "museum fatigue." It also allows the curator to create a dramatic first impression by controlling the initial view into each room.

Figure 5: Museum for a small city (Mies van der Rohe) (Page 335)

Description: The theoretical plan by Mies van der Rohe for a flexible, universal-space museum. Technical Details: The design consists of a single floor slab and roof plate supported by columns. The space is defined by exterior glass walls and free-standing interior partitions. Key areas are numbered: (1) Outer courts defined by stone walls, (3) & (7) Openings in the roof plate admitting light to interior courts, (5) A shallow recessed area for informal discussion, (8) An auditorium defined by free-standing acoustical walls. Construction Notes: This is a seminal example of an open-plan museum. The "absence of architecture" (minimal fixed walls) allows for maximum flexibility in arranging exhibits and places the focus entirely on the art. The structure is independent of the spatial division.

BOQ Implications

- Flexibility vs. Fixed Construction: A design with movable partitions will have lower initial costs for interior walls but may require higher costs for a more robust structural grid (to create large, open spans) and a more uniform, finished floor surface. A traditional design with permanent plaster walls has higher initial construction costs but is less flexible.
- Lighting Systems: Overhead lighting (skylights, monitors) is significantly more expensive and complex to construct and waterproof than a standard roof with lateral windows. This choice heavily impacts the roofing and structural sections of the BOQ.
- Site Work: The preference for park-like settings implies significant BOQ line items for landscaping, tree planting, paving for car parks, and potentially the construction of separate annexes for services.

Critical Notes and Warnings

- Collaboration is Essential: The text repeatedly warns that a museum cannot be planned in the abstract. Close, continuous collaboration between the museum director (the "employer") and the architect is required to achieve a functional building.
- Avoid Monumentality: A museum's architecture should not overpower the collection. The design should be contemporary but subordinated to the primary purpose of displaying art.
- Design for Expansion: A museum should be designed as a "nucleus of a cell, capable of multiplying." The initial plan must always incorporate logical possibilities for future expansion without requiring costly alterations.
- Telescopic Views: Placing gallery doors in a straight line, creating a long view through many rooms, is considered poor design as it can be psychologically fatiguing for visitors.

Section: Small Museums & Gallery Design (Pages 336-340)

Overview

This section provides a practical, function-based guide to planning a small museum and the detailed ergonomic considerations for gallery design.

Technical Specifications

Small Museum Functions & Spaces (Page 336)

- Basic Functions: (1) Curatorial, (2) Display, (3) Display Preparation, (4) Education.
- Required Spaces:
    - Office-workroom, Workshop: For curatorial and preparation work.
    - Reserve Collection Room: For storage.
    - Display Gallery: The main public space.
    - Lecture room, Lobby, Cloak room, Washrooms: For public and educational functions.
    - Mechanical & Janitorial: Service spaces.

Gallery Design - Anthropometrics (Page 339)

- Mean Adult Eye-Level Height: 5 ft 2 in.
- Optimal Vertical Viewing Zone: The area from approximately 1 ft above eye-level to 3 ft below eye-level. This means objects and labels should ideally be placed between ~2 ft 2 in and ~6 ft 2 in from the floor.
- Viewing Distance vs. Object Size: The viewing distance must increase as the size of the artifact increases to allow the visitor to comprehend it as a whole.
- Visitor Flow: Visitor movement is "like the flow of water in a stream." Gently curving or staggered case arrangements are more attractive and effective at guiding visitors than rigid, straight lines.

Visual Elements Analysis

Figure 1: Space organization diagram (Page 336)

Description: A functional bubble diagram showing the ideal circulation and relationships for a small museum. Technical Details: It clearly separates the facility into "STAFF AREAS" and "PUBLIC AREAS."

- Public Flow: Public Entrance -> Lobby -> Sales Counter -> Display Room. The Lecture Room and Washrooms are also off the Lobby.
- Staff Flow: Service Entrance -> Mech/Janitor -> Workshop -> Workroom/Office -> Reserve Collection Storage.
- Control Point: A "Supervision" line of sight is shown from the Office/Sales Counter into the Display Room.
- Separation: A wall is noted as being required to separate staff from public areas.

Figure 2 & 3: Basic Museum Plans (Pages 337-338)

Description: Two dimensioned floor plans for a small museum, showing a basic layout and a potential expansion.

- Plan 1 (Fig. 2): An efficient, compact plan (~1,960 sq ft) with all required functions. The display room is 20'x22'. Note the provision for "knock-out masonry panel walls" to facilitate future expansion.
- Plan 2 (Fig. 3): An expanded version (~3,800 sq ft) of Plan 1. The display room is now 40'x50', and a dedicated "Small Meeting &/or Exhibit Room" has been added. This demonstrates the "design for expansion" principle in practice.

Figure 4 & 6: Viewing Ergonomics (Page 339)

- Figure 4: An elevation diagram comparing the body height and eye-level of an average man (5'9¼"), woman (5'3¾"), and a 6-year-old child in relation to a museum case.
- Figure 6: A diagram illustrating that a large object (dinosaur skeleton) requires a significant viewing distance (12') for comprehension, while a smaller object (statuette) can be viewed from much closer (5'9").

Figure 7: Possible gallery arrangements (Page 340)

Description: Six isometric diagrams showing different ways to arrange display cases to guide visitor flow.

- (a) Simple, straight perimeter cases.
- (b) Gently curving arrangement.
- (c) Staggered cases, creating "mystery and a desire... to peek around corners."
- (d) A narrowed entrance that opens into a larger hall.
- (e) A more complex, staggered arrangement.

- (f) A maze-like arrangement that forces a specific circulation path (indicated by arrows).

EDUCATIONAL FACILITIES 1. Classrooms 1.1 Sizes & Flexibility ● Recommended areas: ○ Elementary classrooms: 850–1,150 ft²; optimum ~1,000 ft². ○ Secondary classrooms: 750–900 ft²; large-group lecture rooms up to 1,150 ft². ● Width-to-length: Favor longer front walls (e.g., 26′×30′ seats ~35 students at 22 ft²/student) . ● Variable sizing: Electrically operated folding partitions allow joining two or more rooms; partitions must be easy to operate and acoustically rated; rooms should then have two egresses . 1.2 Front-of-Room Equipment ● Chalkboard & tack space: continuous chalkboard length 16–48 ft, plus cork-tackboard; map/display rail overhead . ● Darkening: central control of blinds for projection and photometry . ● AV & power: sound cable and antenna wiring, duplex AC outlets near front; projection screen provision . 1.3 Storage & Ancillary Fixtures ● Teacher storage: lockable metal or wood closet for supplies, books, coats, boots, equipment . ● Student storage: in primary grades, adjacent toilets and coat cubicles; in secondary, centralized open-plan locker alcoves with 18″ deep shelves, 4′-6″ high, ventilated via floor and ceiling plenums . ● Drinking fountains: in or adjacent to classrooms . 1.4 General Requirements ● Ceiling height: 9′–12′ max. ● Sightlines: teacher facing class should not face windows; natural light over left shoulder . ● Acoustics: walls/ceiling treated to control reverberation; minimum STC 45 . 2. Learning Resource & Libraries ● Location & sizing: centrally located; allocate 1 ft² per student plus 3 ft² per volume; provide 32 ft shelving per 100 students . ● Layout: central circulation desk with adjacent workroom and office; mix open stacks, group tables, 4-person carrel clusters. ● Lighting: abundant indirect daylight; skylights with UV filtering in windowless sites. ● Skylit mezzanine: two-level centers linked by stairs or wide openings; glass guardrails for supervision . 3. Administrative & Guidance Suites ● Admin offices: near main entrance; private offices ~120 ft² each; vision panels, secure file storage, waiting area . ● Counseling: reception for counselor + visitor; private interview rooms; small conference/test room for 8–10 people . 4. Language Laboratories ● Booth dimensions: each 30″ or 36″ W × 36″ D × 54″ H, sound-absorbent panels; top front half glazed for sight to instructor . ● Equipment per booth: headphone and mic on flexible mount; magnetic tape/disc recorder; balance/volume control; monitor jack . ● Teacher station: platform 6″ high; master console with three-channel distribution, dual-track tape decks, 4-speed phonographs; adjacent sound-proof booth; typewriter with international keyboard . ● Acoustics: walls and ceiling treated with sound-absorbent materials. 5. Science Facilities 5.1 General Science & Biology Labs ● Location: first floor, south/southwest exposure; direct outdoor access for field study . ● Chalkboard: full-length front wall, center raisable; display rail above; projection screen provision . ● Counters: along two sides (one under windows) with multiple sinks, gas and electric outlets . ● Storage: small-item drawer bins 4″×4″; acid-resistant casework; herpes bun (herbaria), aquaria, specimen cabinets; eyewash station; fume hood accessible from three sides . 5.2 Preparation & Storage Rooms ● Adjacency: directly off lab and corridor with dual access doors; teacher prep and bulk-supply storage . ● Furnishings: mobile prep tables for six balances, flat chart shelves, lockable cabinetry; storage for glass tubing, charts, chemicals in ventilated transite-lined closets . 5.3 Plant & Animal Room ● Greenhouse-style: concrete floor with drain; sanitary finishes; southern exposure; thermostatically controlled heating independent of main system; hose bib, hand tools, growing racks on casters, animal cages, feeding trays, bins for soil media . 5.4 Chemistry & Physics Labs ● Station count: 24 student stations per lab—rugged stone-top benches with AC/DC variable power, gas cocks, soapstone sinks . ● Demonstration dais: 5″ high, spotlight lighting, roll-away extension, stone top; central audio/video wiring . ● Physics workshop: workbench and drainboard sink, tool bins, drill press, small lathe, 110 V outlets, ladders with rails; hammer-resistant bench . ● Individual research rooms: adjacent to labs, half-glass partitions, for small-group experimentation . ● Science shop & darkroom: back-to-back on corridor side; shop with metalworking equipment; darkroom with vestibule, two-door light trap, 34–36″ high counters, 24″×30″×18″ sinks, silicone-sealed surfaces, 12″–15″ shelf spacing, safe-light, exhaust fan, four duplex outlets . 6. Student Lockers & Coat Storage ● Locker alcoves: open clusters off single-loaded corridors; 3′ circulation aisles; tile base for cleaning; furred ceilings for plenum ventilation; lower inlet vents and upper plenum return . ● Wardrobe units: recess-mounted in classrooms with folding partition closure; integrated coat hangers permitting natural drying . ● Capacity: one security locker per student for books/personal items; coat hooks permanently attached. 7. Gymnasiums & Physical Education ● Gym sizes: ○ Elementary: 36′×52′ to 52′×72′. ○ Junior high: 65′×86′ (42′×74′ court). ○ Senior high: 79′×96′ (50′×84′ court) . ● Court clearances: 10–12′ around boundary lines; 5′ between bleachers and out-of-bounds . ● Bleachers: retractable or permanent, flush-mounted; balcony sightlines aligned with sidelines. ● Auxiliary gyms: multipurpose rooms for dance, gymnastics; sprung floors; mirrored walls; barre attachments. 8. Swimming Pools ● Elementary pools: depth 2′–4′, length 36′–50′, width 16′–25′. ● Junior high: depth 3′–5′, length 60′–75′, width 25′–42′. ● Senior high: depth 3′–6″ to 9′ (1 m board), length 75′+, width 36′+, diving well minimum 12′ width . ● Locker & shower adjacency: direct access through shower rooms; separate pool lockers per state code. ● Mechanical: 77 °F–82 °F water; 68 °F–75 °F deck; humidity control 50–55 percent. 9. Auditoriums & Assembly ● Capacity: 300–800 seats for active participation; community use up to 1,400 seats accommodated in large centers . ● Sightlines: all seats within ±30 degrees horizontal; balcony overhang ≤1/3 of clear distance to stage . ● Stage: extends beyond proscenium; adjustable teasers, borders, cyclorama; fly-tower clear height ≥30′; backstage corridors for rapid egress . ● Support spaces: band/choral rooms with direct stage access; scenery shop adjacent; green room and dressing rooms on stage wings; ticket booth in lobby. ● Lighting & acoustics: total blackout capability; stage lighting circuits on dimmer racks; auditorium reverberation time 1.2–1.6 s for speech/music. 10. Cafeterias & Multipurpose Rooms These spaces serve dining, assembly, and flexible activities; design must balance seating capacity, service flow, acoustics, and daylighting. 10.1 Seating & Space Allocation ● Dining hall sizing: allocate 12–15 ft² per seated diner for fixed-table arrangements; 15–18 ft² per diner when using movable tables and chairs. ● Table dimensions: ○ Standard four-person rectangular table: 30″×48″; clearance 24″ on each long side, 18″ on short ends. ○ Banquet tables for 6–8 diners: 30″×96″ or 30″×108″. ○ Round tables: 60″ dia. for 6 seats; 72″ dia. for 8 seats. ● Aisle widths: ○ Between table rows: minimum 42″ for two-way service; 36″ for one-way traffic. ○ Main circulation aisles: 60″ wide. ● Stacking clearance: allow 12″ behind chairs for stacking and retrieval. 10.2 Serving & Service Corridors ● Servery counter length: 40–50 ft per 300 diners; split into food-service, beverage, and tray-return zones. ● Counter height: 36″ for standard service; 42″ for self-service hot lines; knee clearance 27″×24″ under tray rails. ● Back-of-house: ○ Hot line passage: 48″ wide corridor behind servery. ○ Tray return: separate conveyor or rolling-rack area 36″×84″. ○ Dishwashing: 4–6 ft of mechanical conveyor-type operation; adjacent 36″ service aisle. 10.3 Acoustics & Finishes ● Reverberation: maintain RT60 ≤1.0 s using acoustic ceiling panels (NRC ≥0.70) and wall baffles. ● Flooring: quarry tile or sheet vinyl with ASTM F1700 class II; slip resistance ANSI A137.1 wet COF ≥0.42. ● Wall protection: vinyl-clad gypsum board wainscot 4′ high; stainless steel impact guards at service zones. ● Lighting: daylight supplemented by 30–50 fc ambient; pendants over serving counters; dimmable LED for evening functions. 10.4 Multipurpose Use ● Stage platforms: deployable unit 4′ deep × variable width; clear height to ceiling grid ≥14′. ● Storage: adjacent closets for chairs and tables sized 1 ft² per seat stored; power and data outlets on movable partitions. ● Flex partitions: acoustical doors or operable walls rated STC 45 to subdivide space; manual or motorized operation. 11. Student Union & Common Areas Centralized social and support facilities for students, including lounges, meeting rooms, and service kiosks. 11.1 Lounges & Informal Seating ● Seating modules: modular sofas and chairs arranged in groupings of 4–6; allow 8 ft diameter clear for group conversation. ● Table heights: coffee tables 18″ H; occasional tables 24″ H; study carrels 36″ H. ● Walkways: 48″ minimum between furniture clusters to maintain ADA egress. 11.2 Meeting & Study Rooms ● Small-group rooms (4–6 persons): 100–150 ft²; table 4′×3′; clearances 36″ on all sides. ● Medium meeting rooms (10–20 persons): 300–500 ft²; table 12′×4′ or round 72″ dia.; AV credenza with 2 ft clearance behind. ● Large seminar rooms (30–50 persons): 800–1,200 ft²; tiered raked seating optional; minimum 15 ft clear from front row to screen. 11.3 Service Kiosks & Vending ● Counter height: 36″; knee clearance 27″×24″ for ADA use. ● Footprint: 3′×6′ per kiosk; 6′ clear queue line. ● Utilities: duplex receptacles every 4′; ¼″ water supply for coffee/ice machines. 12. Computer & Media Labs Spaces dedicated to information technology and media production; must accommodate equipment density, cabling, and ventilation. 12.1 Workstation Layout ● Single-user stations: 6 ft wide desk; 30″–32″ depth; 24″ knee clearance; monitor eye level 42″ AFF. ● Cluster tables: 30″×60″ for four stations; cable trough beneath; 36″ aisle between clusters. ● ADA station: 36″ wide desk; knee clearance 27″ H × 30″ W × 19″ D. 12.2 Infrastructure & Services ● Power: 6 duplex outlets per workstation plus 1 overhead; 20 A circuit per four stations (ANSI/NFPA 70). ● Data: CAT6A outlets at each station; two per desk. ● Ventilation: increased ACH (6–10 air changes/hour); raised-floor plenums optional for underfloor air distribution. 12.3 Media Production Suites ● Audio editing rooms: 100 ft² per workstation; sound-isolated walls STC 55; floating floors. ● Video editing bays: 48″×60″ bench; dual monitors; dimmable task lighting. ● Server room: 100–200 ft²; clearance 3′ around racks; 2 N+1 electrical and mechanical redundancy; 24″ raised floor tiles. 13. Health & Counseling Centers Provide private medical and counseling services to the campus community. 13.1 Exam & Treatment Rooms ● Size: 100 ft² minimum; 8′×12′ preferred. ● Clearances: 30″ clearance each side of exam table; 36″ aisle around table. ● Fixtures: exam table 24″–32″ H; hand-wash sink within 6′; medication cabinet ≥2′ W; wall-mounted vital-sign monitor at 60″ AFF. 13.2 Counseling Offices ● Private offices: 120 ft²; seating area cluster (sofa and two chairs); desk 36″ H with 48″ knee clearance behind. ● Group counseling rooms: 200 ft²; circular seating arrangement; acoustic panels for privacy STC 45. 13.3 Support Facilities ● Waiting area: 12 ft² per occupant; seating for 8–10; adjacent restroom. ● Record storage: fire-rated cabinets in 50 ft² room; 36″ clear access aisle. 14. Maintenance, Custodial & Service Spaces Essential back-of-house areas for building operations and storage. 14.1 Custodial Closets ● Size: 18 ft² per closet; 5′ clear in front of mop sink. ● Fixtures: mop sink 14″ deep; 24″×24″ footprint; utility shelving above; chemical storage lower cabinet ventilated. ● Equipment: wall-mounted vacuum bank, broom and mop racks occupying 2 linear ft. 14.2 Mechanical & Electrical Rooms ● Mechanical room: 200–300 ft²; 3′ clearance on all sides of equipment; floor drain minimum 4″ trap. ● Electrical room: 100 ft² per 1,000 A service; 3′ clear in front of panels; lighting 50 fc. ● IT/MDF closets: 50 ft²; 3′ clear around racks; dedicated 20 A circuit; ventilation 2 ACH. 14.3 Loading & Receiving ● Dock dimensions: 10′ wide × 10′ high door; 12′ deep dockpit; 14′ clear overhead. ● Approach: 14′ aisle from street; turning radius 30′ for delivery vehicles. ● Service corridor: 6′ wide connecting dock to kitchen and custodial; continuous slip-resistant flooring. 15. Campus Site & Circulation Comprehensive site planning ensures safe, efficient pedestrian and vehicular movement. 15.1 Pedestrian Walkways ● Width: 6′ minimum on primary paths; 5′ on secondary. ● Surface: slip-resistant paving with maximum cross slope 1:50; expansion joints ≤15′ apart. ● Crossings: raised crosswalks or contrasting paving; curb cut ramps with 1:12 slope, flared sides. ● Bicycle lanes: 4′ minimum width, separated by 2′ buffer where possible. 15.2 Vehicular Circulation & Parking ● Drive aisles: one-way 12′; two-way 20′–24′. ● Parking stalls: 9′×18′; accessible stalls 8′ wide with 5′ access aisle (van 8′×8′ aisle). ● Fire lanes: 20′ clear width, marked per NFPA 1. ● Drop-off zones: 24′ length; 12′ clear width for school buses; 3′ clear sidewalk buffer. 15.3 Site

Furnishings & Utilities ● Seating: benches 18″ H × 24″ D × 6′ L, 18″ clearance behind. ● Trash receptacles: spaced every 100′ along major routes; lockable, 36″ H. ● Lighting: 0.5 fc minimum average along paths; 3 fc at entrances; fixtures at 12′ height. ● Signage: wayfinding signs 7′ height to lowest element; 6″ lettering minimum; tactile and Braille panels at 48″ AFF. 16. Landscape & Exterior Learning Spaces Outdoor areas extend the educational environment. 16.1 Outdoor Classrooms & Plazas ● Space allocation: 15 ft² per occupant; designate level, drained surfaces. ● Shade structures: provide 50% coverage; roof height 8′–10′; structural framing painted to prevent glare. ● Fixed seating: ledges or benches at 18″ H; backrests optional; 15″ seat depth. ● Power/Data: GFCI-protected duplex outlets at intervals of 50′; weatherproof covers. 16.2 Play & Athletic Courts ● Playgrounds: 75 ft² per child; fall zone safety surfacing per ASTM F1292; equipment guardrails 29″–38″. ● Tennis courts: 36′×60′ minimum play area, 12′ clearance at baselines, 21′ at sidelines. ● Basketball courts: half-court 50′×42′; full court 94′×50′; 25′ overhead clearance free of obstructions. 16.3 Stormwater & Planting ● Bioswales: minimum width 4′; invert depth 6″ below finish grade; grade 0.5%–2%. ● Tree pits: 6′×6′ pourous paving; root barrier as required. ● Plant selection: native species; canopy trees spaced 30′ apart; drip irrigation zones divided by water requirements. 17. Safety, Security & Life-Safety Systems Integrate protective measures throughout campus facilities. 17.1 Access Control & Surveillance ● Card readers: mounted 42″–48″ AFF at exterior doors; 7″ clearance from adjacent walls. ● CCTV: cameras at 8′–10′ height; 110° horizontal field of view; DVR in secured room. ● Emergency call stations: pedestal-mounted, 48″ AFF speaker; push-to-talk button at 42″ AFF. 17.2 Fire Egress & Alarm ● Egress width: 0.2″ per occupant for stairways; 0.15″/occupant for corridors (IBC). ● Stair landings: minimum 44″ depth; uniform riser 7″ max, tread 11″ min. ● Exit signage: illuminated, 6″ high letters; secondary signs at 80% ceiling height. ● Fire alarm devices: strobes at 6′–8′ AFF; horns/bells at 80 dBA in corridors. 17.3 Emergency Power & Lighting ● Generators: sized for life-safety circuits per NFPA 110; runtime ≥2 hrs. ● Emergency lighting: 1 fc minimum at floor level; battery-backed fixtures at 50′ intervals. ● Exit path markings: photoluminescent strips on stair treads and handrails. 18. Quantity Estimation Rules Standardized units and formulas for material takeoff. 18.1 Area & Volume Calculations ● Flooring: gross room area + 5% waste; material roll width 6′ for vinyl; tile area calculated in 1 ft² increments. ● Paint: one gallon covers 350 ft² on smooth surfaces; deduct openings; apply two coats. ● Concrete: slabs computed volume = area × thickness; include 2% waste for forming. 18.2 Linear Components ● Baseboard trim: room perimeter; standard height 4″; include 10% extra for miters. ● Handrails: length of stair runs; metal pipe-type per ASTM A53; elbows counted as 1.5× length. 18.3 Casework & Millwork ● Cabinet faces: count each door/drawer front; average width 18″; hardware sets per opening. ● Countertops: lengths of run; include 3″ backsplash; edge profile specified by code. 19. Residential Halls & Housing Units Design residential living spaces for students, faculty, or staff, balancing privacy, community interaction, and life-safety requirements. 19.1 Unit Types & Sizes ● Single-occupancy room: 9′×12′ (108 ft²) minimum net; built-in wardrobe 24″ deep; desk area 30″×48″. ● Double-occupancy room: 12′×14′ (168 ft²) net; two closets 24″ deep; two desks 30″×48″ each; clear floor 36″ around beds. ● Suite apartment: 2–4 bedrooms sharing common living/kitchen; living area 150 ft²; kitchenette 50 ft²; private bath per bedroom. 19.2 Corridors & Egress ● Corridor width: 8′ minimum for two-way traffic and furnishing movement. ● Dead-end: 20′ maximum length before egress turn. ● Exit stairs: 44″ wide clear; handrails both sides; landing 5′ deep. 19.3 Common Areas & Lounges ● Common room: 15 ft² per resident; modular seating; study alcoves 36″ deep by 60″ wide. ● Laundry room: 200 ft² per 100 residents; washer/dryer ratio 1:10; folding tables 30″ H × 24″ D. 19.4 Bathrooms & Amenities ● Cluster bath: 1 toilet/urinal per 10 residents; 1 shower per 8; vanity length 24″ per fixture; corridor clearance 48″. ● Accessible units: 5% of total units; full ADA kitchens and baths as per Section 11 standards. 20. Mechanical, Electrical & Plumbing (MEP) Spaces Central and distributed service spaces that support building functionality; all dimensions to finished wall faces. 20.1 Mechanical Equipment Rooms ● Boiler room: 300–500 ft²; 3′ clearance around each unit; floor drain centered; exhaust louvers min. 1.5× total intake area. ● Chiller room: 400–600 ft²; condenser coil access 24″ front clearance; vibration isolators. ● Pump room: 150 ft²; baseplate mounted pumps with drip pan; valve access 18″ clearance. 20.2 Electrical Service & Distribution ● Main switchgear: 100 ft²; clear front working space 36″; lockable disconnect per NFPA 70. ● Subpanels: 30 ft² each; 30″ front working space; 24″ side clearance. ● Emergency generator: 250 ft²; exhaust pointing away from air intakes; fuel tank ventilation per NFPA 110. 20.3 Telecom & Data Closets ● MDF room: 100 ft²; 3′ clearance around racks; dedicated 20 A and 5 A UPS circuits. ● IDF closets: 50 ft² per floor; patch panel and cable management racks; 2-hr fire-rated walls. 20.4 Plumbing Risers & Chases ● Riser closets: 6′×6′ minimum; access panels at each floor. ● Domestic water: 2″ CMU chase; shutoff valves at each branch; insulation 1″ thick. ● Drainage: standpipe and waste lines in 8″ chase; cleanouts at every 50 ft horizontally and each floor vertically. 20.5 Vertical Transportation ● Passenger elevators: 5′-6″×7′ interior cab; clear opening 3′×6′; lobby clear 48″×54″. ● Service elevator: 6′×8′ cab; 7′ clear overhead; 4,000 lb capacity. ● Shaft requirements: 5′ clearance from fire service equipment; rated at 2-hr corridor wall assembly.

Chapter 3: Cultural (Part 2 of 4)

Overview

This part of the chapter is dedicated entirely to the architectural standards for public libraries. It begins by establishing the fundamental functional relationships and space requirements for libraries serving populations of 5,000, 10,000, and 25,000.

It then delves into the specific requirements for branch libraries. The core of the section provides exhaustive, data-driven guidelines for allocating space for books, readers, and staff, supported by detailed ergonomic diagrams illustrating optimal shelving heights and clearances. Finally, it provides highly technical data on bookstack loading, capacity calculation formulas, and shelving standards for special collections, essential for structural and spatial planning.

Key Standards and Codes Referenced

- "Interim Standards for Small Public Libraries: Guidelines Toward Achieving the Goals of Public Library Service," ALA-Public Library Association, Chicago, 1962.
- "Practical Administration of Public Libraries," by Joseph L. Wheeler and Herbert Goldhor, New York: Harper and Row, 1962.
- "The Effective Location of Public Library Buildings," by Joseph L. Wheeler, University of Illinois Library School, Occasional Papers, No. 52, 1958.
- Library Journal, Nov. 15, 1934, and Jan. 15, 1936 (source for Bookstack Data).

Section: Libraries (General, Branch, Requirements) (Pages 341-346)

Overview

This section introduces the core principles of library planning, using diagrams to visualize the functional relationships for libraries of different sizes. It then outlines the specific requirements for branch libraries and provides detailed formulas and standards for programming the primary spaces: book collections, reader areas, staff workspaces, and meeting rooms.

Technical Specifications

Space Formulas & Standards

- Space for Books:
    - Open Reading Rooms: 7 volumes per linear foot.
    - Bookstack Areas: 15 books per square foot (includes aisles).
    - General Rule: One-third of each shelf should be left empty for future expansion.
- Space for Readers:

    - Minimum Allowance: 30 sq ft per adult reader; 20 sq ft per child reader. This is net space for the reader, chair, table, and service aisles.
- Space for Staff:
    - ALA Standard: 1 staff member (full-time equivalent) for each 2,500 people in the service area.
    - Space Allocation: 100 sq ft per staff member (includes desk, chair, books, and equipment).
- Meeting Rooms: Allow 7 to 10 sq ft per seat.
- Mechanical Operations: Allocate 20 percent of the total space for mechanical rooms, stairs, toilets, etc.

Library Program Statistics (by Population)

- Town of 5,000:
    - Staff: 1.5 persons
    - Collection: 15,000 volumes
    - Total Estimated Floor Space: 3,500 sq ft
- Town of 10,000:
    - Staff: 3 persons
    - Collection: 20,000 volumes
    - Total Estimated Floor Space: 7,000 sq ft
- Town of 25,000:
    - Staff: 10 persons
    - Collection: 50,000 volumes
    - Total Estimated Floor Space: 15,000 sq ft

Visual Elements Analysis

Figures 1, 2, 3: Diagrams of Essential Library Elements (Pages 341-342)

Description: A series of three isometric "bubble" diagrams illustrating the increasing complexity of libraries as the population served grows.

- Figure 1 (5,000 Population): A simple, single-level layout with a central control desk supervising clear sight-lines to the children's reading, adult reading/stacks, and reference/periodicals areas.
- Figure 2 (10,000 Population): A more complex layout showing the addition of a dedicated Story Telling Area, work room, and a potential conference/audiovisual space.
- Figure 3 (25,000 Population): A two-level scheme. Shows separate public entrances for adults and children, a community meeting room with separate

access for after-hours use, and a book lift for staff circulation between floors. This plan demonstrates a much higher degree of functional separation.

Figures 1, 2, 4: Branch Library Floor Plans (Page 343)

- Description: Three different floor plans for branch libraries of varying sizes.
- Technical Details:
  - Figure 1 (Small): A compact 56'-0" wide plan.
  - Figure 2 (Medium): A 100'-0" wide plan showing more defined areas.
  - Figure 4 (Large): A comprehensive plan, 160'-0" x 90'-0" (14,364 sq ft), showing distinct areas for technical books, a large children's section, a work room, a staff lounge, and dedicated book-mobile stacks.

Figures 1, 2, 3: Optimum Shelving Conditions (Page 344)

Description: Critical ergonomic diagrams showing optimal shelving heights for adults, teens, and children. Technical Details:

- Adult (Fig. 1): Max reach for women is 81". The highest shelf should not exceed 72" (6'-0"). The optimum horizontal scanning zone ("Browsing Shelves") is at 54". Minimum height to avoid squatting is 24".
- Teenager (14 years old, Fig. 2): Optimum browsing height is 39".
- Child (6 years old, Fig. 3): Optimum browsing height is 26".

Section: Service Relationships, Location, Bookmobiles, Bookstacks (Pages 347-351)

Overview

This section focuses on the practical application of library design principles, covering circulation flow, the critical decision of site location, and the use of bookmobiles. The final part provides highly technical data for structural engineers and architects regarding bookstack capacities, loading, and dimensions.

Technical Specifications

Service & Space Relationships

- Supervision Distance: A librarian should not be responsible for an area more than 55 ft beyond their desk.

- Centralized Control: There should be only one circulation desk, located near the main entrance with direct visual control of patrons.
- Separation: Public service areas should be supported by adjacent book storage and work areas. Auditoriums and meeting rooms should not require access through the main library.

Library Location

- Primary Principle: A library is a service organization and must be centrally located where people naturally converge: the heart of the shopping and business district.
- Key Site Criteria:
  - Prominent corner site with high visibility.
  - Must permit a street-level entrance.
  - Rectangular shape is preferred for efficient building layout.
  - Site must be large enough for future horizontal expansion.
  - North or East orientation is preferred to minimize sun glare.

Bookstack Data

- Stack Loading (Diagram, Page 351):
  - Live Load: 40 psf of aisle area.
  - Book & Stack Load: 30 psf (for a 7-tier stack).
  - Slab Load: Varies with construction (e.g., a 4" slab is approx. 50 psf).
- The "Cubook" Method (for capacity):
  - A formula-based system where 1 "cubook" is the space needed for one average library book.
  - A standard single-faced, 3' long x 7'-6" high stack section holds 100 cubooks.
  - Required Stack Floor Area = No. of cubooks x 0.090.
- Stack Loads Table (General Variation): Provides total dead and live load data (in psf) for multi-tier bookstacks (from 1 to 12 tiers high), essential for structural design.
- Shelving Data for Special Collections Table:
  - Specifies the number of volumes per linear foot and the required shelf depth for different subjects.
  - Fiction: 8 vols/ft, 8" depth.
  - Law: 4 vols/ft, 8" depth.
  - Bound Periodicals: 5 vols/ft, 10" & 12" depth.

Calculations and Formulas

Bookstack Section Requirement Formula (Page 351)

- Formula: `N = No. of Volumes ÷ Capacity per Section`
- Variables:
  - N = Number of single-faced sections required.
  - Capacity per Section: Varies by book type.
    - Typical Library (100 cubooks): `N = Vols. ÷ 100`
    - Octavos only: `N = Vols. ÷ 132.3`
    - Quartos only: `N = Vols. ÷ 67.5`
- Example: A library with 50,000 volumes requires `50,000 ÷ 100 = 500` single-faced standard stack sections.

BOQ Implications

- Structural Engineering: The bookstack loading data is a critical and mandatory input for the structural engineer designing the library's floor systems. The specified loads are significantly higher than for standard office or residential construction and directly impact the cost of the structural frame and foundations.
- FF&E Schedule: The shelving data tables allow for precise quantification of the linear footage of shelving required. The BOQ must specify shelf depth (8", 10", 12") and type (standard, periodical display, etc.).
- Space Planning for Bidding: The formulas for reader space (sq ft/person) and staff space (sq ft/person) are used in the initial architectural program to define the gross floor area of the building, which is the basis for preliminary cost estimates and the overall project budget detailed in bid documents.
- Site Work: The strong preference for a central, downtown location implies that the BOQ may include significant costs for demolition of existing structures, navigating tight site logistics, and connecting to dense urban utilities, as opposed to developing a "greenfield" site.

Chapter 3: Cultural (Part 3 of 4)

Overview

This extensive section provides a historical and technical overview of theater design from the turn of the twentieth century to the mid-1960s. It traces the evolution from the traditional proscenium theater to the revival of ancient forms like the arena and open-thrust stages. A significant portion is dedicated to the technical requirements for achieving optimal sight lines, detailing the geometric principles that govern auditorium and balcony slopes, seating layouts, and viewing angles. The section concludes with a detailed breakdown of the spatial requirements for various types of theatrical productions, defining the acting area, scenery space, and working storage needed for everything from legitimate drama to grand opera.

Key Standards and Codes Referenced

- "The Shape of Our Theatre," by Jo Mielziner, Clarkson N. Potter, Publisher, New York. (Primary source for the historical and philosophical text).
- "Theatres and Auditoriums, 2d ed.," by Harold Burris-Meyer and F. G. Cole, Van Nostrand Reinhold Company, ©1964. (Primary source for technical data on sight lines and auditorium layout).

Section: Theaters (General, Stage Forms) (Pages 352-361)

Overview

This section describes the three primary theater forms—Proscenium, Arena, and Open-Thrust—and discusses the rise of multiform and multi-use auditoriums. It provides a critical analysis of the functional trade-offs inherent in each design.

Technical Specifications

- Proscenium Theater: Audience faces the stage on one side through an architectural opening. The actors and audience are in separate, connected rooms.
- Arena Stage (Theater-in-the-round): The stage is surrounded on all sides by the audience. This form maximizes intimacy.
- Open-Thrust Stage: The audience surrounds the stage on three sides. It combines the intimacy of the arena with some of the directional focus of the proscenium.
- Multiform Stage: A single theater space designed with complex mechanical systems (e.g., lifts, turntables) to convert between proscenium, thrust, and arena forms. The text is highly critical of this type, stating it is a compromise where "no single arrangement... is a perfect" version of that form.

Visual Elements Analysis

Figure 5: The open stage of Jacques Copeau's Vieux Colombier (Page 353)

Description: A perspective sketch of an early 20th-century open-thrust stage. Technical Details: This sketch illustrates a permanent, multi-level architectural set with a central platform, stairs, and various entrance/exit points. Construction Notes: This design represents a move away from changeable, illusionistic scenery toward a permanent, flexible architectural environment that places the focus on the actor.

Figure 9: The Stratford, Ontario, Shakespeare Festival Theatre (Page 356)

Description: A detailed plan and section of a highly influential modern open-thrust stage. Technical Details: The plan shows a hexagonal thrust stage surrounded by steeply-banked, semicircular seating on three sides, a "Greco-Roman audience seating plan." The stage has multiple levels and entrances, including vomitories from beneath the seating. Construction Notes: This theater is a prime example of a design tailored specifically for a classical repertory, combining Elizabethan stage elements with classical seating to create an intimate and dynamic actor-audience relationship.

Figure 12: The Loeb Drama Center at Harvard University (Page 359)

Description: Three plan diagrams illustrating a mechanically multiform stage. Technical Details: The diagrams show how electrically operated mobile seating units and stage sections can be rearranged to create:

- (a) A basic proscenium shape.
- (b) A basic open-thrust shape.
- (c) A modified arena or center-stage shape. BOQ Implications: This design requires extremely expensive, custom-engineered mechanical systems (lifts, turntables, mobile seating wagons) and a complex structural pit below the stage, representing a massive cost increase over a single-form theater.

Section: Sight Lines (Pages 362-365)

Overview

This is a highly technical section that establishes the fundamental geometric rules for ensuring every patron can see the performance satisfactorily. It defines the horizontal and vertical limits of human vision and applies them to auditorium layout.

Technical Specifications

- Horizontal Viewing Angle (Polychromatic Vision): Approximately 40°.

- Horizontal Angle for Theatrical Relationship: Objects on stage cease to relate to each other and the background beyond an angle of approximately 60° from the center line.
- Horizontal Angle for Projection Screen: Distortion becomes intolerable beyond 60° to the far side of the screen.
- Vertical Viewing Angle (to recognize shapes): Falls off rapidly beyond 30°.
- Motion Picture Projection Angle: Recommended maximum angle to the horizontal is 12°.

Floor Slope Calculation Method (Page 364)

- Concept: A graphical method for determining the slope of the orchestra floor to ensure each spectator can see over the head of the person in front of them.
- Procedure:
    i. Establish the "focal point" on stage (e.g., the downstage edge of the floor).
    ii. Establish the eye position of the first-row spectator (3 ft 8 in. above the floor at their seat).
    iii. Draw a sight line from the first-row eye position to the focal point.
    iv. Establish the eye position for the second row by moving back one seat depth and up 5 inches (the "clearance") from the first sight line.
    v. Repeat this process for every row to the back of the house, generating a curved (isacoustic) floor profile.
- Standing Spectator: A standing spectator's eye level at the back of the orchestra is assumed to be 5 ft 6 in above their floor level. Their sight line to the top of the stage/screen determines the maximum allowable balcony overhang.

Visual Elements Analysis

Figure 14: Horizontal Sight Line Angles (Page 362)

Description: Three diagrams illustrating the key horizontal viewing angles.

- (a) Shows the 60° angle from the center line, defining the limit for understanding onstage action.
- (b) Ranks the desirability of seating locations, with front-center (A) being most desirable and rear-side (F) being least desirable.
- (c) Shows the 100° angle from the proscenium line, beyond which audiences will not choose seats. The shaded areas represent undesirable seating.

Figure 20: Vertical Sight Line Angles (Page 364)

Description: Diagrams showing the maximum tolerable upward sight line angles.

- (a) Shows the 30° maximum upward angle for motion pictures.

- (b) Shows how this angle determines the location of the closest seats.
- (c) Provides the basic dimensions for plotting the floor slope: eye height is 3'-8" when seated; the clearance over the head in front is 5".

Section: Stage Space (Pages 365-370)

Overview

This section defines the functional divisions of the stage—acting area, scenery space, and working/storage space—and provides detailed spatial requirements for different types of theatrical productions, from intimate drama to grand opera.

Technical Specifications

- Functional Divisions:
  - Acting Area: The space where performers work.
  - Scenery Space: Where the scenic investiture is arranged.
  - Working and Storage Space: For operating and storing scenery.

Table 2: Spatial Requirements for Various Types of Theatrical Productions (Pages 366, 368)

Description: A detailed table providing the required acting area size and shape for different performance types.

- Legitimate Drama:
  - Area: Min: 240 sq ft (12'x20'); Usual: 525 sq ft (15'x35'); Max: 1,000 sq ft (25'x40').
  - Shape: Quadrilateral with an aspect ratio of 1 to 2.
- Grand Opera:
  - Area: Min: 1,000 sq ft; Usual: 2,500 sq ft; Max: 4,000 sq ft.
  - Shape: Quadrilateral with sides converging toward the back of the stage.
- Dance:
  - Area: Anything under 700 sq ft is constricting; Max: 1,200 sq ft.
  - Shape: Rhomboid with an aspect ratio of 3 to 4. May project into the audience.
- Vaudeville/Revue:
  - Area: Usual: 450 sq ft.
  - Shape: Rhomboid with an aspect ratio of 1 to 3.

Calculations and Formulas

- House Depth vs. Visibility: The section establishes empirical relationships between house depth and the ability to perceive detail.
  - Facial Expression: Not plainly recognizable beyond 50 ft.
  - Individual Actor's Significance: Diminishes to insignificance beyond 125 ft.
  - Radio City Music Hall Example: At 160 to 200 ft, a ballet is reduced to the "size of midgets."

BOQ Implications

- Earthwork & Concrete: The calculation of a sloped or "dished" auditorium floor (Fig. 22) results in complex concrete formwork and varying slab thicknesses, which must be accurately quantified in the BOQ. This is significantly more expensive than a flat floor.
- Structural Steel: For proscenium theaters, the need for a clear span over the auditorium and a high stage house (for flying scenery) requires long-span trusses and heavy structural steel, a major cost component in the BOQ.
- Mechanical Systems: The complex geometry of a theater requires sophisticated HVAC design to ensure proper air distribution without creating noise. Ductwork, diffusers, and air handling units must be specified.
- Specialty Equipment (Divisions 11 & 13): This is a massive part of a theater BOQ. It includes:
  - Stage Rigging: Battens, counterweights, pin rails, and the gridiron structure.
  - Stage Lifts/Elevators: Orchestra lifts, stage lifts, turntables.
  - Acoustical Treatment: Acoustic wall panels, ceiling reflectors ("clouds"), and sound-absorbing finishes.
  - Theatrical Lighting: Dimmer racks, control consoles, circuit distribution, catwalks, and a full inventory of lighting instruments (spotlights, floodlights, etc.).
  - Seating: The BOQ must specify the exact number, type, and width of seats.
  -

Chapter 3: Cultural (Part 4 of 4)

Overview

This concluding part of the chapter details the architectural requirements for a range of specialized cultural performance venues. It begins with a comprehensive guide to Community Theaters, outlining the necessary public, backstage, and support spaces for these versatile, often amateur-run facilities. It then transitions to the unique challenges of outdoor Amphitheaters, focusing on site planning, acoustics, and large-scale circulation. The chapter concludes with an in-depth analysis of Music Facilities, covering everything from rehearsal halls and practice rooms to the specific acoustical and seating requirements for creating optimal performance environments.

Key Standards and Codes Referenced

- "Time-Saver Standards, 1st ed.," McGraw-Hill, Inc., New York, 1946. (Source for Community Theater organization chart).
- "An Amphitheatre for Epic Drama," Institute of Outdoor Drama, University of North Carolina, Chapel Hill, N.C., 1966. (Source for Amphitheater standards).
- "Music Buildings, Rooms and Equipment," Music Educators National Conference, Reston, Va., 1966. (Source for Music Facility standards).
- Henry Powell Hopkins and Associates, Architects: Credited for a high school music department plan (Fig. 1).
- Edward J. Schulte and Associates, Architects: Credited for the University of Cincinnati music facility plan (Fig. 2).
- Everett I. Brown Company, Architects: Credited for the North Central High School music facility plan (Fig. 5).

Section: Community Theaters & Amphitheaters (Pages 371-379)

Overview

This section outlines the requirements for both indoor community theaters and large outdoor amphitheaters. The community theater is presented as a flexible, multipurpose venue serving amateurs and professionals alike, requiring robust workshop and rehearsal spaces. The amphitheater section focuses on the logistical challenges of large crowds, outdoor acoustics, and environmental integration.

Technical Specifications

Community Theaters

- Capacity: Typically 500 to 1,000 seats.
- Stage (Conventional): Gridiron height should be at least 70 ft.
- Dressing Rooms: Require overhead lights for wigs/costumes and even, face-illuminating lights at mirrors.
- Scene Shop: Must be able to accommodate large scenery. A paint frame at least 30 ft high is required.
- Stage Dimensions (Encircling Stage): Requires a 40'-0" stage shop and a 40'-0" scene wagon (Fig. 3).
- Auditorium Seating: Must not be less than 20 in. on centers. "Continental" seating requires increased back-to-back spacing (up to 42 in).

Amphitheaters

- Capacity: Can be up to 3,000 spectators without voice amplification. Recommended upper limit is 2,500.
- Parking: Requires 1 car for every 3 spectators.
- Auditorium Slope: A two-part slope is recommended: 12° for the lower half and 24° or steeper for the upper half.
- Main Stage Proscenium: 70 ft opening.
- Main Stage Depth: 40 ft from the proscenium line.
- Proscenium Wall Height: 16 to 18 ft.
- Lighting Towers: May need to be 30 to 35 ft high.
- Scene Shop: Minimum size of 30 ft x 30 ft x 20 ft high.

Visual Elements Analysis

Figure 1: Organization chart (Community Theater) (Page 371)

Description: A bubble diagram illustrating the functional separation and circulation between "Front" (public) and "Backstage" (work) areas. Technical Details: Shows public flow from Lobby/Box Office to Auditorium and Toilets/Coats. Backstage flow connects the Stage Door to Dressing Rooms, Rehearsal, and various workshops (Design, Paint, Props, Electrics, Costumes). Control of the stage door is shown as a key security feature.

Figure 3: Stages (Community Theater) (Page 375)

Description: Detailed plans and a section of a conventional stage and a more complex "encircling stage." Technical Details:

- Conventional Stage: Shows a 70'-0" to 90'-0" gridiron height, a trapped space, and a large paint frame in the stage shop.

- Encircling Stage: Shows a complex plan with a central elevator forestage and large scene wagons that travel on tracks from side stages. This design allows for rapid, mechanized scene changes.

Seating and Aisle Arrangements (Page 373)

Description: A series of diagrams comparing different seating layouts. Technical Details: Illustrates the sightline trade-offs of Center Aisle, Continental, Side Section, and Stadium Type seating. Heavily shaded areas represent stage and seating area losses from comparative visual position. This diagram visually argues that a center aisle wastes the best seats, while continental seating (with wider rows) and stadium-style layouts are more efficient.

Section: Music Facilities (Pages 380-392)

Overview

This final, highly detailed section covers the specific architectural requirements for music education and performance facilities. It provides data for rehearsal halls, practice rooms, listening facilities, and offices, with a strong emphasis on acoustics, room volume, and specialized equipment.

Technical Specifications

Rehearsal Halls

- Room Size (Instrumental): Allow 20 to 24 sq ft per student. An 80-piece band requires 1,600 to 1,920 sq ft.
- Room Height (Instrumental): Average ceiling height should be 14 to 18 ft. Minimum 400 cubic ft per performer.
- Risers (Instrumental): Should be 60 in. wide and 6 to 8 in. high. Top riser should be wider (up to 120 in.) for percussion.
- Room Size (Choral): 6 sq ft per pupil (standing); 10 sq ft per pupil (seated on 30 in. wide risers).
- Room Volume (Choral/Recital): Not less than 125 cubic ft per seat.

Practice Rooms & Studios

- Individual Practice Rooms: Satisfactory in the 55 to 65 sq ft range.
- Faculty Studios (Piano): Must be large enough to accommodate two grand pianos.

- Acoustics: Nonparallel walls are widely used to prevent standing waves in small rooms. Double-glass windows into corridors are needed for supervision.

Calculations and Formulas

Practice Room Requirement Calculation (Page 381)

- Concept: A formula to determine the number of practice rooms needed based on student load and hours of use.
- Formula: `(Total Practice Hours per Week) / (Hours Available for Use per Week) = Number of Practice Rooms Needed`
- Example Calculation:
    - A sample student body requires a total of 1,500 practice hours per week.
    - The rooms are available 60 hours per week.
    - `1,500 / 60 = 25` practice rooms needed.

Auditorium Dimensions "Rule of Thumb" (Page 391)

- Formula: Allow 7.5 sq ft per seat, including aisles and crossovers.
- Use: Sufficiently accurate for preliminary planning and rough sketches.

Visual Elements Analysis

Figure 1: Plan for a two-teacher music department (Page 383)

Description: A detailed floor plan showing a large, shared Instrumental Rehearsal hall and Choral Rehearsal hall buffered by a central block of offices, storage, and practice rooms. Construction Notes: This is an exemplary layout for acoustic separation. The storage and office block in the middle prevents sound from the loud instrumental hall from bleeding into the choral hall. The plan also shows dedicated storage for gowns/uniforms, music libraries, and large instruments.

Figure 6: Divisible auditorium (Page 387)

Description: A plan of a circular music facility with a central stage, surrounded by a divisible auditorium. Technical Details: The main auditorium can be subdivided into smaller lecture/rehearsal spaces by moving large partitions. The facility is ringed by specialized support spaces: choral music, radio & television, instrumental music, practice rooms, and dressing rooms.

Figures 7 & 8: Auditorium Seating Layouts (Pages 389, 390)

Description: Highly detailed diagrams showing standard seating dimensions and different row/aisle configurations.

- Figure 7 (Typical Seats): Provides standard seat widths (19" to 22"), back-to-back spacing, and pitch of back.
- Figure 8 (Types of Rows and Aisles): Compares straight, canted, and curved rows, noting that curved rows are recommended for comfort, ease of vision, and safety. It also illustrates how poorly placed diagonal aisles create dangerous "pockets" and waste space.

Table IV: Numbers of Seats (Stock Sizes) for Any Row Length (Page 392)

Description: An exhaustive data table used to calculate the exact number of seats of varying stock widths (19", 20", 21", 22") that can fit into a row of a specific length. Use: This table is a critical tool for any architect or designer laying out theater seating. For a given row length (e.g., 21'-6"), the table shows all possible combinations of seat widths to fill that length precisely (e.g., five 19" seats, five 20" seats, and three 21" seats).

BOQ Implications

- Acoustic Construction: This is the single most critical and costly component for music facilities. The BOQ must include specifications for nonparallel wall construction, sound-rated doors and windows, isolated floor slabs, sound locks (double-door vestibules), and extensive use of sound-absorbing and sound-reflecting finish materials.
- Specialty Equipment: The BOQ will be extensive, including items like orchestra shells, portable risers, specialized instrument storage cabinets, theatrical lighting for stages, and broadcast/recording equipment.
- Fixed Seating: The BOQ must quantify the exact number, model, and width of auditorium seats, a major FF&E cost item.
- Stage Rigging: For theaters and large halls, the BOQ will include a complete stage rigging system (battens, counterweights, gridiron), which is a specialized construction trade.
- HVAC: Music facilities require "silent" HVAC systems with low-velocity air, oversized ducts, and sound traps (baffles) to prevent mechanical noise from interfering with performances and recordings. This represents a significant increase in cost over standard commercial HVAC systems.
-

Chapter 4: Health (Part 1 of 10)

Overview

This initial part introduces the complex, multifaceted nature of hospital design. It establishes that a hospital is a composition of highly specialized components, each requiring unique design considerations. The focus is on providing examples of critical space organization rather than a comprehensive guide to all hospital departments. The section begins with a detailed analysis of the fundamental patient bedroom, covering variations in size, furniture, plumbing, and finishes. It then illustrates the functional flow of key departments like Admitting, Medical Records, and Nursing, providing detailed floor plans and equipment legends for each.

Key Standards and Codes Referenced

- AIA Committee on Hospitals & Health: Source for the analysis of patient bedrooms.
- U.S. Public Health Service, Department of Health, Education and Welfare: Primary source for the detailed departmental flow charts and floor plans, specifically:
    - *Design and Construction of General Hospitals* (1953)
    - *Administrative Services and Facilities for Hospitals*
    - *Planning the Patient Care Unit in the General Hospital* (June 1962)
- NFPA Bulletin 565: Referenced as the standard for the installation height of medical gas outlets.

Section: Introduction and Patient Bedrooms (Pages 395, 397)

Overview

This section sets the stage for hospital design by focusing on the most basic component: the patient bedroom. It reviews numerous plans to distill common features, variations, and critical details related to room size, furniture arrangement, plumbing fixtures, and environmental controls.

Technical Specifications

Bedroom Size and Dimensions

- Net Clear Floor Area Ranges:
    - Single Rooms: 117 to 172 sq ft.
    - Double Rooms: 157 to 210 sq ft.

    - Four-Bed Rooms: 306 to 401 sq ft.
- Room Depth: Varies from 14 ft 6 in to 21 ft 6 in (from corridor partition to exterior wall).
- Clearance for Beds: A clear distance of 14 ft 0 in is considered "snug" for two beds and two bedside tables. 15 ft 0 in is the USPHS standard and preferred.
- Room Width (Centerline of Partitions):
    - Single Rooms: 10 ft 0 in to 12 ft 0 in.
    - Double Rooms: 12 ft 0 in is the typical majority.
    - Four-Bed Rooms: 20 ft 0 in to 24 ft 0 in.
- Door Width: Standard is 3 ft 10 in or 4 ft 0 in. This can be reduced by 2 in with the use of offset hinges. Toilet room doors are 2 ft 0 in to 2 ft 4 in.

Furniture & Equipment

- Bedside Table: Typical size is 16 in x 20 in.
- Bed: Motor-operated high-low beds can be up to 7 ft 3 in in overall length.
- Overbed Light: Mounted 5 ft 2 in to 6 ft 6 in above the floor.
- Oxygen and Suction Outlets: Mounted 4 ft 0 in to 5 ft 6 in above the floor. (5 ft 0 in is the minimum per NFPA 565 if not recessed).
- Flower Shelves: A common feature, typically 9 in wide, bracketed on the wall beside or opposite the bed at a height of 4 ft 6 in.

Plumbing Fixtures

- Private Toilets: Now considered a basic feature for each bedroom.
- Toilet Room Size: 2 ft 10 in to 3 ft 2 in wide by 3 ft 10 in to 4 ft 10 in deep.
- Bedpan Cleansing Device: Incorporated in almost every case. Locating the water closet slightly off-center provides more space for its use.
- Lavatory Location: An even split in preference between locating it in the bedroom proper (invites more use by staff) or in the toilet room (less institutional). Some hospitals specify a 3 ft 0 in mounting height.
- Showers: Tubs are not common in patient toilet rooms; when showers are provided, they are typically tub/shower combinations with grab bars and non-slip mats.

Visual Elements Analysis

Figure 2, 4: Four-bed and Single Room Plans (Page 396)

- Figure 2: Four-bed room: Shows a room with a net area of 360 to 432 sq ft. The dimensions are 18'-0" deep by 20'-0" to 24'-0" wide.
- Figure 4: Single room, small: Shows a room with a net area of 120 sq ft plus toilet. Dimensions are 10'-0" wide.

Figure 3, 5, 6: Double and Single Room Plans (Pages 396, 397)

- Figure 3: Double bedroom, small, shared toilet: Shows two rooms sharing a common toilet. Each room has a net area of 170 sq ft plus toilet. The layout is 13'-6" wide.
- Figure 5: Double room, medium: A room with a net area of 202 sq ft plus toilet. The layout is 12'-0" wide.
- Figure 6: Single room, medium: A room with a net area of 136 sq ft plus toilet. The layout is 11'-0" wide.

Figure 7: Wall elevation of single room (left) and double room (right) (Page 397)

Description: A detailed elevation showing the placement of all wall-mounted patient services at the head of the bed. Legend/Technical Details:

1. Overbed light
2. Nurses' call (2A. Micro speaker in ceiling)
3. Oxygen outlet
4. Suction outlet
5. Suction bottle bracket
6. Night light-switch outside room door
7. Double duplex outlet
8. Telephone, radio, TV jacks

Section: Administrative and Nursing Units (Pages 398-402)

Overview

This section provides functional flow charts and detailed architectural plans for key hospital support departments, including Admitting, Medical Records, and the core Nursing Unit itself. These diagrams illustrate the complex interrelationships and circulation patterns necessary for efficient hospital operation.

Technical Specifications

- Medical Records (100-bed hospital): Requires space for a Public Area, Return Desk, File Clerk, Transcribing Room, and an Assistant's office.
- Conference Unit (100-bed hospital): A conference room designed for 19 sq ft per person is noted.

- Nursing Unit (Double-Corridor Plan): Plan shows two units, one 30-bed and one 34-bed.

Visual Elements Analysis

Figure 1: Flow charts (Page 396)

Description: A set of three functional flow charts illustrating the primary circulation paths for (a) a general hospital, (b) an administration department, and (c) an out-patient department. Technical Details (Administration Department): Shows the patient flow from entrance to Admitting, then to Records, and finally to the nursing unit or other services. It highlights the central role of Admitting as the control point.

Figure 8: Admitting Department Functional Flow Chart (Page 398)

Description: A detailed flow chart showing the process of patient admission. Technical Details: Traces the flow from Physician/Self-Referred Individual to Reservation and Scheduling, then to Pre-admitting Information, Interview, and finally to Inpatient or Outpatient services. The chart clearly shows the interaction with Medical Records and Financial Management. The NOTE legend defines different line types for Information Flow, Routine Patient Flow, and Emergency Patient Flow.

Figure 10: Central admitting department for a 500-bed hospital (Page 399)

Description: A detailed floor plan of a large admitting department. Technical Details: The plan is organized with a main Waiting Lobby, a core of Admitting Offices, and separate Work Areas for staff. Key equipment from the legend includes: Desks (#7), Control counter (#5), Pneumatic tube station (#25), and an Admittance chart (#26).

Figure 11: Medical library unit with patient and general library facilities (Page 400)

Description: A comprehensive floor plan for a hospital library facility. Technical Details: Shows a clear division between a Professional Stack/Reading Area for staff and a General Library with a Reading Area for patients. A central administrative corridor with a librarian's office and medical records provides control and services both areas.

Figure 14: Double-corridor patient care floor (Page 402)

Description: A complete floor plan of a 64-bed nursing floor. Technical Details: This is a classic "racetrack" or double-corridor plan. Patient rooms (single and double occupancy) line the exterior walls. A central core contains all the support services: Nurses' Station, Clean Supply, Soiled Holding, Medicine room, elevators, and other services. A key feature is the "centrally located mechanical conveyors for the handling of supplies and food-tray service," indicating a vertical supply system.

BOQ Implications

- Casework and Millwork: The detailed plans for admitting departments, medical records, and especially nursing stations (Fig. 15) require extensive custom or semi-custom millwork. This includes reception desks, charting counters, medicine preparation counters, and file storage units, all of which must be quantified in the BOQ.
- Specialty Equipment: The plans call for specific hospital equipment like pneumatic tube stations, bedpan cleansers, and built-in metal wardrobes, which must be included in the Division 11 (Equipment) section of the BOQ.
- Mechanical Systems: The designation of "Clean Utility" and "Soiled Utility" rooms (Fig. 15) implies specific HVAC requirements (positive pressure for clean, negative for soiled) that must be reflected in the mechanical drawings and BOQ. The note about a central mechanical conveyor system (Fig. 14) indicates a significant vertical transportation system beyond standard elevators.

Critical Notes and Warnings

- Control and Observation: A recurring theme in the plans is the strategic location of the Nurses' Station to provide maximum visual control over corridors, entrances, and patient areas.
- Separation of Flows: The flow charts and plans emphasize the need to separate different types of traffic: patient, staff, and supplies. The double-corridor plan (Fig. 14) is a prime example, with a "clean" core and separate patient corridors.
- Flexibility and Adaptability: The text notes that hospital design must be flexible. The plans show modular layouts (e.g., patient rooms) that allow for adaptation. The shared toilet plan (Fig. 3) is noted as saving space but creating problems with patient segregation and flexibility.
- Ergonomics and Safety: Details like the mounting height of lavatories and grab bars in toilet rooms are critical for patient safety and comfort.

This completes the detailed analysis of the first part of the "Health" chapter.

Would you like me to proceed with the analysis of the next part, which covers the Surgical Suite, Nursery, and Pediatric Nursing Units (pages 403-411)?Of course. I will now begin the detailed analysis of Chapter 4: Health. This is a very large and complex chapter. As you requested, I will divide it into approximately 10 logical parts for clarity and manageability.

Here is the analysis of the first part, covering the introduction to Hospitals, general design principles for patient bedrooms, and the layout of administrative and nursing units (pages 395-402).

Chapter 4: Health (Part 1 of 10)

Overview

This initial part introduces the complex, multifaceted nature of hospital design. It establishes that a hospital is a composition of highly specialized components, each requiring unique design considerations. The focus is on providing examples of critical space organization rather than a comprehensive guide to all hospital departments. The section begins with a detailed analysis of the fundamental patient bedroom, covering variations in size, furniture, plumbing, and finishes. It then illustrates the functional flow of key departments like Admitting, Medical Records, and Nursing, providing detailed floor plans and equipment legends for each.

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Section: Introduction and Patient Bedrooms (Pages 395, 397)

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  - Single Rooms: 117 to 172 sq ft.
  - Double Rooms: 157 to 210 sq ft.
  - Four-Bed Rooms: 306 to 401 sq ft.
- Room Depth: Varies from 14 ft 6 in to 21 ft 6 in (from corridor partition to exterior wall).
- Clearance for Beds: A clear distance of 14 ft 0 in is considered "snug" for two beds and two bedside tables. 15 ft 0 in is the USPHS standard and preferred.
- Room Width (Centerline of Partitions):
  - Single Rooms: 10 ft 0 in to 12 ft 0 in.
  - Double Rooms: 12 ft 0 in is the typical majority.
  - Four-Bed Rooms: 20 ft 0 in to 24 ft 0 in.
- Door Width: Standard is 3 ft 10 in or 4 ft 0 in. This can be reduced by 2 in with the use of offset hinges. Toilet room doors are 2 ft 0 in to 2 ft 4 in.

Furniture & Equipment

- Bedside Table: Typical size is 16 in x 20 in.
- Bed: Motor-operated high-low beds can be up to 7 ft 3 in in overall length.
- Overbed Light: Mounted 5 ft 2 in to 6 ft 6 in above the floor.
- Oxygen and Suction Outlets: Mounted 4 ft 0 in to 5 ft 6 in above the floor. (5 ft 0 in is the minimum per NFPA 565 if not recessed).
- Flower Shelves: A common feature, typically 9 in wide, bracketed on the wall beside or opposite the bed at a height of 4 ft 6 in.

Plumbing Fixtures

- Private Toilets: Now considered a basic feature for each bedroom.
- Toilet Room Size: 2 ft 10 in to 3 ft 2 in wide by 3 ft 10 in to 4 ft 10 in deep.
- Bedpan Cleansing Device: Incorporated in almost every case. Locating the water closet slightly off-center provides more space for its use.

- Lavatory Location: An even split in preference between locating it in the bedroom proper (invites more use by staff) or in the toilet room (less institutional). Some hospitals specify a 3 ft 0 in mounting height.
- Showers: Tubs are not common in patient toilet rooms; when showers are provided, they are typically tub/shower combinations with grab bars and non-slip mats.

Visual Elements Analysis

Figure 2, 4: Four-bed and Single Room Plans (Page 396)

- Figure 2: Four-bed room: Shows a room with a net area of 360 to 432 sq ft. The dimensions are 18'-0" deep by 20'-0" to 24'-0" wide.
- Figure 4: Single room, small: Shows a room with a net area of 120 sq ft plus toilet. Dimensions are 10'-0" wide.

Figure 3, 5, 6: Double and Single Room Plans (Pages 396, 397)

- Figure 3: Double bedroom, small, shared toilet: Shows two rooms sharing a common toilet. Each room has a net area of 170 sq ft plus toilet. The layout is 13'-6" wide.
- Figure 5: Double room, medium: A room with a net area of 202 sq ft plus toilet. The layout is 12'-0" wide.
- Figure 6: Single room, medium: A room with a net area of 136 sq ft plus toilet. The layout is 11'-0" wide.

Figure 7: Wall elevation of single room (left) and double room (right) (Page 397)

Description: A detailed elevation showing the placement of all wall-mounted patient services at the head of the bed. Legend/Technical Details:

1. Overbed light
2. Nurses' call (2A. Micro speaker in ceiling)
3. Oxygen outlet
4. Suction outlet
5. Suction bottle bracket
6. Night light-switch outside room door
7. Double duplex outlet
8. Telephone, radio, TV jacks

Section: Administrative and Nursing Units (Pages 398-402)

Overview

This section provides functional flow charts and detailed architectural plans for key hospital support departments, including Admitting, Medical Records, and the core Nursing Unit itself. These diagrams illustrate the complex interrelationships and circulation patterns necessary for efficient hospital operation.

Technical Specifications

- Medical Records (100-bed hospital): Requires space for a Public Area, Return Desk, File Clerk, Transcribing Room, and an Assistant's office.
- Conference Unit (100-bed hospital): A conference room designed for 19 sq ft per person is noted.
- Nursing Unit (Double-Corridor Plan): Plan shows two units, one 30-bed and one 34-bed.

Visual Elements Analysis

Figure 1: Flow charts (Page 396)

Description: A set of three functional flow charts illustrating the primary circulation paths for (a) a general hospital, (b) an administration department, and (c) an out-patient department. Technical Details (Administration Department): Shows the patient flow from entrance to Admitting, then to Records, and finally to the nursing unit or other services. It highlights the central role of Admitting as the control point.

Figure 8: Admitting Department Functional Flow Chart (Page 398)

Description: A detailed flow chart showing the process of patient admission. Technical Details: Traces the flow from Physician/Self-Referred Individual to Reservation and Scheduling, then to Pre-admitting Information, Interview, and finally to Inpatient or Outpatient services. The chart clearly shows the interaction with Medical Records and Financial Management. The NOTE legend defines different line types for Information Flow, Routine Patient Flow, and Emergency Patient Flow.

Figure 10: Central admitting department for a 500-bed hospital (Page 399)

Description: A detailed floor plan of a large admitting department. Technical Details: The plan is organized with a main Waiting Lobby, a core of Admitting Offices, and separate Work Areas for staff. Key equipment from the legend includes: Desks (#7), Control counter (#5), Pneumatic tube station (#25), and an Admittance chart (#26).

Figure 11: Medical library unit with patient and general library facilities (Page 400)

Description: A comprehensive floor plan for a hospital library facility. Technical Details: Shows a clear division between a Professional Stack/Reading Area for staff and a General Library with a Reading Area for patients. A central administrative corridor with a librarian's office and medical records provides control and services both areas.

Figure 14: Double-corridor patient care floor (Page 402)

Description: A complete floor plan of a 64-bed nursing floor. Technical Details: This is a classic "racetrack" or double-corridor plan. Patient rooms (single and double occupancy) line the exterior walls. A central core contains all the support services: Nurses' Station, Clean Supply, Soiled Holding, Medicine room, elevators, and other services. A key feature is the "centrally located mechanical conveyors for the handling of supplies and food-tray service," indicating a vertical supply system.

BOQ Implications

- Casework and Millwork: The detailed plans for admitting departments, medical records, and especially nursing stations (Fig. 15) require extensive custom or semi-custom millwork. This includes reception desks, charting counters, medicine preparation counters, and file storage units, all of which must be quantified in the BOQ.
- Specialty Equipment: The plans call for specific hospital equipment like pneumatic tube stations, bedpan cleansers, and built-in metal wardrobes, which must be included in the Division 11 (Equipment) section of the BOQ.
- Mechanical Systems: The designation of "Clean Utility" and "Soiled Utility" rooms (Fig. 15) implies specific HVAC requirements (positive pressure for clean, negative for soiled) that must be reflected in the mechanical drawings and BOQ. The note about a central mechanical conveyor system (Fig. 14) indicates a significant vertical transportation system beyond standard elevators.

Critical Notes and Warnings

- Control and Observation: A recurring theme in the plans is the strategic location of the Nurses' Station to provide maximum visual control over corridors, entrances, and patient areas.

- Separation of Flows: The flow charts and plans emphasize the need to separate different types of traffic: patient, staff, and supplies. The double-corridor plan (Fig. 14) is a prime example, with a "clean" core and separate patient corridors.
- Flexibility and Adaptability: The text notes that hospital design must be flexible. The plans show modular layouts (e.g., patient rooms) that allow for adaptation. The shared toilet plan (Fig. 3) is noted as saving space but creating problems with patient segregation and flexibility.
- Ergonomics and Safety: Details like the mounting height of lavatories and grab bars in toilet rooms are critical for patient safety and comfort.

Chapter 4: Health (Part 2 of 10)

Overview

This part of the chapter delves into three of the most specialized and critical areas of a hospital: the Surgical Suite, the Newborn Nursery, and the Pediatric Nursing Unit. It provides an in-depth analysis of the functional zones, workflow, and environmental requirements essential for aseptic control and patient safety in each area. The section includes detailed floor plans illustrating different organizational strategies, from traditional layouts to more modern, efficient configurations like the double-corridor nursing floor and the cohort system nursery. An extensive equipment legend provides a checklist of necessary furnishings and medical devices.

Key Standards and Codes Referenced

- The Modern Hospital, November 1955: Referenced for research on surgical instrument processing from the University of Pittsburgh.
- National Fire Code: Referenced for requirements related to view windows and doors in nurseries.
- "Manual for the Care of Children in Hospitals," U.S. Dept. of Health, Education, and Welfare, 1968. (Source for equipment legend for pediatric units).

Section: Surgical Suite (Pages 403-404)

Overview

This section describes the surgical suite as a highly complex workshop requiring meticulous planning. It emphasizes a zonal approach to design based on sterility levels—Outer, Intermediate, and Inner—to ensure aseptic control. The text stresses that operating rooms themselves account for only about one-quarter of the suite's total area, with the majority dedicated to essential support functions.

Technical Specifications

Zoning Principles

- Outer Zone: Administrative and control areas. Where personnel enter, patients are received, and public-facing activities like conferences occur. Street clothes are permitted here.
- Intermediate Zone: The work and storage core. Includes instrument processing, sterile supply storage, anesthesia services, and lounges/lockers for staff who have changed into scrubs. Outside personnel deliver to, but do not enter from, this zone.
- Inner Zone: The most sterile area. Comprises the operating rooms, scrub areas, and sterile corridors. All alien traffic is eliminated.

Operating Room (OR) and Support Spaces

- Free Floor Space (OR): 18 ft x 20 ft (approx. 350 sq ft) is a common size. Surgeons and supervisors often recommend 20 ft x 20 ft.
- Specialized ORs: Cardiac and neurosurgery require extra-large rooms to accommodate larger teams and more equipment (e.g., heart-lung machines, monitoring devices).
- Instrumentation Room: An area adjacent to specialized ORs for housing electronic equipment that is not explosion-proof. It is often elevated with a plate glass window for observation.
- Gross Area Calculation: A rule of thumb is provided: a suite of 8 ORs (avg. 350 sq ft each) would require a total gross area of approximately 11,200 sq ft, or 1,400 sq ft per OR.
- Post-Anesthesia Recovery Room (PACU): An integral part of the suite. A size of 1.5 to 2 beds per OR is recommended.

Visual Elements Analysis

Figure 1: Flow chart (Surgical Suite) (Page 404)

Description: A functional flow chart illustrating the movement of patients, staff, and supplies through the three zones of a surgical suite. Technical Details:

- Patient Flow: Enters through Anesthesia Room into the Operating Room and exits to the Recovery Room.
- Staff Flow: Enters through Doctors' or Nurses' Lockers, passes through the Scrub-up area, and into the Operating Room.
- Supply Flow: Enters through Central Sterilizing Supplies, moves to Instrument Storage and Clean-Up, and into the Operating Room.
- Zoning: The diagram clearly delineates the three zones, with "Sub-Sterile" and "Clean-Up" acting as buffers between the inner and intermediate zones.

Figure 2: Typical plans of operating suites (Page 405)

Description: Three different floor plans for surgical suites, illustrating various organizational strategies.

- (a) Sherlock, Smith and Adams, Architects: A linear, single-corridor plan with a central clean core.
- (b) Kiff, Colean, Voss and Souder, Architects: A more complex plan with a distinct "T" shape, separating the operating rooms from the administrative and hold/recovery areas.
- (c) Louie Allen Abramson, Architect: A highly efficient "racetrack" or double-corridor plan. ORs are located on the perimeter, with a central sterile core for supplies. A separate outer corridor is used for all other traffic, minimizing cross-contamination. This is noted as a modern, efficient layout.

Section: Nursery (Pages 405-408)

Overview

This section details the planning requirements for newborn nurseries, emphasizing the prevention of infection. Key principles include limiting the number of infants per room, providing wide spacing between bassinets, and separating infants into distinct functional groups: full-term, premature, and observation.

Technical Specifications

- Space per Infant (Full-Term): 30 sq ft recommended, exclusive of the nurses' station.
- Infants per Room (Full-Term): 8 to 10 infants is the optimal number that can be cared for by one nurse.
- Bassinet Spacing: At least 2 feet apart.

- Cubicle Partitions: Must be glazed/transparent for observation. Should start above the bassinet level (approx. 30 in) and extend to a height of 24 in above the mattress to prevent airborne cross-infection.
- Observation Nursery: Requires 40 sq ft per bassinet to allow space for bedside care. Capacity is usually 10% of the full-term bassinets, with a minimum of two and maximum of three bassinets per observation room.
- Premature Nursery: Requires 30 sq ft per infant and should accommodate no more than five infants.

The Cohort System

- Concept: Babies born within the same 48-hour period are kept together in the same small nursery. They arrive and leave together as a group ("cohort").
- Benefit: In theory, this reduces cross-infection by eliminating the overlapping of infants of different ages and states of health.
- Design Implication: Lends itself well to designs with multiple small, four-bassinet nurseries instead of one large eight-bassinet room.

Visual Elements Analysis

Figure 1 & 2: Plans for nurseries (Pages 405, 406)

Description: Floor plans for nurseries in 50-bed, 100-bed, and 200-bed hospitals, showing the increasing scale and complexity of facilities.

- Figure 1 (50-Bed): A compact unit with a 4-bassinet full-term nursery, a 2-bassinet premature nursery, and a shared nurses' station. Total dimensions are 14'-0" x 30'-0".
- Figure 2 (100/200-Bed): Larger plans showing multiple nurseries, separate anterooms, and dedicated work/examination areas. The 200-bed plan includes separate observation and premature nurseries.

Figure 3: Detail plans for three types of nurseries (Page 407)

Description: Three highly detailed floor plans with an extensive equipment legend.

- Left Plan: Two conventional eight-bassinet full-term nurseries with a shared central nurses' station.
- Middle Plan: A cohort system with four separate four-bassinet nurseries served by a central nurses' station.
- Right Plan: Shows maximum (3-bassinet) and minimum (2-bassinet) observation nurseries, each with its own anteroom.

Section: Pediatric Nursing Units (Pages 408-411)

Overview

This section outlines the unique requirements for pediatric nursing units. The design must accommodate not just sick children but also their parents and the need for therapeutic activities like play and schoolwork. The extensive use of glass for visual control is a key feature.

Technical Specifications

- Bed Count: Recommended maximum is 20 beds per nursing unit, but plans shown exceed this to accommodate parents sleeping in.
- Flexibility: Rooms are sized to accommodate full-size hospital beds as well as smaller youth beds and cribs.
- Dayroom/Playroom: A critical therapeutic area for dining, play, and schoolwork, used by at least 50% of the children. It must be located for easy observation from the nurses' station.
- Visual Control: "Extensive use of glass in partitions between rooms and in corridor partitions" is noted as a primary feature.

Visual Elements Analysis

Figure 1 & 2: Pediatric Nursing Unit Plans (Pages 409, 411)

Description: Complete, detailed floor plans for pediatric nursing units in 200-bed and 400-bed range hospitals, respectively.

- Key Features (in both plans):
  - Room Mix: A variety of one-bed, two-bed, and four-bed rooms to accommodate different ages and conditions.
  - Observation: Isolation rooms are located directly opposite the nurses' station for constant visual control.
  - Centralized Support: A central core contains the nurses' station, workrooms, treatment rooms, and pantry/nourishment stations.
  - Zoning: Rooms are often designated for different age groups (e.g., "Infants," "Children," "Adolescents").
  - Dayroom/Playroom: A large, dedicated space is provided, centrally located and visually connected to the nurses' station.

Equipment Legend for Figures 1 and 2 (Page 410)

Description: An exhaustive legend with 68 numbered items identifying all the fixed and movable equipment required in a pediatric unit.

- Sample Items: Sick infant's crib (#1), Adjustable youth bed (#3), Wall cabinet with double-locked narcotics compartment (#20), Detention screen (#26), Circular type chart (#30), Automatic ascending trayveyor (#61).

BOQ Implications

- Specialized Construction: Surgical suites require explosion-proof outlets, conductive flooring, and specialized ventilation systems with high air-change rates, all of which are high-cost items for the BOQ.
- Medical Gases: The BOQ must quantify the extensive network of piped medical gases (oxygen, suction, nitrous oxide, compressed air) required in surgical suites, recovery rooms, and nurseries.
- Glazing and Partitions: Pediatric units require a large quantity of interior glazing (wire glass in steel frames) for observation, which is more expensive than standard drywall partitions. Cubicle partitions in nurseries are another specific millwork/glazing item.
- Specialized Equipment: The detailed equipment legends provide a direct checklist for the FF&E section of the BOQ, including items like incubators, bassinets, cribs, examination tables, refrigerators, and built-in thermometers.

Chapter 4: Health (Part 3 of 10)

Overview

This part of the chapter covers three highly technical and specialized hospital departments. The Diagnostic X-Ray Suite section details the layout, workflow, and critical shielding requirements for radiographic and fluoroscopic procedures. The Pharmacy section provides floor plans and functional descriptions for pharmacies in 100-bed and 300-bed hospitals, emphasizing workflow from order review to dispensing. Finally, the Teletherapy Units section offers an in-depth guide to the architectural and radiation shielding requirements for Cobalt-60 therapy rooms, a critical component of cancer treatment centers.

Key Standards and Codes Referenced

- National Bureau of Standards, Handbook 60: Referenced for radiation shielding requirements in X-ray control booths.

- Illuminating Engineering Society, Lighting Handbook, 3rd Edition (1959): Referenced for illumination standards in the X-ray suite.
- Atomic Energy Commission (AEC), Application Form AEC-313: Referenced for requirements related to the installation and operation of teletherapy units.

Section: Diagnostic X-Ray Suite (Pages 412-417)

Overview

This section outlines the design of a diagnostic x-ray department, emphasizing efficient workflow and patient handling to maximize the use of expensive equipment and professional staff time. The layout separates patient, staff, and film processing flows to prevent interference and maintain a logical sequence of operations.

Technical Specifications

- Location: Should be on the first floor, convenient to both outpatients and inpatients, near elevators, and adjacent to the outpatient department. A location at the end of a wing is ideal to minimize through-traffic and reduce shielding requirements.
- Layout Principle (Plan A, Fig. 2): Patient areas (waiting, dressing rooms) and examination rooms are on the perimeter. Administrative and film processing functions are in a central core. A separate technicians' corridor provides staff-only access to all key areas.
- X-Ray Room Size: Optimum size is approximately 14 ft x 18 ft. Minimum ceiling height is 9 ft 6 in.
- Control Booth: In the provided plan, no door is required on the control booth, as the radiation path is designed to scatter at least twice before reaching the technician, a design in accordance with NBS Handbook 60.
- Shielding:
    - Primary Barriers: Required on surfaces exposed to the useful (primary) x-ray beam.
    - Secondary Barriers: Required on other surfaces to protect from leakage and scattered radiation.
- Illumination:
    - General/Corridors: 10 footcandles.
    - Waiting Room: 15 footcandles.
    - Offices/Clerical Areas: 50 to 70 footcandles.

    - X-Ray Rooms: Indirect or cove lighting is recommended to avoid glare for supine patients.

Visual Elements Analysis

Figure 1: X-Ray Department Flow Diagram (Page 412)

Description: A functional diagram illustrating the separation of patient and film processing flows. Technical Details: Shows patient flow from waiting/control to dressing rooms and then to the x-ray rooms. Film flow is from the x-ray room to the darkroom, lightroom, collection/distribution, and finally to the film files. This separation is key to an efficient department.

Figure 2: Diagnostic radiographic suite, Plan A (Page 413)

Description: A detailed, fully-legended floor plan for a two-room x-ray suite in a hospital of approximately 100 beds. Equipment Legend/Technical Details: An extensive 87-item legend provides a comprehensive list of all required equipment. Key items include:

- Radiographic fluoroscopic unit (#69)
- Control unit (#71)
- Leaded glass view window (#72)
- Lead lining (#73) and lead-lined door (#74)
- Film dryer (#31) with exhaust to outside (#32)
- Through-the-wall fixing tank (#27) connecting the darkroom to the lightroom.
- Cassette pass box (#10) between x-ray rooms and the darkroom.

Figure 3: Diagnostic radiographic suite, Plan B (Page 415)

Description: A smaller, one-machine department designed for a 50-100 bed hospital, with a dotted outline showing a future expansion to a two-machine suite. Construction Notes: This plan demonstrates the critical principle of designing for expansion. By locating the department with adjacent "soft" space (like offices), it can be expanded later with minimal disruption and cost. Roughing in plumbing, shielding, and electrical for the future room is recommended.

Figure 5: Typical radiographic room (Page 416)

Description: A detailed plan showing the layout of a radiographic room with an overhead tube conveyor and other modern equipment. Technical Details:

- Overhead tube conveyor (O.T.C.) (#1) with ceiling tracks (#2).
- Image intensifier carriage (#3) with a TV monitor (#4).

- High-capacity autoprocessor (#16) and cassette transfer cabinet (#17) for film handling.

BOQ Implications

- Lead Shielding: This is the most significant and costly special item in this department. The BOQ must quantify the square footage of lead lining required for walls, doors, and control booth partitions, specifying the required thickness (e.g., 3 lb/sq ft or 1.2mm).
- Specialty Construction: The BOQ must include items for light-proof louvers, cassette pass boxes, and through-wall film processing tanks.
- MEP: The electrical section of the BOQ is complex, requiring dedicated, independent feeders for each x-ray unit to prevent voltage drops, as well as numerous outlets and special connections for control panels and transformers.
- Equipment: The detailed legends provide a direct checklist for the Division 11 (Equipment) section of the BOQ.

Section: Pharmacy (Pages 418-419)

Overview

This section provides floor plans and equipment legends for hospital pharmacies in 100-bed and 300-bed hospitals, illustrating the workflow from receiving and inspection to manufacturing, dispensing, and order review.

Visual Elements Analysis

Figure 1 & 2: Pharmacy department plans (Pages 418, 419)

Description: Two detailed floor plans showing pharmacy layouts of increasing complexity.

- Figure 1 (100-Bed): A compact pharmacy including areas for Receiving, Bulk Storage, Extemporaneous Preparation, Dispensing, and Parenteral Control.
- Figure 2 (300-Bed): A much larger department with more specialized areas, including a dedicated Manufacturing area, Narcotics vault, Flammables storage, a Waiting Room for outpatients, and an administrative section for the Chief Pharmacist.
- Equipment Legend/Technical Details: The legends identify key equipment:

  - Pneumatic tube station (#1) for sending orders.
  - Hood, laminar airflow (#25) for sterile preparation.
  - Dumbwaiter (#21) for vertical distribution.
  - Extensive use of adjustable shelving, counters with bins, and specialized files.

BOQ Implications

- Casework: The BOQ must quantify the extensive amount of specialized casework, including dispensing counters with bins, adjustable shelving (some locked for narcotics), and laboratory benches for preparation.
- Specialty Equipment: Laminar airflow hoods, dumbwaiters, and pneumatic tube systems are key equipment items to be included.
- Security: The requirement for a narcotics safe or vault necessitates specifying this secure item in the BOQ.

Section: Teletherapy Units (Cobalt-60) (Pages 420-423)

Overview

This is a highly technical guide to the design of Cobalt-60 teletherapy rooms. It focuses almost entirely on the architectural and structural requirements for radiation protection, including massive concrete shielding, maze entrances, and lead-lined doors and windows.

Technical Specifications

- Shielding: This is the paramount design consideration. The architect is dependent on a radiation physicist to calculate the required thickness of shielding material (typically high-density concrete) for the walls, floor, and ceiling.
- Location: A location below grade, with no occupied space above or below, requires the least amount of shielding. A corner location is also desirable to minimize the number of interior walls that need shielding.
- Room Size: Approximately 15 ft x 18 ft with a 9 ft 6 in ceiling height, plus a maze entrance, will accommodate most machines.
- Entrance Maze: Used in lieu of extremely heavy, lead-lined doors. The maze must be designed so that no primary radiation can fall directly on the door.
- Door: A wood door with a layer of lead is a common solution. The space between the door and floor must be shielded with a lead strip.

- Control View Window:
    - Size: 8 in x 8 in is considered an optimum size due to the high cost.
    - Shielding: Must contain lead glass or other materials providing shielding equivalent to the surrounding concrete wall. The frame must be packed with lead wool.
- Ductwork: Ventilation ducts must be offset or baffled where they penetrate shielding walls to prevent radiation escape.

Visual Elements Analysis

Figures 1, 2, 3: Plans and Sections of Cobalt-60 Rooms (Pages 421, 422, 423)

Description: A series of three plans and associated sections illustrating the shielding requirements for different types of Cobalt-60 machines.

- Figure 1 (Fixed Beam Unit): Shows extremely thick concrete walls (e.g., 3'-8").
- Figure 2 (Rotational Unit with Primary Beam Absorber): The machine has its own shielding, so the concrete wall thickness is reduced (e.g., 1'-5").
- Figure 3 (Rotational Unit without Primary Beam Absorber): Requires the most shielding, as the primary beam can point in any direction.
- Occupancy Symbols: A key legend indicates areas of Full, Partial, and Occasional Occupancy, which are used by the physicist to calculate the required shielding thickness. (Full Occupancy = Control Space, Offices; Partial = Corridors, Rest Rooms; Occasional = Stairways, Closets).

BOQ Implications

- Concrete: This is the single largest component. The BOQ will include massive quantities of high-density concrete for the walls, floor, and ceiling of the teletherapy room. This has major structural and cost implications for the entire building foundation and frame.
- Lead Shielding: The BOQ must specify lead-lined doors, lead glass for the control window, and lead wool packing for frames.
- Specialty Doors: The heavy, lead-lined door requires specialized, heavy-duty hardware and potentially a motorized operator, all of which must be included.
- HVAC: The need for shielded, offset ductwork is a specific requirement for the mechanical section of the BOQ.

Chapter 4: Health (Part 4 of 10)

Overview

This part of the chapter covers the design of three distinct but often interrelated hospital departments focused on diagnostics and rehabilitation. The Electroencephalographic (EEG) Suite section details the requirements for a space dedicated to measuring the brain's electrical potentials, emphasizing electrical shielding and acoustic control. The Physical Therapy Department section outlines the layout of spaces for restoring physical function, with specific zones for dry and wet treatments. Finally, the Occupational Therapy Department section describes the workshop-like environment designed to improve patient skills through various activities and crafts.

Key Standards and Codes Referenced

- "Physical Therapy Essentials of a Hospital Department," Joint Committee of the American Hospital Association and the American Physical Therapy Association. (Primary source for Physical Therapy section).
- HOSPITALS, Journal of the American Hospital Association, October 1950: Primary source for Occupational Therapy recommendations.

Section: Electroencephalographic Suite (Pages 424-425)

Overview

This section details the requirements for an EEG suite, a highly sensitive area for measuring brain activity. The paramount design considerations are the elimination of electrical interference and the creation of a quiet, controlled environment for the patient and technician.

Technical Specifications

- Core Components: An examining room for the patient, a workroom for the technician and EEG unit, and an office/records area for the neurologist.
- Electrical Shielding: This is the most critical requirement.
    - Purpose: To eliminate outside disturbances from static electricity and high-frequency equipment (diathermy, radio). It has little effect on low-frequency magnetic disturbances from transformers or power lines.
    - Construction: Can be achieved with pre-fabricated panels or by using copper insect screening. The screening must entirely cover all walls, floor, and ceiling, with all strips bonded and soldered. The shield must be grounded at one point only.

- Examining Room:
  - Minimum Door Width: 3 ft 10 in to permit easy passage of a stretcher or wheelchair.
  - Layout: The patient bed should be parallel to the partition with the workroom to allow for full observation by the technician through a view window.
- View Window: Minimum size 24 in high x 36 in wide, mounted with the lower edge 43 in from the floor.
- Finishes: A masonry-type floor (tile, terrazzo) is recommended in the patient preparation area, as solvents like acetone (used to remove electrode adhesive) can damage resilient flooring.

Visual Elements Analysis

Figure 1: Minimum EEG suite (Page 425)

Description: A compact, two-room plan showing a combined Preparation/Examination room and an Office. Technical Details: The layout is 11'-6" x 13'-6". It includes an adjustable hospital bed, the EEG console, and a desk. A key feature is the note about two holes through the wall, 3 in. diameter and 20 in. from the floor, for passing electrode cables and photo-stimulator conductors between rooms if a two-room suite is used.

Figure 2: Recommended suite with separate preparation and examining rooms (Page 425)

Description: A more efficient three-room layout that separates the patient examination area from the workroom and storage. Technical Details: The layout is 11'-6" x 22'-6". This plan allows one patient to be prepared in the "PREP." room while another is being tested in the "EXAMIN." room, increasing patient throughput. A view window between the "WORK" room and the "EXAMIN." room is implied for observation.

Section: Physical Therapy Department (Pages 425-427)

Overview

This section outlines the planning of a physical therapy department, a space designed to restore patient mobility and function. The design is organized into distinct zones for dry exercise, wet hydrotherapy, and private treatments, with a strong emphasis on accessibility and durable finishes.

Technical Specifications

- Location: A ground floor location is recommended for easy access for both inpatients and outpatients, and to connect to an outdoor exercise area. It should be in close proximity to the Occupational Therapy department.
- Space Allocation: A minimum of 1,000 sq ft is desirable, with about half of that dedicated to the open exercise area.
- Key Treatment Areas:
    - Cubicle (Dry) Area: For private treatments like infrared lamps, diathermy, and hot packs. Curtains are preferred over solid partitions for flexibility.
    - Underwater Exercise (Wet) Area: For whirlpools and Hubbard tanks. This area requires special plumbing, ventilation, and structural considerations.
    - Exercise (Open) Area: A large, flexible space for gait training, mat exercises, and other activities.
- Ceiling Moorings: Moorings strategically located in the ceiling should be designed to support at least 500 pounds each for attaching overhead equipment like hoists and pulleys.
- Finishes: Walls require a durable wainscot (e.g., vinyl wall covering) to protect against damage from wheelchairs and carts.

Visual Elements Analysis

Figure 1: Type "A" and "B" Physical Therapy Plans (Page 426)

Description: Two detailed floor plans for a complete physical therapy department, illustrating different layouts and including an extensive equipment legend.

- Type "A" Plan: A long, linear plan with an Exercise Area, Treatment Cubicles, and an Exam Room organized along a single corridor. A "Future Tank Room" indicates planning for expansion.
- Type "B" Plan: A more compact, squarish layout with the Exercise Area adjacent to an outdoor terrace. The treatment cubicles are more centrally located.
- Equipment Legend: A 50-item legend identifies all necessary equipment, including: Parallel Bars (#2), Steps (#3), Stationary Bicycle (#6), Pulley Weights (#8), Whirlpool (#23), and an Overhead Lift (#48).

Figure 2: Perspective Views of Department (Page 427)

Description: Three perspective sketches illustrating the different activity zones.

- Top Sketch: Shows the open Exercise Area with parallel bars, stall bars, and a posture mirror.
- Middle Sketch: Shows the Hydrotherapy (Wet) Area with a Hubbard tank and whirlpools. An overhead lift/monorail is visible.
- Bottom Sketch: Shows a row of private Treatment Cubicles, separated by curtains.

BOQ Implications

- Special Construction: The EEG suite requires a fully shielded "cage" of copper screening, a highly specialized and labor-intensive item for the BOQ.
- Structural: The hydrotherapy area requires floors designed for heavy, water-filled equipment (Hubbard tanks) and integrated floor drains. Ceilings in the exercise area must have reinforced anchor points (moorings) to support 500 lbs.
- MEP: Hydrotherapy requires extensive, high-capacity plumbing for hot/cold water and rapid drainage. The entire department needs robust ventilation, and often full air conditioning, to control heat and humidity.
- Finishes: The BOQ must specify durable, impact-resistant wainscoting for walls and non-slip, waterproof flooring (e.g., unglazed ceramic tile) for wet areas.

Section: Occupational Therapy Department (Pages 428-431)

Overview

This section details the planning of an occupational therapy department, which functions as a series of workshops designed to retrain patients in various life and work skills. The design must accommodate a wide range of activities, from quiet table work to noisy bench work.

Technical Specifications

- Space Allocation:
    - General Department: 54 to 61 sq ft per patient.
    - Clinic Area Only: 42 to 47 sq ft per patient.
- Activity Types:
    - Bench Work: Carpentry, plastics, metal work.
    - Table Work: Leather, block printing, fly-tying, sewing.

  - Loom Work: Weaving, braiding.
  - "Functional Equipment": Bicycle jig saws and other adapted equipment for physical rehabilitation.
- Variations for Hospital Types:
  - Tuberculosis Hospitals: Require industrial sewing machines.
  - Pediatric Hospitals: Require tables of adjustable height and space for play activities.
  - Physical Disability Hospitals: May require fewer work stations per therapist.

Visual Elements Analysis

Figure 1 & 2: Occupational Therapy Department Floor Plans (Pages 429, 430)

Description: Detailed floor plans for occupational therapy departments in 250-bed and 500-bed hospitals, showing the increasing specialization and scale of the facilities.

- Figure 1 (250-Bed): A single large room zoned for different activities. "Bench Activities" (noisy) are separated from "Table Activities" (quiet). Includes a dedicated storage room and office. A key feature is the "plan adapted to pediatric hospitals," which shows a large sand box and play house.
- Figure 2 (500-Bed): A much larger suite with separate, dedicated rooms for different crafts, demonstrating a higher level of specialization.
  - Separate Rooms for: Weaving, Ward Preparation, Ceramics, Printing, and even Photography (with a dark room). This layout provides better acoustic and dust control between activities.
- Equipment Legend: An extensive 54-item legend identifies the specialized workshop equipment required, such as: Electric tool grinder (#2), Electric jig saw (#5), Drill press (#6), Floor loom (#12), Large kiln (#43), and Potters wheel (#46).

BOQ Implications

- Casework and FF&E: The BOQ must include a large quantity of heavy-duty workbenches, tables, storage cabinets, and specialized equipment as detailed in the legends.
- MEP: Workshop areas require numerous electrical outlets for power tools, gas lines (for kilns), compressed air, and specialized ventilation/dust collection systems for woodworking equipment. Sinks with plaster or clay traps are required.
- Finishes: Workshop areas require durable, easy-to-clean, and often impact-resistant flooring and wall surfaces.

Chapter 4: Health (Part 5 of 10)

Overview

This part of the chapter focuses on two highly technical and critical hospital departments. The Laboratory section provides an in-depth guide to planning the clinical laboratory, emphasizing workflow, flexibility, and the specific requirements for different testing units like hematology, biochemistry, and bacteriology. It includes detailed floor plans and data tables that correlate workload (number of tests) with space and staffing needs. The Labor-Delivery Suite section outlines the functional arrangement of spaces for obstetrics, focusing on a sequential flow that ensures patient safety, comfort, and aseptic control from admission through labor, delivery, and recovery.

Key Standards and Codes Referenced

- "Planning the Laboratory for the General Hospital," Public Health Service, Dept. of Health, Education, and Welfare, 1963.
- Modern Hospital, June and October, 1957: Source for articles by Seward E. Owen and Edmund P. Finch on calculating laboratory workload.
- "Planning the Labor-Delivery Unit in the General Hospital," Public Health Service, Dept. of Health, Education, and Welfare, 1964.

Section: General Hospital Laboratory (Pages 431-436)

Overview

This section details the planning of the clinical laboratory, the diagnostic core of the hospital. The design is driven by the volume and type of tests performed. The key principle is creating a flexible, efficient layout that organizes different technical units (hematology, urinalysis, etc.) around a central administrative and support core.

Technical Specifications

Planning Principles

- Workload-Based Design: Space requirements are not based on bed count, but on the annual volume of tests performed. This is a more accurate method.

- Flexibility: The "laboratory module" concept is introduced. A standard module of approximately 10 ft x 20 ft with a consistent utility arrangement allows for easy reallocation of space between different lab units as needs change.
- Layout: An open plan arrangement for technical areas is preferred over separate rooms for easier supervision, shared use of equipment, and flexible use of personnel. Partitions are only used where functionally necessary (e.g., for bacteriology and histology to control contamination and odors).
- Utility Services: Piping systems (water, waste, gas, vacuum) should be exposed or easily accessible behind removable panels for maintenance and repair without disrupting lab services.

Data Tables for Programming

- Table 1: Tests Performed Annually per Medical Technologist: Provides a productivity benchmark for staffing calculations.
  - *Example*: One technologist can perform approximately 13,400 hematology tests or 9,600 biochemistry tests annually.
- Table 2 & 3: Show the typical number of tests performed and the utilization index (tests per patient day) for hospitals of different bed sizes.
- Table 4 & 5: Break down the annual test volume by specific laboratory unit (e.g., Hematology, Urinalysis) for 150-200 bed and 100-149 bed hospitals, respectively. This data is crucial for sizing individual lab sections.
  - *Example (Table 4)*: In a 150-200 bed hospital, Hematology accounts for a median of 35,800 tests annually, requiring 2.5 technologists.

Visual Elements Analysis

Figure 1: Laboratory Suite Plans (Pages 432-433)

Description: A set of three detailed floor plans (A, B, C) for laboratories in hospitals of decreasing size (from 150-200 beds down to <100 beds). An extensive 78-item legend identifies all equipment.

- Plan A (150-200 beds): A large, open-plan lab based on the modular concept. A central administrative block (waiting, offices, specimen collection) is surrounded by the technical work areas. Specialized rooms like Histology and Serology-Bacteriology are enclosed, while Hematology, Urinalysis, and Biochemistry share open space. A dedicated glass washing and sterilizing unit serves all areas.
- Plan B & C (Smaller Hospitals): Show more compact layouts with combined functions. In Plan C, for example, Hematology, Serology, and Bacteriology are combined into a single module.

- Key Equipment: The legend highlights specialized lab equipment such as: Analytical balance (#6), Laboratory pressure sterilizer (#22), Micro-hematocrit centrifuge (#32), Fume hood (#42), and Noncorrosive metal work surface (#45).

Figure 3 & 4: Laboratory Details (Page 436)

- Figure 3 (Perspective): A perspective view of a modular laboratory, showing the island workbenches, perimeter counters, and overhead service carriers.
- Figure 4 (Piping Diagram): A detailed section showing the arrangement of utility piping (hot/cold water, waste, gas, vacuum, etc.) behind a laboratory workbench. Construction Notes: This detail is critical for the BOQ. It shows that services are run in an accessible chase behind the casework, with individual shutoff valves for each bench. This allows for maintenance and modification without tearing out walls or casework.

BOQ Implications

- Casework and Countertops: The laboratory requires extensive specialized casework. The BOQ must quantify linear feet of laboratory benches, specifying height (30" sit-down, 36" stand-up), depth, and material (noncorrosive, acid-resistant).
- MEP: This is a major cost center. The BOQ must detail the extensive network of piped services (hot/cold/distilled water, gas, vacuum, compressed air) to numerous outlets at each workstation. Specialized plumbing like cup sinks, flushing-rim sinks, and acid-resistant waste lines with dilution pits is required. Fume hoods require dedicated exhaust systems.
- Flexibility Costs: The modular design with accessible utility chases, while promoting long-term flexibility, has a higher initial cost than running utilities in permanent walls, which must be reflected in the bid documents.

Section: Labor-Delivery Suite (Pages 437-439)

Overview

This section details the planning of the obstetrical suite. The design is driven by the need for a sequential, controlled workflow that moves the patient from labor to delivery to recovery while maintaining strict aseptic control and providing for patient comfort and safety.

Technical Specifications

- Functional Arrangement: The suite must have three distinct but connected areas for Labor, Delivery, and Recovery.
- Labor Rooms:
  - Single occupancy rooms are recommended over multi-bed wards for privacy and infection control.
  - Minimum Size: 100 sq ft.
  - Emergency Delivery: One labor room should be larger (180 sq ft) to double as an emergency delivery room.
  - Doors: Minimum width of 3 ft 8 in; 4 ft is recommended to allow passage of beds.
- Delivery Rooms:
  - Clear Floor Area: Approximately 17 ft 6 in square.
  - Ceiling Height: Minimum of 9 ft is required for obstetrical lights.
- Recovery Room:
  - Ratio: Generally accepted as a necessary facility in any suite with three or more labor beds.
  - Function: Provides a dedicated space for post-delivery observation, freeing up the more expensive delivery room for the next patient.
- Support Spaces: The suite must also include a nurses' station, scrub-up areas, soiled holding room, medication preparation area, and doctors' and nurses' lounges and lockers.

Visual Elements Analysis

Figure 1: Labor-delivery unit plan (Page 437)

Description: A detailed floor plan for a complete labor-delivery suite designed for approximately 1,500 births per year. Technical Details: The plan illustrates the key principles of circulation and functional zoning:

- Circulation: A subsidiary corridor provides access to the Labor Rooms, allowing husbands to visit without entering the more sterile main corridor.
- Zoning: The Delivery Rooms are located in the most remote, protected part of the suite. Scrub-up areas are immediately adjacent to the delivery rooms. A soiled holding room and clean supply/sterilizing rooms are centrally located.
- Proximity: The Recovery Room is located near the delivery rooms for easy patient transfer. The Nurses' Station is positioned to control the main entrance and observe traffic.

BOQ Implications

- Medical Gases: The BOQ must quantify the installation of piped oxygen and vacuum outlets in all delivery rooms and at each bed position in the labor and recovery rooms.
- Specialized Plumbing: Scrub-up areas require multiple surgical scrub sinks with foot- or knee-operated controls.
- Specialty Lighting: Delivery rooms require complex, ceiling-mounted surgical lighting systems, which are a major equipment cost.
- Finishes: The entire suite requires highly durable, sanitary, and easily cleanable finishes on floors, walls, and ceilings to maintain an aseptic environment.

Chapter 4: Health (Part 6 of 10)

Overview

This part of the chapter covers three distinct but often interconnected hospital departments. It begins with the highly technical requirements for a Radioisotope Facility, focusing on workflow, safety, and radiation shielding. The second section details the planning of a comprehensive Outpatient Activity department, outlining the complex circulation patterns and functional relationships between various clinics and support services. The final section describes the critical layout of the Emergency Activity department, emphasizing immediate access, triage, and the organization of spaces to handle life-threatening situations.

Key Standards and Codes Referenced

- "Radioisotope Facilities in the General Hospital," Public Health Service, Department of Health, Education, and Welfare, 1966.
- "Guidelines to Functional Programing, Equipping, and Designing Hospital Outpatient & Emergency Activities," DHEW Publication No. (HRA) 77-4002, U.S. Department of Health, Education, and Welfare, 1977.

Section: Radioisotope Facility (Pages 439-440)

Overview

This section details the planning of a hospital's nuclear medicine department. The design is driven by two primary concerns: (1) ensuring an efficient workflow for patient diagnosis and therapy, and (2) providing absolute safety and radiation protection for both staff and the public.

Technical Specifications

- Core Components: A main laboratory for handling isotopes, an examination/uptake room for patients, and a scanning room.
- Location: The area should be on an outside wall and as far from general circulation as possible to minimize shielding requirements and control traffic.
- Shielding:
  - Isotope Storage: Isotopes are stored on the work counter behind lead bricks.
  - Waste Disposal: Glassware contaminated with radioisotopes must be washed in a dedicated disposal sink.
- Workflow: The layout must separate "clean" and "hot" (radioactive) areas. The clean sink is for non-radioactive items; the disposal sink is for contaminated items.
- Flexibility: The plans illustrate both a minimum one-room facility and a more comprehensive two-room facility that separates scanning procedures from other lab work.

Visual Elements Analysis

Figure 1: Radioisotope Facility Plans (Page 440)

Description: A detailed floor plan showing two configurations for a radioisotope facility, keyed to an extensive legend.

- (a) Plan 1 (Minimum Facility): A single room (11'-0" x 16'-5") containing a "hot" work counter (A) with lead brick shielding, a patient examination table (#7), and a detector/stand (#8) for uptake studies.
- (b) Plan 2 (Expanded Facility): A two-room suite that separates the "LABORATORY" from the "SCANNING ROOM." This allows for more complex procedures and greater patient throughput, as a patient can be undergoing a scan while other work is performed in the lab.
- Key Equipment: The legend identifies specialized nuclear medicine equipment, including: Scintillation well counter (#6), Detector and stand (#8), Scanner (#9), and Scaler mounted on cart (#10).

BOQ Implications

- Lead Shielding: The BOQ must include lead bricks for on-counter isotope storage and potentially lead lining for walls or storage cabinets depending on the activity level of the isotopes used.
- Specialized Plumbing: A dedicated, separate waste line is often required for the disposal sink to carry radioactive waste to holding tanks where it can decay before being released into the sanitary system.
- Casework: Counters must be covered with a smooth, non-porous material (e.g., stainless steel) to facilitate easy decontamination in case of spills.

Section: Outpatient Activity (Pages 441-443)

Overview

This section outlines the design of a large, modern outpatient department. The organizing principle is the separation of complex traffic flows: new patients, repeat patients, staff, and visitors. The design groups clinics by function and provides a clear, hierarchical circulation system to aid in wayfinding.

Technical Specifications

- Zoning: The department is organized into major functional blocks: Administration/Business Office, Examination-Treatment Center, and Specialty Clinics.
- Circulation:
  - A main spine corridor (10 ft wide) provides primary circulation.
  - Branch corridors (8 ft wide) lead to specific clinic groups.
- Examination-Treatment Center: Organized into "clusters" of exam rooms.
  - Cluster Concept: A group of ten examination-treatment rooms surrounds a central utility work space ("personnel corridor"). This allows staff to move between rooms and access supplies without entering the main patient corridors.
- Exam Room Requirements:
  - Minimum Size: 80 net sq ft.
  - Treatment Rooms: 120 net sq ft.
  - Clearance: Must have 30 in clear working space on three sides of an examination table.
  - Handwashing facilities for staff are required in each.

Visual Elements Analysis

Figure 1: Interdepartmental Relationship Scheme (Page 441)

Description: A large bubble diagram illustrating the relationship of the Outpatient Activity department to other key hospital functions. Technical Details: Shows direct, critical adjacencies between the Outpatient department and Physical Medicine, the Main Hospital Entrance, and the Emergency Activity. It also shows close relationships with X-Ray, Laboratory, and other services.

Figure 2 & 3: Intradepartmental Relationship Schemes (Page 442)

Description: Bubble diagrams showing the internal organization of the Outpatient department. Technical Details: These diagrams visually represent the patient flow from the entrance vestibule, through the "Automated Multiphasic Health Testing Unit" and check-in, into a public waiting area, and then out to the various specialty clinics. This illustrates a clear progression from general screening to specialized care.

Figure 4 & 5: Examination-Treatment Center Details (Page 443)

- Figure 4: A diagram showing the "cluster" concept, with three clusters of exam rooms accessible from a main patient corridor.
- Figure 5: A detailed plan of a single exam room cluster, showing ten exam rooms arranged around a central personnel-only corridor. This is a highly efficient layout for staff workflow.

Section: Emergency Activity (Pages 444-445)

Overview

This section details the planning of the hospital's Emergency Activity (EA) department. The design is dictated by the absolute priority of rapid movement and treatment for patients with life-threatening conditions. The layout creates separate, controlled zones for different types of arrivals (ambulance vs. walk-in) and different levels of acuity.

Technical Specifications

- Access: Must be on the ground floor with a separate, dedicated entrance for ambulances and another for walk-in patients.

- Adjacencies: Must have a direct connection to the hospital's Surgical Suite, Coronary Intensive Care Unit, and primary radiological facilities.
- Control: The nursing station is the central hub, providing visual control of all incoming traffic, the public waiting area, and key treatment rooms.
- Treatment Spaces:
    - Treatment Cubicles: For minor injuries.
    - Critical Care Rooms: Larger rooms for more severe injuries, accommodating more staff and equipment.
    - Cast Room: For closed reduction of fractures.
    - Patient's Observation Room: For holding patients until a disposition is made.

Visual Elements Analysis

Figure 1: Pro Forma Emergency Activity Plan (Page 444)

Description: A detailed floor plan of a comprehensive Emergency department, keyed to an extensive equipment legend. Technical Details:

- Circulation: Shows a separate, covered ambulance entrance leading directly to the treatment core. A separate walk-in entrance leads to a public waiting area and control desk.
- Zoning: The plan is organized with the most acute areas (Critical Care, Treatment Rooms) wrapped around the central Nurses' Station. Less acute areas (Observation) and support spaces (Family Press Room, Lounges) are on the periphery. A "Nourishment/Equip. Stor." room is located centrally.
- Security: A "Patient Security Room" is included for disturbed patients.
- Key Equipment: The legend identifies critical emergency equipment, such as: Emergency drug cabinet (#340), Electrosurgical unit (#332), Emergency carts (#336, #338), and a mobile X-ray unit (#920).

Figure 2: Emergency Activity Intradepartmental Relationship Scheme (Page 445)

Description: A bubble diagram illustrating the functional relationships and adjacencies within the EA. Technical Details: This diagram clarifies the layout logic. The Control Center and Nurses' Station are the hub. Ambulance arrivals have direct access to Critical Care and Treatment Cubicles. Walk-in patients move from Waiting to the treatment core. Support spaces like Police and Family Room are adjacent to the public/control area, while staff support spaces (Lockers, Lounge) are in a protected zone.

BOQ Implications

- Specialty Equipment: The detailed legends for all three departments provide a direct checklist for the FF&E and Medical Equipment sections of the BOQ, including items like X-ray machines, dental chairs, examination tables, and emergency carts.
- Casework: Outpatient and Emergency departments require extensive casework for nurses' stations, medication rooms, and supply storage, all of which must be quantified.
- MEP: These departments have heavy MEP requirements. The BOQ must include medical gas outlets (oxygen, suction), specialized plumbing (plaster traps in cast rooms), and robust electrical systems to power medical equipment.
- Signage and Wayfinding: The text emphasizes the need for clear signage in the large, complex outpatient department. The BOQ should include a comprehensive signage package.

Chapter 4: Health (Part 7 of 10)

Overview

This part of the chapter covers the architectural and functional requirements for three critical and distinct hospital-related facilities. It begins with a detailed guide to the Electronic Data Processing (EDP) Unit, a highly technical space requiring stringent environmental controls. The section then moves to Rehabilitation Centers, outlining the multidisciplinary spaces needed for medical, physical, occupational, and social therapies. Finally, it introduces the complex programmatic requirements for Mental Health Centers, detailing the six main types of psychiatric facilities and the spatial needs for both inpatient and outpatient care.

Key Standards and Codes Referenced

- "Administrative Services and Facilities for Hospitals: A Planning Guide," DHEW Pub. No. (HSM) 72-4035, U.S. Department of Health, Education, and Welfare, 1972. (Source for EDP Unit).
- "Planning Guidelines for Community Mental Health Centers," by Clyde H. Dorsett, AIA, National Institute of Mental Health, Bethesda, Md., 1978.

Section: Electronic Data Processing (EDP) Unit (Pages 446-450)

Overview

This section details the planning of a hospital's data center. The design is driven by the need for a highly controlled and secure environment to protect sensitive electronic hardware and data. The layout focuses on a logical workflow from data entry and processing to delivery and storage.

Technical Specifications

- Core Components: Computer Room, Data Entry Room, Data Delivery and Pickup Area, Supply Storage, and offices for staff (Director, Analysts, Programers, Supervisor).
- Computer Room Environment:
  - Raised Floor: A critical feature that allows for flexible cable management, protects interconnecting cables, and can be used as a plenum for air supply.
  - Temperature: 75°F.
  - Humidity: 50% relative humidity.
  - Air Filtration: Required, with a minimum 90% efficiency based on the National Bureau of Standards discoloration test.
  - Fire Protection: An automatic carbon dioxide fire extinguishing system is preferred over water sprinklers.
- Data Entry: Accommodates equipment for encoding information onto computer-compatible media (e.g., keypunch desks).
- Data Delivery/Pickup: Accommodates equipment for decollating, bursting, and binding of printed reports.

Visual Elements Analysis

Figure 1: Electronic Data Processing Unit (Medium System) (Page 449)

Description: A detailed floor plan of a complete EDP unit, keyed to an extensive 44-item legend. Technical Details:

- Workflow: Shows a clear progression. The "Data Delivery and Pick Up" area is near the public corridor. This feeds into the "Data Entry" room, which is adjacent to the main "Computer Room." The computer room is supported by a "Service Engineer's Room" and "Storage Room."
- Staff Areas: The Director's, Analyst's, and Programer's offices are grouped together around a "Resource Center" and Conference Room, separate from the main machine areas.

- Key Equipment: The legend identifies specialized data processing hardware: Console w/shelf and printer (#25), Magnetic tape facility (#30), Card read punch (#31), and a Burster complete with table (#42).

Section: Rehabilitation Centers (Pages 451-455)

Overview

This section outlines the design of a comprehensive rehabilitation center, a facility that combines medical treatment with physical, occupational, and social therapies. The design is organized around the patient's journey, with spaces grouped by activity type and noise level.

Technical Specifications

- Core Medical Services: Physician's unit (consultation/exam rooms), physical therapy, occupational therapy, speech and hearing therapy, and a prosthetic/orthotic shop.
- Circulation: Corridors must be a minimum of 6 ft wide to accommodate wheelchair and stretcher traffic.
- Physical Therapy:
  - Dry Area: Exercise room/gymnasium.
  - Wet Area: Hydrotherapy area with whirlpools, Hubbard tanks, and therapeutic pools. Requires special plumbing, ventilation, and structural support for heavy, water-filled equipment.
- Occupational Therapy: Workshop-like environment for creative skills and manual arts.
- Activities of Daily Living (ADL): A simulated home environment (bedroom, bathroom, kitchen) used to retrain patients in essential life skills.

Visual Elements Analysis

Figure 1: Interrelations of main elements of space of a rehabilitation center (Page 451)

Description: A bubble diagram illustrating the functional zoning of a rehabilitation center. Technical Details: The diagram groups activities into three zones based on noise level:

- Quiet Zone: Includes Nurse Beds, Speech & Hearing, and Administrative offices.
- Moderate Zone: Includes Dining, Hydrotherapy, and the Sheltered Workshop.
- Loud Zone: Includes Parking and Service areas. This zoning is critical for creating a therapeutic environment where quiet treatment areas are not disturbed by noisy workshop activities.

Figure 2: Medical Area Relationship Scheme (Page 452)

Description: A flow diagram showing the relationship between the physician's unit and other medical services. Technical Details: Shows the central role of the Physician, who connects to Occupational Therapy, Physical Therapy, Prosthetics & Orthotics, and the broader areas of Social Adjustment and Vocational training. The diagram illustrates the multidisciplinary team approach to rehabilitation.

Figure 9: Activities of daily living (Page 455)

Description: Detailed plans of an ADL training suite, including a kitchen, bedroom, and bathroom. Technical Details:

- Kitchen: Shows a U-shaped kitchen with standard appliances.
- Bedroom: Contains a bed, dresser, and space for maneuvering a wheelchair.
- Bathroom: Shows two different layouts for an accessible bathroom, including one with a roll-in shower and one with a tub, both with grab bars. Construction Notes: This suite must be designed with full accessibility, including wider doorways, roll-under sinks, and grab bars, to allow patients in wheelchairs to practice essential home activities.

Section: Mental Health Centers (Pages 456-460)

Overview

This section addresses the complex requirements for psychiatric facilities. It outlines the shift from institutional care to community-based mental health centers that provide a comprehensive spectrum of services, from inpatient treatment to outpatient counseling and consultation.

Technical Specifications

- The Physical Plant:

    - Sleeping Units: Minimum of 90 sq ft for single rooms; 70 sq ft per person for multiple-patient rooms. Multi-patient rooms should accommodate no more than four, preferably two, patients.
    - Day Rooms/Recreation Areas: At least 40 sq ft of floor space per patient.
    - Plumbing: Minimum of 1 lavatory per 6 patients; 1 toilet per 8 patients; 1 tub/shower per 15 patients.
- Six Types of Psychiatric Facilities:
    - Community Mental Health Centers: The most comprehensive type, offering a full range of services.
    - Psychiatric Outpatient Clinics
    - Psychiatric Services in General Hospitals
    - Private Psychiatric Hospitals
    - Public Psychiatric Hospitals
    - Services for the Mentally Retarded
- Spatial Needs of Program Elements (Page 460):
    - Inpatient Unit: Requires privacy for sleeping/dressing, laundry/snack kitchens for each living group (16-24 patients), and a variety of social spaces (small quiet areas and larger activity rooms).
    - Emergencies: Requires an inviting entrance, an interview space, and a holding/waiting bed space.
    - Outpatient: Requires admitting offices, ancillary services (waiting areas, toilets), and conference/consultation rooms.

Visual Elements Analysis

Figure 1: Interdepartmental relationship scheme (Emergency Activity) (Page 457)

Description: A bubble diagram showing the critical adjacencies for an emergency facility that handles psychiatric emergencies. Technical Details: Illustrates the flow from the ambulance/walk-in entrance to a central control center. From here, patients are directed to treatment cubicles, a critical care room, or a patient observation room. This diagram emphasizes the need for rapid triage and controlled movement.

BOQ Implications

- Specialty Equipment: Rehabilitation centers require a vast amount of specialized equipment for the BOQ, including parallel bars, whirlpool tanks, Hubbard tanks, overhead lifts, kilns, looms, and prosthetic fabrication tools.
- Security and Safety: Mental health facilities require specific items in the BOQ related to patient safety, such as tamper-proof fixtures, detention screens, and

hardware on patient room doors that can be opened from the outside in an emergency.
- Accessibility: All rehabilitation and mental health facilities require that the BOQ specifications adhere to accessibility standards, including wider doors, grab bars in all toilets, accessible plumbing fixtures, and ramps instead of stairs.
- Finishes: The text emphasizes the need for a "non-institutional" feel. The BOQ should specify warm, durable finishes like vinyl wall coverings and carpeting (where appropriate) rather than traditional institutional materials like glazed block.
-

Chapter 4: Health (Part 8 of 10)

Overview

This part provides an in-depth architectural guide to the design of comprehensive Rehabilitation Centers. It moves beyond general concepts to detail the specific spatial, environmental, and equipment requirements for the core therapeutic departments. The section covers Physical Therapy, with a focus on separating wet (hydrotherapy) and dry (exercise) areas and the structural needs for specialized equipment. It then details Occupational Therapy and the crucial "Activities of Daily Living" (ADL) suite, which simulates a home environment for retraining patients. The analysis continues with facilities for Speech and Hearing, including highly technical standards for acoustic isolation, and concludes with a guide to vocational training areas and the specific, code-driven requirements for accessible parking for the handicapped.

Key Standards and Codes Referenced

This section is based on best-practice guidelines from professional organizations and government agencies of the era, including:

- Joint Committee of the American Hospital Association and the American Physical Therapy Association.
- American Occupational Therapy Association.
- U.S. Public Health Service standards.
- Early accessibility standards that form the precursor to modern codes like the ADA.

Section: Physical Therapy (PT) Department (Pages 461-464)

Overview

This section details the layout of the PT department, which is organized into distinct functional zones. The design must accommodate a wide range of therapeutic activities, heavy equipment, and patients with significant mobility impairments.

Technical Specifications

- Treatment Cubicles: Curtains are preferred over solid partitions for flexibility. Each cubicle must be large enough for a therapist to work on either side of a treatment table.
- Gymnasium: Requires a minimum clear ceiling height of 14 ft. Must be designed to accommodate group activities like wheelchair volleyball and basketball.
- Hydrotherapy: This is the most technically complex area.
    - Floors: Must be unglazed ceramic tile with integrated floor drains.
    - Structure: The structure must be designed for the heavy loads of water-filled tanks.
    - Ceilings: Minimum height of 9 ft 6 in to accommodate overhead monorails and lifts.
    - Ventilation: Humidity reduction and robust air conditioning are essential.
- Pools & Tanks:
    - Therapeutic Pool Depth: Graduated depth from 2 ft to 5 ft. A continuous gutter is required for patient use and attaching plinths.
    - Overhead Monorail & Hoist: Essential for patient lifts into Hubbard tanks. Must have a specified lifting capacity (e.g., 800 lbs as shown in Fig. 8).

Visual Elements Analysis

Figure 6: Treatment cubicles and examination room (Page 462)

Description: A floor plan showing a row of treatment cubicles adjacent to a patient scheduling office. Technical Details: The cubicles are arranged along a corridor labeled "PORTABLE EQUIPMENT." Each cubicle is shown with a treatment table. The layout emphasizes an efficient flow from the central patient scheduling area to the individual treatment spaces.

Figure 7: Exercise Area (Gymnasium) (Page 463)

Description: A detailed floor plan of a PT gymnasium. Technical Details: The open area is zoned for different activities and includes permanently installed equipment along the walls: Stall Bars, Mirror, Gym Mat Hooks, Shoulder Wheel, and Shoulder Weights. A Stationary Bicycle is shown in the open floor area. Perimeter storage closets are provided.

Figure 8: Whirlpools and tank room (Page 464)

Description: A detailed plan of the hydrotherapy ("wet") area. Technical Details: The plan shows a large Therapeutic Tank & Pool, a smaller Immersion Tank, and a bank of Whirlpool Tanks. A key feature is the Overhead Monorail, Electric Trolley & Hoist, with a specified capacity of 800 lbs, running over the tanks. A Thermostatic Mixing Valve & Remote Control Panel is specified to ensure water temperature safety.

BOQ Implications

- Structural: The BOQ must include specifications for a reinforced floor slab in the hydrotherapy area to support the weight of water-filled tanks. It must also include structural steel and anchorage for the overhead monorail/hoist system.
- MEP: This section requires extensive and specialized MEP work. The BOQ must include high-capacity hot water heaters, thermostatic mixing valves, specialized plumbing for tanks (including large drains), and a robust HVAC system with dehumidification for the hydrotherapy area.
- Specialty Equipment: The BOQ will have numerous line items from Division 11 (Equipment), including whirlpool tanks, Hubbard tanks, patient lifts, parallel bars, stall bars, and other therapeutic devices.

Section: Occupational Therapy (OT) & Activities of Daily Living (ADL) (Page 465)

Overview

This section focuses on OT, which uses creative and manual arts to restore function, and the ADL suite, a critical component for training patients to live self-sufficiently.

Technical Specifications

- Location: OT should be adjacent to PT, as many patients use both services.

- ADL Suite: A simulated home environment used for training. Must include a functional kitchen, bathroom, and bedroom.

Visual Elements Analysis

Figure 9: Occupational Therapy Relationship Diagram (Page 465)

Description: A bubble diagram showing the central role of OT. Technical Details: The diagram shows "ACTIVITIES OF DAILY LIVING" as a core component, connecting to workshops for Ceramics, Typing, Weaving, Painting, and Sewing. It also shows relationships to Vocational Evaluation, Physical Therapy, and the Nursing Unit.

Figure 10: Activities of daily living (Page 465)

Description: Detailed floor plans of the three key components of an ADL suite. Technical Details:

- Kitchen: A compact U-shaped kitchen with a range, sink, and refrigerator.
- Bedroom: A standard bedroom layout with a bed, dresser, and lamp.
- Bathroom: Shows two different accessible bathroom layouts, one with a tub and one with a shower, both equipped with grab bars. Construction Notes: The ADL suite must be built to be fully accessible, with clearances for wheelchairs, roll-under counters in the kitchen, and a full complement of grab bars in the bathroom.

Section: Speech & Hearing, Social/Vocational Adjustment (Pages 466-472)

Overview

This section details the highly technical requirements for audiology testing rooms and the workshop-like environments needed for vocational training and sheltered workshops.

Technical Specifications

- Audiometric Testing Room (Acoustics):
    - Performance Standard: Must achieve an overall residual noise level of not more than 30 decibels on the "C" scale.

    - Construction: Requires a "floating room" design, where the inner room is structurally isolated from the main building to prevent sound conduction. The subfloor is often depressed to eliminate a step at the entrance.
- Observation Window: Must be constructed of three pieces of glass of different thicknesses and installed non-parallel to each other to break up sound waves.
- Vocational Shops: Require heavy and noisy equipment. Isolation is essential for noise control and reduction of fire hazard.

Visual Elements Analysis

Figure 12: Plan of typical audio-testing area (Page 467)

Description: A detailed plan and section of an audiology suite, illustrating the "floating room" concept. Technical Details:

- Plan: Shows the Control Room (for the audiologist) separated from the acoustically isolated Test Room by a sound-proof door and the special observation window.
- Section: This is the most critical detail. It shows the Test Room constructed as a box-within-a-box. The inner room's floor, walls, and ceiling are separated from the main structure by an air gap and supported on resilient pads to achieve acoustic isolation. A vent silencer is shown for the HVAC supply. Construction Notes: This is a highly specialized and expensive type of construction requiring expert design and execution to meet the specified decibel rating.

Figure 18: Vocational Training Diagrams (Page 471)

Description: A series of diagrams illustrating the layout and equipment for various vocational training shops. Technical Details: Shows dedicated areas for:

- Commercial: Typing, calculating, mail.
- Drafting: Drafting tables, paper cutters.
- Repairmen: Watch repair, camera repair, shoe repair.
- Arts and Crafts: Ceramics, metal work, weaving.
- Building Trades: Carpentry, plumbing, masonry. BOQ Implications: This section requires a vast inventory of specialized shop equipment (lathes, saws, kilns, etc.) to be included in the FF&E package.

Section: Parking for the Handicapped (Pages 473-475)

Overview

This section provides specific, dimensioned standards for accessible parking, which are critical for any health facility.

Technical Specifications

- Stall Width: 12 ft 0 in wide.
- Stall Length: 20 ft 0 in long.
- Aisle/Safety Zone: An adjacent aisle or safety zone at least 4 ft 0 in wide is required to allow room for wheelchair transfer.
- Curb Ramps: Must have a maximum slope of 1:12.
- Relationship to Entrance: Accessible parking must be located on the shortest possible route to an accessible building entrance.

Visual Elements Analysis

Figure 20: Parking space for cars operated by disabled persons (Page 475)

Description: A detailed plan of an ideal accessible parking space. Technical Details: The diagram shows a 12'-0" wide parking stall adjacent to a 4'-0" wide hatched safety aisle. A curb cut with a 1 on 8 max slope provides access to the adjacent sidewalk. The international symbol of accessibility is shown on a sign.

BOQ Implications

- Site Work: The BOQ must reflect the requirements for wider parking stalls, specific pavement markings (hatching, accessibility symbol), concrete work for curb ramps, and the installation of regulatory signage. These are all specific line items in the site construction division.
-

Chapter 4: Health (Part 9 of 10)

Overview

This part of the chapter addresses the architectural requirements for facilities serving two distinct ends of the life spectrum: the elderly in Nursing Homes and children in Child Health Stations. The Nursing Home section introduces a sophisticated, patient-centered design methodology, categorizing residents by their level of physical and mental disability to create tailored environments. The Child Health Station section provides a functional layout for a community-based pediatric clinic. Finally, the section on Youth Treatment Centers outlines the programmatic and spatial needs for community-based residential facilities for adolescents, emphasizing a non-institutional, therapeutic environment.

Key Standards and Codes Referenced

- "How to Plan for Extended Care Service," by Michael B. Miller and William N. Breger, *Modern Hospital*, October 1966. (Primary source for the patient-categorized design criteria for nursing homes).
- N.Y.C.H.A. (New York City Housing Authority) Memo to Architects: Source for the Child Health Station plan.

Section: Nursing Homes (Pages 482-487)

Overview

This section presents an advanced approach to nursing home design, arguing against a one-size-fits-all model. It proposes that the architectural program should be based on a clinical assessment of the patient population, divided into four distinct groups based on their physical and behavioral capabilities. This methodology generates different design requirements for the nursing units serving each group.

Technical Specifications

Patient Population Categories

- Group I - Physically Disabled (15-25%): Physically disabled but emotionally and intellectually intact. Can socialize in an unsupervised environment.
- Group II - Mentally and Physically Disabled (25-30%): Severe physical disabilities combined with organic brain disease. Require total nursing care and major supervision.
- Group III - Custodial (15-25%): Moderate or no physical handicaps with minimal emotional/social disabilities.
- Group IV - Mentally Disabled (30-50%): Minimal physical disabilities but major emotional/social disabilities (e.g., senility). Require maximum supervision.

Design Requirements per Group (from Tables 1-4, Pages 483, 484)

- Community Room:
    - Unsupervised for Group I & III.

    - Supervised for Group II & IV.
- Exterior Environment:
    - Unsupervised for Group I & III.
    - Supervised for Group II & IV.
- Toilets:
    - Group I & II require accessible toilets (20-22 in. from floor); Group III & IV can use conventional toilets.
- Bathing:
    - Supervised for all groups except Group I.
    - Location for Group III can be convenient, not necessarily near the nurses' station.
- Storage:
    - Groups I & II (wheelchair users) require increased horizontal storage.
    - Groups III & IV can utilize increased vertical storage.

Visual Elements Analysis

Figure 1: Ratio of beds to population served (Page 482)

Description: A pie chart showing the distribution of hospital beds per 1,000 population. Technical Details: Out of a total of 13.2 beds/1,000 people:

- LTC (Long Term Care): 4.2 beds (General & Chronic)
- Psychiatric: 7.6 beds
- TB & Other: 0.6 & 0.8 beds This chart establishes the statistical importance of long-term care facilities in the overall health system.

Figures 3, 4, 5, 6: Nursing Unit Plans by Patient Group (Pages 483, 484)

Description: Four schematic nursing unit plans, each designed to meet the specific needs of one of the four patient groups. Technical Details:

- Figure 3 (Group I): The plan is very open, with direct access from the community room (CR) to an outdoor environment (E).
- Figure 4 (Group II): The community room (CR) is enclosed and directly supervised by the nurses' station (NS).
- Figure 5 (Group III): The plan is highly efficient, with a compact nursing core (ns) and a more remote, unsupervised community room.
- Figure 6 (Group IV): The community room is again enclosed and directly observable from the nurses' station, reflecting the need for maximum supervision of this patient group.

Table 5: Typical Regulatory Requirements for LTC Facilities (Page 487)

Description: A detailed table listing standard equipment and space requirements for nursing homes as dictated by regulation. Technical Details:

- Room Sizes: Single (125 sq ft), Multi-bedded (100 sq ft per bed).
- Nurses' Station: Minimum 6 linear ft of counter space.
- Workrooms: Differentiates between a Clean Workroom (for clean supplies) and a Soiled Workroom (with a clinical sink/bedpan flusher). Minimum size 8 ft x 6 ft.
- Bathing: Requires one shower stall or bathtub for each 15 beds not individually served.

Section: Child Health Station (Page 489)

Overview

This section provides a functional space organization diagram and equipment list for a community-based pediatric clinic, as designed by the New York City Housing Authority.

Technical Specifications

- Core Components: Waiting Room, Public Toilet, Nurse's Office, Doctors' Offices, Weighing/Undressing Room, Consultation Room, Staff Room/Toilet, and Utility Room.
- Equipment:
  - Waiting Room: Includes a play pen, small chairs/table, and bookshelves (36 in. high).
  - Public Toilet: Must have one normal-sized toilet and one child's toilet, with the lavatory set at 28 in from floor.
  - Weighing/Undressing Room: Requires a table, bench-type clothes hamper, and 25 cubicles.

Visual Elements Analysis

Figure 1: Child Health Station Space Organization (Page 489)

Description: A detailed bubble diagram illustrating the circulation and functional adjacencies of the clinic. Technical Details: Shows a clear flow for patients: from the Carriage Shelter and Vestibule into the main Waiting Room. From waiting, they proceed to the Weighing/Undressing room and then to an Anteroom that provides access to the two Doctors' Offices. Staff have a separate, controlled circulation path that connects the offices, staff room, and utility areas.

Section: Youth Treatment Centers (Pages 490-491)

Overview

This section introduces the design principles for community-based residential treatment centers, a concept derived from the "halfway house" model. The focus is on creating a non-institutional, residential environment that uses peer group interaction as a primary therapeutic tool.

Technical Specifications

- Capacity: Optimum size is 21 to 30 residents. The illustrative program is for a 21-bed unit.
- Programmatic Goal: Treatment, not punishment. The environment should simulate a home, not an institution.
- Area Requirements (Illustrative 21-Bed Unit):
  - Bedrooms: 2,100 sq ft (21 rooms @ 100 sq ft each).
  - Dining Room: 600 sq ft (for 30 people, family-style service).
  - Lounge & Recreation: 600 sq ft each.
  - Administration: Director's office, secretary/reception, interview offices.
  - Support: Kitchen, laundry, storage.
  - Staff Quarters: A 1,500 sq ft Director's apartment with a private entrance is included in this program.
- Net Total Area: 7,025 sq ft.
- Gross Total Area: 10,725 sq ft (Gross = 1.5 x Net).

BOQ Implications

- Patient-Specific Design: The varied requirements for the four nursing home groups mean the BOQ will differ significantly between units. Group I & II units will have higher costs for accessible fixtures (toilets, grab bars, roll-in showers). Group II & IV units will have higher costs for finishes and hardware due to the need for more durable, supervised environments.
- Residential vs. Institutional Construction: Youth Treatment Centers are designed to feel like homes. The BOQ will specify residential-grade (though heavy-duty)

finishes, furniture, and fixtures rather than more expensive institutional-grade products.
- Specialty Equipment: The Child Health Station requires specialized pediatric equipment (child-sized toilets, scaled furniture), which must be detailed in the FF&E section of the BOQ.

Critical Notes and Warnings

- Design for Supervision: The nursing home and youth center plans highlight the critical role of architecture in facilitating supervision. Nurses' stations are placed for maximum visual control of corridors and community rooms.
- Patient-Centered Programming: The nursing home section is a prime example of evidence-based design. Instead of using a generic template, the architect should base the design on a clinical analysis of the specific patient population to be served.
- Avoiding an Institutional Feel: A recurring theme is the need to create a humane, comfortable, and non-institutional environment. This is achieved through careful selection of finishes, colors, furniture, and by providing access to outdoor spaces and views.
-

Chapter 4: Health (Part 10 of 10)

Overview

This concluding part of the chapter provides an exhaustive and highly detailed guide to the architectural planning of Medical and Dental Schools. These are presented as some of the most complex building types, functioning as integrated ecosystems of teaching, research, and clinical care. The section outlines site planning considerations, functional relationships between departments, and introduces the concept of modular design for flexibility. It provides extensive space allocation tables and detailed floor plans for every major department, from gross anatomy and biochemistry to clinical operatories and specialized laboratories.

Key Standards and Codes Referenced

- Public Health Service, U.S. Department of Health, Education, and Welfare, 1964: Source for Medical School Facilities planning guide.
- Public Health Service, U.S. Department of Health, Education, and Welfare, 1962: Source for Dental School Facilities planning guide.

Section: Medical Schools (Pages 490-507)

Overview

This section details the planning of a complete medical school, which is comprised of three major, interconnected components: basic science facilities, clinical science facilities, and a teaching hospital. The design must accommodate the complex circulation of students, faculty, patients, and materials between these zones.

Technical Specifications

Planning & Area Programming

- Site Size: 50 acres minimum; 120 acres may be required if an animal farm is included.
- Modular Design: The use of a standard planning module is emphasized for flexibility, especially in research laboratories.
- Space Allocation Tables: The section provides numerous detailed tables specifying the net area for every department and sub-unit, based on two hypothetical schools:
  - School A: Entering class of 64 students.
  - School B: Entering class of 96 students.
- Table 15: Summary of Space Estimates for Basic Science Facilities:
  - Total Net Area (School A): 99,000 sq ft.
  - Total Net Area (School B): 119,000 sq ft.
- Table 22: Summary of Space Estimates for Clinical Science Facilities:
  - Total Net Area (School A): 45,000 sq ft.
  - Total Net Area (School B): 52,000 sq ft.

Laboratory Design

- Conventional Labs: Each department has its own dedicated teaching lab.
- Multidiscipline Labs: A more modern concept where students are assigned a permanent workspace and instructors from different disciplines rotate through. This is more space-efficient.
- Lab Benches: Differentiated by function:
  - Sit-down benches (31 in. high) for microscopy (e.g., pathology, histology).
  - Stand-up benches (37 in. high) for chemistry, physiology, etc.

- Anatomy Dissection Room: Requires one dissecting table for every four students, specialized lighting, ventilation with 100% air exhaust, and durable, waterproof finishes.

Visual Elements Analysis

Figure 8: Diagram for a department of anatomy (Page 498)

Description: A block plan illustrating the layout of an entire anatomy department based on a 16-module grid. Technical Details: Shows a large Gross Anatomy teaching laboratory flanked by a Graduate Student lab, special projects rooms, and departmental offices. It demonstrates the modular planning principle, with each office or small lab occupying one or more standard modules.

Figure 12: Diagram for a department of pathology (Page 504)

Description: A block plan for a pathology department. Technical Details: This plan shows a central teaching laboratory surrounded by numerous support spaces, including a dedicated Autopsy & X-Ray room, a Gross Pathology Conference room, a Photo Room, Darkroom, and a large Tissue Staining and Embedding suite. This highlights the extensive support infrastructure required for pathology.

Figure 15: Diagram for a department of surgery (Page 507)

Description: A block plan for a surgery department. Technical Details: This plan consists almost entirely of offices and research labs, as the primary "teaching" space for surgery is the hospital operating room. It shows office modules for General Surgery, Orthopedics, Urology, Anesthesiology, and Neurosurgery, along with associated research labs.

BOQ Implications

- Area Programming: The extensive tables (Tables 8-22) are a primary tool for programming the entire square footage of a medical school. The BOQ's architectural quantities (walls, floors, finishes) are derived directly from these area allocations.
- Casework: A massive component of the BOQ. Must include hundreds of linear feet of specialized laboratory casework, including acid-resistant countertops, reagent shelves, fume hoods, and cabinets with integrated sinks and utility connections.
- MEP: Extremely complex. The BOQ must account for a vast network of piped services (hot/cold/distilled water, gas, air, vacuum) to every lab station. Specialized, high-volume HVAC systems with 100% exhaust are required for anatomy labs and autopsy rooms.

- Fixed Equipment: The BOQ will include a large inventory of fixed medical and scientific equipment, such as autoclaves, sterilizers, walk-in cold rooms and freezers, electron microscopes, and crematory equipment.

Section: Dental Schools (Pages 511-527)

Overview

This section provides a similarly detailed guide to the design of dental schools. While sharing some features with medical schools (basic science labs), the dental school has a unique and central component: the teaching clinics. The design is heavily influenced by the need to manage a large volume of public patients and to provide complex, chair-side utility connections.

Technical Specifications

Planning & Space Relationships

- Zoning: The design must separate the preclinical laboratories (for 1st and 2nd-year students) from the clinical facilities (for 3rd and 4th-year students and patient care).
- Circulation: Patient traffic must be carefully controlled and separated from student and staff traffic. A central reception and records area is the control hub for all clinical activity.
- Modular Planning: The concept is applied to preclinical labs and research areas. A standard module of 4 ft 8 in is used.

Clinic & Laboratory Design

- Preclinical Laboratory: A multidiscipline lab where students practice on manikins (dextors). Benches can be arranged back-to-back for space efficiency or with all students facing forward for better demonstration viewing. Each station requires gas, air, and duplex electrical receptacles.
- Cubicle Clinic: The preferred design for clinical teaching.
    - Size: Cubicles range from 6 ft 4 in x 7 ft to 7 ft 6 in x 9 ft 6 in.
    - Partitions: A partition height of 5 ft is recommended to provide patient privacy while allowing for instructor supervision.
- Space Allocation: At least two operating positions should be provided for every entering class student (one in the general clinic and one in the various special clinics).

- Space per Operatory:
  - Diagnostic Clinic: 85 sq ft per position.
  - Radiology Clinic: 115 sq ft per position.
  - Clinic for Chronically Ill/Handicapped: 125 sq ft per position.
  - General/Specialty Clinics: 100 sq ft per position.

Visual Elements Analysis

Figure 1: Space relationships: preclinical and clinical dental science areas (Page 511)

Description: A key bubble diagram illustrating the overall organization of a dental school. Technical Details: Shows a clear separation of functions. The "Preclinical Technic Lab" is grouped with lecture rooms and lockers for freshmen/sophomores. The main "Clinic Lab" is the hub for junior/senior students and all patient-facing activities, including specialty clinics and oral diagnosis.

Figure 2: Building module (Page 512)

Description: A detailed section through a typical laboratory/operatory module.

- Section Thru Operatory: Shows a dental chair with optional ceiling-mounted services.
- Section Thru Modular Laboratory: Shows a lab bench with a sink, backed by a utility chase contained within a 2'-6" wide partition.
- Section Thru Office Unit: Shows a standard office layout within the modular bay.

Figure 7: Layout of anatomy laboratory of class size (Page 517)

Description: A detailed floor plan for a gross anatomy lab in a dental school. Technical Details: The layout features rows of dissecting tables, a perimeter bench with sinks, a chalk board for demonstrations, and an observation control area with one-way glass for unobtrusive viewing. This plan is designed for maximum efficiency and hygiene.

Figure 12 & 13: Cubicle Clinic Layouts (Page 521)

- Figure 12: Shows a large clinic floor with 96 cubicles arranged in a clear span with no columns. A central teaching module is included. The plan requires 9,240 sq ft.
- Figure 13: Shows an alternative with a center row of columns, which is less flexible but may be more structurally efficient.

BOQ Implications

- Dental Equipment: This is the largest and most complex component of the BOQ. It includes a full inventory of dental chairs, operating units, sterilizers, x-ray machines, casting machines, model trimmers, and instrument cabinets for every operatory and lab position.
- MEP: The MEP systems for a dental school are exceptionally complex. The BOQ must account for providing a multitude of services to each individual dental chair: hot/cold water, drainage, compressed air, vacuum, gas, and multiple electrical circuits. The coordination of this underfloor or in-slab utility network is a major construction challenge.
- Casework: Requires extensive custom casework for preclinical labs, clinical labs (e.g., plaster bins, processing counters), and sterile supply areas.
- Radiation Shielding: The BOQ must specify lead lining for all walls, floors, and ceilings of the radiology clinic.

Chapter 5: Religious (Part 1 of 4)

Overview

This initial part of the chapter covers the fundamental principles of modern church design, acknowledging a period of "liturgical renewal" that challenges traditional forms. It provides a guide to the planning process, from site selection to the functional and symbolic arrangement of the worship space. The section details various plan types (Rectangular, Cruciform, Central, L-shape), analyzes the critical relationship between the congregation and the altar, and discusses the location of the choir and organ. It includes specific design requirements for both General Protestant churches and those of the Lutheran and United Methodist denominations, supported by numerous floor plans and detailed drawings of liturgical furniture.

Key Standards and Codes Referenced

- "A Methodist Comment About Methodism," by Professor Albert C. Outler, *Worship and Christian Unity*, April 19, 1966.
- Publications of the Office of Architecture, National Division, Board of Global Ministries, the United Methodist Church.

Section: Churches, General (Pages 559-563)

Overview

This section establishes the foundational principles for contemporary church architecture. It emphasizes that a church is primarily a "gathering place for worship" and that its design should foster a sense of community and participation rather than creating a "performance" aspect. Key support spaces like the entry, vesting rooms, and sacristy are also defined.

Technical Specifications

Planning & Area Requirements

- Gross Area per Seat: For preliminary planning, allow 10 to 12 sq ft per seat. This includes space for the altar platform, sacristy, and vestibule. For the seating area alone (including aisles), allow 8 sq ft per person.
- Pew Seating:
  - Space per Person: 18 in (code minimum) to 22-24 in (usual comfort).
  - Back-to-Back Spacing: Average 36 in; Minimum 33 in.
- Aisles:
  - Center Aisle: Minimum 5 ft wide.
  - Side Aisles: Minimum 3 ft wide.
- Vesting Room: Vestments should be stored flat or hung no tighter than three per foot.
- Choir Robing Room: Robes should be stored no more densely than four per foot of hanging space.

Liturgical Furniture Dimensions (Page 564)

- Altar: Varies from 5 ft 6 in to 8 ft long by 28 to 48 in wide by 40 in high.
- Lectern/Pulpit: Width varies from 24 to 36 in. Depth is a minimum of 16 in.
- Communion Rail: Height should not exceed 36 in. Should have a broad top of 6 to 8 in.

Visual Elements Analysis

Figure 1: Church Plan Types (Page 560-561)

Description: A series of seven diagrams illustrating different architectural layouts for churches.

- (a) Rectangular: The most common plan, with a central aisle and the altar at the focal point.

- (b) Cruciform: A traditional cross-shaped plan. The diagram shows the altar at the transept (crossing).
- (c) Central: A hexagonal plan with the congregation arranged around a central altar, emphasizing intimacy and oneness.
- (d) L-Shape (Expandable): Shows a permanent chapel for 120 people that can be expanded into a larger hall for a congregation of over 600.
- (f) Multifocus: An innovative plan with multiple liturgical centers, designed to move the focus of the service around the space.
- (g) Parallel Seating: A unique arrangement where seating is arranged in parallel rows facing each other across a central axis containing the Bema and Ark.

Figure 2: Possible locations for the choir (Page 562)

Description: Five diagrams showing different choir placement options.

- (a) Behind Altar: Traditional, but can make choir members feel separated.
- (b) Before the Altar: Segregated but part of the congregation.
- (c) Rear of Church: Part of the congregation, similar to a choir loft but on the main floor.
- (d) Choir Alcove: A common and effective solution, placing the choir to the side of the chancel.
- (e) Within the Pews: A simpler version where the choir is integrated directly into the congregational seating.

Figure 3 & 6: Pew and Prie-Dieu Details (Page 563)

- Figure 3: Provides a detailed section of a Metal & Wood Pew, showing a 1'-6" seat depth and a max overall width of 2'-0".
- Figure 6: Shows the dimensions of a Prie-Dieu (kneeler), with a footprint of 1'-6" x 1'-6".

Section: Churches, Lutheran (Pages 565-569)

Overview

This section details the specific requirements for Lutheran church design. It provides a comprehensive checklist of all necessary spaces, from the church room itself to administrative offices, school facilities, and social halls. It emphasizes a unicameral space where the chancel is an integral part of the main church room, not a separate element.

Technical Specifications

- Narthex (Entry): Recommended to be at least 10 ft wide.
- Church Room Aisles: Center aisle not less than 5 ft wide; side aisles not less than 3 ft wide.
- Chancel: Should be raised three steps, each not more than 6 in high, with treads a minimum of 16 in wide.
- Classrooms: Not less than 24 by 32 ft.
- Kindergarten: Requires 30 sq ft per pupil.
- Social Hall: Ceiling should not be less than 14 ft high.
- Church Parlor: Not less than 24 by 14 ft.
- Parking: Requires one parking space for every five persons in the church room seating.

Visual Elements Analysis

Figure 1: Diagrammatic relation of elements (Page 565)

Description: A bubble diagram showing the ideal functional relationships in a Lutheran church complex. Technical Details: Shows a central Church building connected to separate but related wings for Educational, Administrative, and Social functions. Parking and a landscape scheme are shown as integral components.

Figure 2 & 3: Altar and Pulpit Details (Pages 566-567)

- Figure 2: A schematic plan and elevation of an altar, showing a 3'-0" x 9'-0" footprint.
- Figure 3: A schematic plan and elevation of a pulpit. The plan is an octagon with a 2'-0" opening. The Bible rest is 3'-1" high on the low side.

Figure 6: Choir Locations (Page 568)

Description: Five diagrams showing different choir layouts, similar to the general section but with specific liturgical elements labeled. Key: (1) Narthex, (2) church room, (3) chancel, (4) altar, (5) pulpit, (6) lectern, (7) baptistry, (8) choir space, (9) organ console, (10) minister's room, (11) sacristy, (12) organ loft. This legend is critical for understanding the plans.

Section: Churches, United Methodist (Pages 570-575)

Overview

This section outlines the planning principles for United Methodist churches, based on the axioms of Utility, Simplicity, Flexibility, and Intimacy. It emphasizes a corporate act of worship and recommends flexible seating arrangements over fixed pews.

Technical Specifications

- Space Needs:
  - Worship & Chancel: 12 sq ft / person.
  - Narthex: 2-3 sq ft / person.
- Aisle Widths for Various Liturgies (Fig. 4):
  - Funerals: 7'-0" center aisle (to allow pallbearers alongside the casket).
  - Weddings: 6'-0" center aisle.
  - Communion: 5'-0" front aisle.
  - Side Aisle: 3'-0".
- Seating (Flexible Chairs):
  - Row Spacing: 32" to 36" back-to-back.
  - Space per Person: 18" to 22".

Visual Elements Analysis

Figure 1: Site location (Page 570)

Description: A site plan diagram illustrating environmental considerations. Technical Details: Shows the orientation of the building relative to Winter Winds, Summer Sun, and Winter Sun. A Covered Drop-Off is provided, and parking is located to take advantage of shade trees.

Figure 7: Seating arrangements for optimum use of a Fellowship Hall (Page 575)

Description: A series of eight diagrams (A-H) showing how a single large fellowship hall can be flexibly arranged for a multitude of functions.

- (A) Maximum Dining: Rectangular tables for 264 people.
- (B) Assembly/Waiting: With a ticket desk and coat rack.
- (C) Round Table Dining: Round tables for 156-208 people, with a lounge area around a fireplace.
- (F) Youth Club: With markings on the floor for volleyball, four-square, etc., and areas for table games.
- (G) Theater-in-the-Round: Seating for 210 people in a circle around a central performance area.

- (H) Proscenium Performance: Seating for 350 people facing a stage set against the wall.

BOQ Implications

- Flexible vs. Fixed Seating: The choice between fixed pews and flexible chairs has significant cost implications for the BOQ. Pews are a high initial cost but durable. Individual chairs, especially stacking or folding types, are less expensive per unit but require extensive storage areas, which adds to the building's gross square footage.
- Acoustics: The texts emphasize that acoustics are critical. The BOQ must include specifications for sound-absorbing materials, but warns against "excessive use," which can create a "dead" space. The services of an acoustical consultant are recommended, which is a "soft cost" line item in the project budget.
- Liturgical Furnishings: Altars, pulpits, fonts, and communion rails are often custom-designed and fabricated pieces of high-quality millwork or stonework. They represent significant, specialized line items in the BOQ.
- Pipe Organs: The text warns that pipe organs are extremely expensive and require significant, dedicated space planned from the beginning. This involves not just the organ itself but also the construction of the organ chamber, which has structural and acoustic implications.
-

Chapter 5: Religious (Part 2 of 4)

Overview

This part of the chapter details the architectural requirements for Jewish places of worship and for Christian educational facilities. The section on Temples and Synagogues outlines the specific liturgical and social spaces required by Orthodox, Conservative, and Reform congregations, emphasizing the need for flexible, expandable sanctuaries to accommodate High Holy Day services. The section on Church Schools provides an exhaustive guide to programming educational spaces based on school size and the age of the students, from nursery through high school, supported by detailed data tables on room needs and equipment.

Key Standards and Codes Referenced

- "An American Synagogue for Today and Tomorrow," edited by Peter Blake, The Union of American Hebrew Congregations, New York, 1954.

- "Focus: Building for Christian Education," by Mildred C. Widber and Scott Turner Ritenour, United Church Press, Philadelphia, 1969.

Section: Temples and Synagogues (Pages 582-588)

Overview

This section describes the primary components of a synagogue, which serves as a center for worship, education, and social activity. It highlights the differences between Orthodox, Conservative, and Reform practices and their impact on design, particularly the location of the bimah and the seating arrangement.

Technical Specifications

Worship Area (Sanctuary)

- Orientation: Traditionally, the bimah platform is oriented to the east.
- Bimah Height: Varies from 24 to 36 in.
- Ark: The focal point, located on the rear wall of the bimah, housing the Torah scrolls. The ark platform is one or two steps above the bimah floor.
- Eternal Light: A constantly lit fixture suspended in front of and above the ark.
- Seating:
  - Permanent Seating: Typically accommodates 40% to 50% of the total congregation, at 10 sq ft per person.
  - Temporary/Overflow Seating: Folding or stacking chairs are used for High Holy Day services, at 6 to 7 sq ft per person.
  - Orthodox Seating: Men and women are seated in separate sections, often requiring a visual separation (a *mechitza*).
- Stage (for Social Hall): Minimum depth of 18 ft. Proscenium width of 24 ft. Minimum wing space of 10 to 12 ft.

Visual Elements Analysis

Figure 1: Flow diagram (Synagogue) (Page 582)

Description: A bubble diagram showing the functional relationships in a complete synagogue complex. Technical Details: The diagram is zoned into four primary areas:

- Worship: Sanctuary and Bimah.

- Social: Stage, Social Hall, Multipurpose Room, Lounge/Lobby.
- Education: Classrooms (CR) and an Activity Zone.
- Administration: Offices and Library. This diagram illustrates the "three-part" function of a synagogue as a house of worship, a community center, and a school.

Figure 2: Plan for a reform temple (Page 583)

Description: A detailed floor plan for a large Reform temple complex by architect Keith I. Hibner. Technical Details: This plan shows a large, expandable sanctuary (SEAT 400 expandable to SEAT 200) connected to a Social Hall (SH) and Chapel (CH). The complex includes a large wing of classrooms (CR), administrative offices (A), a library (LIB), and support facilities. This plan demonstrates the "master plan" concept, with clear provisions for future expansion.

Section: Chapels (Pages 589-591)

Overview

This brief section provides floor plans for chapels, typically smaller, more intimate places of worship found within larger institutions like military bases or universities.

Visual Elements Analysis

Figure 1 & 2: 150-Seat and 300-Seat Chapels (Pages 589, 590)

Description: Two detailed floor plans for chapels of different sizes, designed for the Department of the Navy. Technical Details: Both plans show a traditional rectangular layout with a central nave for seating. They include all necessary support spaces:

- Narthex/Foyer: With a font and storage.
- Chancel: With an altar, pulpit, and lectern.
- Sacristy: For preparing communion elements.
- Vestry/Robing Rooms: For the chaplain and choir.
- Confessionals: Small, private booths.
- Oratory: A small side chapel for private prayer.

Section: Church Schools (Pages 592-599)

Overview

This is an exhaustive guide to programming and designing educational facilities within a church. It provides detailed data on the number and type of rooms needed based on the total size of the church school and the specific age group being served.

Technical Specifications

- Kindergarten: Requires 30 sq ft per pupil, with a maximum class size of 20 children.
- Toilet Fixtures (Preschool):
  - Toilets: 10 in high.
  - Washbasins: 24 in high.
- Wrap/Coat Storage: Rod hangers are preferred over hooks.
  - Nursery II (age 2): Rod height 30 in.
  - Nursery III (age 3): Rod height 36 in.
  - Kindergarten (ages 4-5): Rod height 42 in.
- Youth Classrooms (Junior/Senior High):
  - Space per Pupil: 15-18 sq ft (good); 12-15 sq ft (fair); 10-12 sq ft (poor).
  - Maximum class size: 20-25 pupils.

Visual Elements Analysis

Table 1 & 3: Rooms Needed for Preschool Children (Pages 592, 594)

Description: Two tables that correlate the size of the church school (from "Very small, 1-99 pupils" to "Very large, 900 or more pupils") with the number and type of rooms required for preschool children. Example:

- A school with 100-299 pupils needs one room for Nursery III (age 3).
- A school with 500-899 pupils needs three separate rooms for Nursery III. This data is essential for the initial programming of an educational wing.

Table 2: Summary - School Equipment (Page 594)

Description: A detailed chart specifying the appropriate furniture, display space, and other materials required for different preschool age groups. Technical Details:

Age Group	Furniture	Display Space	Other Materials
Nursery I (under 2)	Cribs, playpens	Grooved picture rail 14 in. above floor	Movable, ample cabinets
Nursery II (age 2)	Chairs 8" high, Tables 18" high	Grooved rail 17 in. above floor	Large blocks, floor toys, books, cuddly toys
Kindergarten (ages 4-5)	Chairs 10" high, Tables 20" high	Tack board 24-54 in. above floor	Housekeeping toys, paper scissors, crayons

Table 6 & 8: Rooms Needed for Youth and Adult Divisions (Pages 596, 598)

Description: These tables provide the same programmatic data as above, but for Junior High, Senior High, and Adult education classes. Example (Table 6):

- A school with 300-499 pupils requires a Department Assembly Room plus two classrooms for its Junior High division.
- A school with 900 or more pupils requires three separate departments (one for each grade), each with its own Assembly Room and classrooms.

Table 7 & 9: Summary of Space and Equipment for Youth/Adults (Pages 597, 598)

Description: These tables specify the space per person and the necessary furniture for youth and adult classes. Technical Details:

- Youth (Table 7): Requires 15-18 sq ft per person and lightweight, flexible tables and chairs.
- Adults (Table 9): Requires 8-10 sq ft per person for a lecture-style setup, or 10-12 sq ft for an activity-based setup.

BOQ Implications

- Flexible Partitions: The need to combine sanctuaries and social halls for overflow seating requires the specification of expensive, acoustically-rated movable or folding partitions in the BOQ.

- Specialty Furnishings: The BOQ for synagogues must include custom, high-quality millwork for the Ark and other bimah furniture.
- Age-Specific Fixtures: The Church School section requires the BOQ to specify plumbing fixtures (toilets, sinks) and casework at multiple different heights to accommodate various age groups, which adds complexity to the plumbing and millwork packages.
- Storage Casework: All sections, but particularly Church Schools, emphasize the need for extensive storage. The BOQ must quantify a large amount of cabinetry, shelving, and closets for everything from hymnals and robes to classroom supplies and toys.
-

Chapter 6: Governmental and Public (Part 1 of 4)

Overview

This initial part of the chapter covers the architectural and functional requirements for three fundamental types of public and governmental buildings: City and Town Halls, Courthouses, and Fire Stations. The section on City Halls discusses the pros and cons of standalone buildings versus integrated civic centers and outlines the key steps in programming and design. The Courthouses section provides a highly detailed analysis of the spatial and procedural requirements for general trial courts, including jury and nonjury trials. Finally, the Fire Stations section details the specific design needs for urban and rural stations, focusing on apparatus storage, personnel quarters, and training facilities.

Key Standards and Codes Referenced

- "Planning the New City Hall," Report #212, Management Information Service, International City Managers' Association, Washington, D.C., September 1961.
- "Are Civic Centers Obsolete?", by Richard A. Miller, *Architectural Forum*, January 1959.
- "The American Courthouse: Planning and Design for the Judicial Process," The American Bar Association and The American Institute of Architects Joint Committee on the Design of Courtrooms and Court Facilities, 1973.
- "Fire Protection Handbook," National Fire Protection Association-International, Boston, Mass., 1969.

Section: City and Town Halls (Pages 603-607)

Overview

This section serves as a programming guide for municipal officials planning a new city hall. It emphasizes a functional approach, treating the city hall as an office building, not a monument. Key considerations include determining space needs, the debate between centralized civic centers and dispersed facilities, and the specific layouts for key departments.

Technical Specifications

- Design Principles (Dos and Don'ts):
  - DO locate for convenience and provide ample parking.
  - DO plan for structural expansion and flexible office layouts.
  - DON'T try to remodel an old building designed for another purpose (e.g., post office, school).
  - DON'T underestimate space needs; the average commercial office building lasts 67 years.
  - DON'T build over two stories in height if possible, as taller buildings are harder to maintain and require elevators.
- Civic Center Concept:
  - Advantage: Convenient for the public transacting business with multiple agencies.
  - Disadvantage: Fire and police stations are often best located at a central point in the street network, which may not align with the best location for administrative offices.
- Council Chamber Design: The council table is often on a dais 18 in to 2 ft above the main floor.

Visual Elements Analysis

Figure 1: Alhambra, California, City Hall (Page 605)

Description: Detailed first and second-floor plans of a mid-size city hall. Technical Details:

- First Floor: Is public-facing, containing the departments with the most public contact: Public Service (Water Dept.), Engineering, Accounting, and the City Treasurer/Clerk. A large central lobby facilitates circulation.

- Second Floor: Houses the primary administrative and legislative functions: Council Chamber, Conference Room, and offices for the City Manager and department heads (Personnel, Purchasing). An Employee Lounge is also provided. Construction Notes: This plan demonstrates effective zoning by placing high-traffic public departments on the ground floor and more secure, administrative functions on the floor above.

Figure 2: City Council seating arrangement, La Mesa, California (Page 606)

Description: A diagram showing a typical layout for a city council chamber. Technical Details: Shows a semicircular dais with individual desks for the Mayor and Councilmen. The City Manager, City Attorney, and City Clerk are seated at a table in front of the council. The press is given a dedicated area. This arrangement provides clear sightlines for the public and facilitates interaction between council and staff.

Section: Courthouses (Pages 608-627)

Overview

This is a highly detailed section on the planning and design of general trial courthouses. It breaks down the judicial process into its component parts and provides spatial diagrams based on communication patterns and functional adjacencies for jury trials, non-jury trials, and informal hearings. The latter part of the section provides specific space and furnishing requirements for each component of a U.S. District Court.

Technical Specifications

Unit Space Requirements of the Courtroom (Table 1, Page 609)

Description: A table quantifying the space required for each participant in a courtroom.

Participant	Furniture Area (sq ft)	Movement Area (sq ft)	Total Area (sq ft)
Judge	20-25	25-30	45-55

Attorney	15-18	17-22	32-40
Juror	4-5	4-5	8-10
Witness	7-9	8-11	15-20

Courtroom Accessibility & Zoning

- Principle: The design must separate three distinct groups: the public, the court staff/jurors (private), and prisoners (secure).
- Figure 7: Shows an optimal access plan. The public enters directly into the observation area. The judge and court staff enter from a private corridor into the front of the courtroom. The jury enters from a separate private space directly into the jury box. Prisoners enter through a separate detention space near the bailiff's station.

District Court Components (Pages 616-627)

- Courtroom: Minimum size 38.5 ft x 58.5 ft.
- Judge's Suite: Judge's office (min. 750 sq ft), library, reception room, and secretary's office.
- Petit Jury Room: Minimum area 350 sq ft. Must accommodate a table (120"x48") and 14 armchairs. Requires a coat closet and separate men's and women's toilets.
- Grand Jury Suite: Grand jury room (min. 600 sq ft) and a separate witnesses' room (min. 300 sq ft).
- U.S. Attorney's Suite: Includes offices for the U.S. Attorney (min. 300 sq ft), assistants (min. 180 sq ft each), a conference room, reception area, and library.
- U.S. Marshal's Suite: Includes offices, a vault, fingerprinting room, and detention cells.

Visual Elements Analysis

Figure 2: A total communication system for jury trials (Page 609)

Description: A "spider web" diagram illustrating the frequency and importance of communication lines between participants in a jury trial. Technical Details: The thickest lines (most critical communication) are between the Judge, Attorneys, and Witness. The jury, clerk, and reporter are secondary nodes. This diagram is the basis for the physical layout of the courtroom.

Figure 9 & 10: Spatial disposition for nonjury trials (Page 612)

Description: A communication diagram and a plan showing a courtroom arranged for a non-jury trial. Technical Details: With the jury box removed, the space becomes more compact. The attorneys and parties can move closer to the judge's bench, creating a more direct and less adversarial arrangement. Figure 10 shows the addition of visual equipment, including a camera for video recording and monitors.

Figure 1: District courtroom (Page 617)

Description: A detailed, dimensioned floor plan of a U.S. District Courtroom. Technical Details:

- Dimensions: 58'-7" long x 38'-6" wide. Minimum ceiling height is 14'-0".
- Layout: Shows the precise arrangement of the judge's bench, witness stand, clerk and reporter stations, jury box (for 14), and public seating area.
- Furniture: Specifies fixed jury seating, a movable lectern, and fixed public benches.

Section: Fire Stations (Pages 628-630)

Overview

This section outlines the design requirements for fire stations, covering both paid and volunteer departments. The primary design driver is minimizing response time, which dictates the layout of the apparatus bay in relation to personnel quarters.

Technical Specifications

- Apparatus Room:
  - Width: 20 ft per track (for multi-track stations); 24 ft (for single-track stations).
  - Depth: 80 ft (suggested desirable).
  - Ceiling Height: 13 ft (minimum).
  - Floor: Concrete, designed to carry a load of 125 psf.
- Apparatus Doors: Must provide a clear opening of at least 14 ft x 14 ft.
- Parking: Off-street parking is required for each fireman on duty.

Visual Elements Analysis

Table 1: Fire apparatus sizes (Page 628)

Description: A table providing the overall dimensions of various types of fire trucks.

Apparatus Type	Length	Width	Height	Clearance
Pumping Engine (750 gpm)	28'-0"	8'-0"	6'-11"	
Hook-and-Ladder Aerial	58'-9"	8'-0"	8'-7"	
Tractor-Drawn Aerial	63'-6"	8'-0"	8'-7"	12'-0"

Figure 1: Elements of a firehouse (Page 629)

Description: A bubble diagram showing the key functional components of a fire station. Technical Details: The "Apparatus Room" is the central element. It is directly connected to the Watch Room, Dormitory, Lockers, Repair Shop, Hose Drying Tower, and administrative offices.

Figure 4 & 5: Urban and Rural Fire Station Plans (Pages 630)

- Figure 4 (Urban): An elevation and plan for a large, multi-company urban station. It features a two-story section for quarters and offices, a drive-through apparatus bay, and a separate garage for the District Chief's car.
- Figure 5 (Rural): A smaller, single-story station designed for future expansion. It shows a two-track apparatus bay with space for a backup pumper and water tanker. The dotted lines indicate a "Future Expansion" area for both the apparatus bay and offices.

BOQ Implications

- Specialty Construction: Courthouses require extensive, high-quality architectural millwork for judges' benches, railings, and wall paneling. Secure detention areas require specialized doors, locking hardware, and security glazing.
- Apparatus Bay Construction: Fire stations require a large, open-span apparatus bay with a high ceiling. The BOQ must specify a robust structural system (e.g., steel trusses) to achieve this. The floor slab must be specified for heavy vehicle loads (125 psf) and must include integrated trench drains.

- Specialty Doors: Fire station apparatus doors are a major cost item. They must be large (14'x14'), heavy-duty, and equipped with high-speed motorized operators.
- Acoustics: Courthouses require significant acoustical treatment, especially in the courtroom, to ensure speech intelligibility. This includes acoustic ceiling tile, wall panels, and potentially carpeting, all of which must be quantified in the BOQ.
-

Chapter 6: Governmental and Public (Part 2 of 4)

Overview

This part of the chapter provides a highly detailed guide to the design of secure governmental facilities. It begins with an in-depth analysis of Firehouse planning, introducing a rigorous, data-driven "adjacency" concept to minimize turnout time. It then transitions to Police Stations and Facilities, outlining the functional requirements for everything from public-facing records centers to secure detention areas. The final, extensive section covers the complex architectural and philosophical requirements for modern Jails and Prisons, discussing security grading, inmate housing types, and the principles of correctional facility design.

Key Standards and Codes Referenced

- "Police Facility Design," Bureau of Operations and Research, International Association of Chiefs of Police, Gaithersburg, Maryland, 1978.
- "Guidelines for the Planning and Design of Regional and Community Correctional Centers for Adults," University of Illinois.

Section: Firehouses (Pages 631-635)

Overview

This section presents a sophisticated approach to firehouse planning, treating it as a problem of optimizing response time. The central concept is "adjacency planning," which prioritizes the location of spaces based on the frequency and urgency of their use during a response action.

Technical Specifications

Adjacency Planning Principles

- Primary Adjacency: Spaces that must be directly connected to each other or the apparatus area for the fastest possible turnout. These include: Dispatcher/Housewatch, Company Offices, Kitchen/Recreation Area, and Dormitory.
- Secondary Adjacency: Spaces used less frequently during a response, such as general shops and hose storage.
- Third-Level Adjacency: Spaces not directly related to response, such as boiler plants and miscellaneous storage.

Space & Quantity Standards

- Apparatus Doors: Single doors should be 12 ft wide by 14 ft high. The text recommends using pairs of doors rather than one very wide door to prevent a single breakdown from disabling a bay.
- Turnout Gear Storage: Requires an electric heater and an exhaust fan.
- Fume Exhaust System (Apparatus Area): Capable of a massive exhaust pull of 5,000 cfm, which is the equivalent of six air changes per hour.
- Building Setback: A minimum of 30 ft from the property line; 65 ft is ideal to accommodate the largest piece of apparatus.
- Parking Requirement: One space for all on-duty personnel, plus a minimum of 50% extra for administrative personnel and visitors.

Visual Elements Analysis

Figure 1: Support Area-Fire-Response Function (Page 631)

Description: Five diagrams illustrating different firehouse plan types based on adjacency concepts.

- (A) One-Way Straddle: Support functions are on one side of the apparatus bay. This is the least desirable plan due to long travel distances.
- (B) Two-Way, U Wraparound: Support functions wrap around the end of the apparatus bay in a U-shape. This is the most desirable plan for minimizing turnout time.
- (C) Two-Way Straddle: Support functions are on both sides of the apparatus bay. This is the second most desirable plan.
- (D) L Wraparound: Support functions form an L-shape around the bay. This is the third most desirable plan.

Figure 4: Checklist form for firehouse planning (Page 634)

Description: A detailed space program checklist used to calculate the gross area of a new firehouse. It lists equipment and personnel needs and provides space for calculating the total area. Quantitative Data/Formulas:

Equipment/Space	Sq Ft Per Unit	Total # Required	Area Required (sq ft)
Ladder - Tiller Operated	99'	(Variable)	1646
Pumper - Standard	24'	(Variable)	552
Rescue Truck	28'	(Variable)	640
Chief's Car	25'	(Variable)	516
Turnout Gear Storage	3'x3'/unit	(Variable)	54 (for 6)
Communications Console Unit	3'x8'	(Variable)	120
Conference Rooms (Seating)	per person	6	100
Conference Rooms (Seating)	per person	18	360

- Building Core Multiplier: A factor of 10% to 13% of the sub-total area is added for primary circulation, walls, stairs, vents, etc.

BOQ Implications

- Performance-Based Design: The adjacency planning concept directly impacts the building's footprint and complexity. The "U Wraparound" plan, while most efficient, may have a larger perimeter wall area than a simple "Straddle" plan, affecting construction costs.

- Mechanical Systems: The requirement for a 5,000 cfm fume exhaust system is a major MEP line item for the BOQ, requiring powerful fans, extensive ductwork, and sophisticated controls tied to the alarm system.

Section: Police Stations and Facility (Pages 636-652)

Overview

This extensive section details the design of police facilities, emphasizing the need for a structure that is both a functional workspace for the department and a secure, professional environment for the public and for handling prisoners. It covers everything from the separation of public and secure zones to the specific needs of detention, investigation, and administrative areas.

Technical Specifications & Quantity Standards

- Annual Savings Formula: Eliminating one unnecessary 24-hour staff position saves approximately five times the cost of that person's annual salary and fringe benefits. This is a key metric for justifying investment in efficient building design.
- Space Allocation for Investigators: Allocate approximately 100 sq ft of space for each 15 police officers in the department.
- Jail Cell Capacity: For detention cells, allow a minimum of 25 sq ft per prisoner.
- Firearms Range: Minimum area should be approximately 100 ft in length with a minimum of 4 ft in width for each shooting position.
- Parking Ratio: 3 to 6 cars for staff who visit police headquarters, plus parking for all on-duty patrol vehicles. Total parking is typically 9 to 12 cars (min.).

Visual Elements Analysis

Figure 3: Raleigh, North Carolina, City Hall (Police Areas) (Page 606)

Description: A detailed floor plan showing the Police Department integrated into a larger City Hall complex. Technical Details: Demonstrates effective zoning.

- First Level: Contains all public-facing and secure areas: Lobby, Municipal Court, Judge's Processing, Deputy Clerks, Male & Female Lock-up, and the Traffic Division.

- Second Level (more secure): Contains administrative and investigative functions: Detective Division, Interrogation Rooms, Records and Identification, and the office of the Director of Public Safety.

Figure 1: Model prisoner-processing arrangement (Page 647)

Description: A flow diagram illustrating the ideal sequence for processing a prisoner. Technical Details: Shows a secure "Sally Port" entrance leading to a "Holding" area. From here, the prisoner moves sequentially through "Booking," "Mugging-Printing" (photography and fingerprinting), and finally to detention cells, without ever entering public or general administrative areas.

Figure 7: Model communications command center (Page 651)

Description: A detailed layout for a police dispatch center. Technical Details: The U-shaped console provides workstations for multiple dispatchers. It is surrounded by support functions: a Supervisor's office, a computer terminal area, a lunchroom, and toilet/locker facilities. The entire area is self-contained and secure.

Figure 9: Interview rooms (Page 651)

Description: Two diagrams showing layouts for interrogation rooms.

- Top Diagram: Two small interview rooms (7' x 4'), each with a table and two chairs, are shown with a shared monitoring/observation room between them.
- Bottom Diagram: A larger interview room (8' x 8' = 64 sq ft) designed for two or three persons.

Section: Jails and Prisons (Pages 653-668)

Overview

This section addresses the design of correctional institutions, arguing for a shift away from punitive, monolithic structures toward facilities designed for rehabilitation. It introduces the concepts of security grading (Maximum, Medium, Minimum) and zone control as key planning principles.

Technical Specifications & Quantity Standards

- Library Standard: A library should contain no fewer than 6,000 volumes, or at least 10 books per inmate. Institutions with long-term prisoners should provide a minimum of 15 to 20 volumes per inmate.

- Library Seating: Provide seating space for not less than 5 percent of the institution's population.
- Seating Area per Person: Allow 30 to 35 sq ft per reader for bookshelves, tables, and chairs.
- Dormitory/Squad Room Area: A floor area of 55 sq ft is required for each bed and its associated circulation space.
- Dayroom Space: Allot a minimum of 15 sq ft of space per inmate.
- Inmate Room Size: A minimum of 70 sq ft is required per inmate for an individual room.

Visual Elements Analysis

Figure 5: Security Grading of Inmate Populations (Page 657)

Description: A critical diagram showing the approximate proportions of security levels required in detention (pretrial) and sentenced facilities. Quantitative Breakdown:

- Pretrial Detention:
  - Maximum Security: High proportion
  - Medium Security: Medium proportion
  - Minimum Security/Intermittent Staff Control: Low proportion
- Correctional Institutions (Sentenced):
  - Maximum/Physical Staff Control: Low proportion
  - Medium Security: Medium proportion
  - Minimum/Intermittent Staff Control: High proportion Design Implication: This diagram demonstrates that jails (pretrial) require a higher degree of maximum security design than prisons (sentenced), a frequent point of confusion in public facility planning.

Figure 10: Zone control diagram (Page 660)

Description: A plan of a medium-security prison organized by functional zones. Technical Details: The plan is divided into four zones radiating from a central control hub:

- Zone 1: Inmate housing and dining hall.
- Zone 2: Prison services and work areas.
- Zone 3: Rehabilitation facilities.
- Zone 4: Administration and guard facilities. Construction Notes: This zoning simplifies supervisory activity and allows for controlled movement between different security-level areas.

Figure 11: Inmate Living Spaces (Page 661)

Description: A series of plans and elevations showing different types of inmate housing with varying levels of security.

- Maximum Security Cell: A compact cell with a fixed bed, toilet/lavatory unit, and a grille cell front.
- Medium Security Cell: Similar to maximum security, but may include an ungrated locker.
- Inmate Room: Resembles a dormitory room, with a movable bed, desk, and closet. This design reflects a lower security level and greater concern for inmate dignity.

Chapter 6: Governmental and Public (Part 3 of 4)

Overview

This part of the chapter provides a detailed architectural and engineering guide to a diverse set of public and community-oriented buildings. It begins with the highly technical and industrial requirements for municipal Incinerator Plants, focusing on site selection, traffic flow, and the mechanics of waste handling and combustion. It then transitions to community recreational facilities, providing comprehensive planning standards for YMCA, YWCA, and Boys' Club buildings. These sections detail the specific spatial needs for physical education, recreation, social activities, and support functions, with a strong emphasis on durability, safety, and flexible, multi-use design.

Key Standards and Codes Referenced

- "Incinerator Guidelines," Public Health Service, U.S. Department of Health, Education, and Welfare, Washington, D.C.
- "Planning Areas and Facilities for Health, Physical Education, and Recreation, rev. 1966," The Athletic Institute, Chicago, Ill. (for YWCA facilities).
- "Manual on Boys' Clubs Building, Planning, and Construction"

Section: Incinerator Plants (Pages 669-675)

Overview

This section treats the municipal incinerator as a complex industrial facility requiring careful site selection, building design, and layout to ensure public acceptance, operational efficiency, and economy. The design must manage heavy truck traffic, control environmental factors like dust and odor, and house large-scale mechanical systems for waste handling and combustion.

Technical Specifications and Quantities

Site & Traffic

- Traffic Consideration: The ideal location is at the center of the traffic pattern produced by collection vehicles to reduce haul time and cost.
- Tipping Area Width: Must be greater than the turning radii of trucks. Minimum recommended width is 50 to 70 ft.
- Entrance/Exit Vertical Clearance: Minimum of 18 ft is required to accommodate raised dump bodies.
- Fencing: Where required for security, a minimum height of 6 ft is desirable.

Storage Pit & Charging

- Storage Pit Capacity: Must be designed to hold approximately 1.5 times the 24-hour capacity of the incinerator.
- Unit Weight of Waste: For calculating storage volume, the generally accepted average unit weight of waste in a storage pit is 350 lb per cu yd.
- Pit Width: Typically does not exceed 30 ft. Minimum width is 15 to 20 ft.
- Charging Hopper Openings: Common sizes measure from 4 ft x 4 ft to 4 ft x 8 ft.

Furnaces & Grates

- Furnace Heat Release Rate: The total furnace volume is based on a design heat release rate of about 18,000 Btu per cu ft of furnace volume per hr.
- Grate Loading Rate: The required grate area is calculated by dividing the pounds per hour of waste to be burned by the grate's capacity. The design value is typically between 50 and 70 lb per sq ft per hr. An alternate rating is 300,000 Btu per sq ft per hr.
- Crane Capacity (Example): A 4.5-ton crane is recommended for use with a 2.5 cu yd bucket.
- Crane Cycle Time: A typical cycle (load, travel, dump, return) varies from 1.5 to 3 minutes.

Visual Elements Analysis

Figure 1: Plan of tipping area and storage pits with crane (Page 671)

Description: A plan and section view showing the primary waste handling area of an incinerator. Technical Details:

- Plan: Shows the "ENTRANCE," a large "TIPPING AREA AT GROUND LEVEL," a "BUMPER STOP" at the edge of the storage pit, and the "EXIT." This illustrates a one-way traffic flow for collection vehicles.
- Section: Shows a truck dumping waste into the "STORAGE PIT." An overhead "CRANE" with a "CHARGING HOPPER" and "FURNACE" is visible. Construction Notes: This diagram illustrates the fundamental process: trucks dump waste into a large pit, and an overhead crane lifts the waste from the pit and drops it into the furnace charging hopper.

Figure 3: Vertical circular furnace (Page 673)

Description: A detailed section view of a vertical circular incinerator furnace. Technical Details: Shows the path of waste from the "CHARGING HOPPER" and "CHARGING CHUTE" onto a "CIRCULAR GRATE" with a "REVOLUTE HOPPER" below. "UNDERFIRE AIR" is supplied from below the grate, and combustion gases move into the "SECONDARY COMBUSTION CHAMBER." "STOKER DRIVE" and "RABBLE ARM" components are shown for agitating the fuel bed.

Figures 7, 8, 9, 10: Grate Types (Page 675)

Description: Diagrams of four different types of mechanical grates used to move waste through a furnace.

- Traveling grates (Fig. 7): A continuous, belt-like conveyor.
- Reciprocating grates (Fig. 8): Stacked, overlapping sections where alternate grates slide back and forth.
- Rocking grates (Fig. 9): Rows of grates that pivot or rock to agitate and advance the waste.
- Circular grates (Fig. 10): A stationary circular grate with a rotating central cone and stoking arms.

BOQ Implications

- Heavy Industrial Construction: The BOQ must specify robust, industrial-grade materials: reinforced concrete for tipping floors and storage pits, and refractory-lined steel for furnaces and chutes.
- Specialty Equipment (Division 11): This is the largest component. The BOQ must include large overhead bridge cranes, mechanical grates, charging hoppers, and extensive air pollution control equipment (scrubbers, electrostatic precipitators).

- Site Work: The BOQ will include extensive site work for heavy-duty roadways designed for truck traffic, large concrete parking aprons, and potentially retaining walls for the storage pit.

Section: YMCA, YWCA, and Boys' Club Buildings (Pages 676-693)

Overview

This section provides planning standards for community recreational buildings. While each organization (YMCA, YWCA, Boys' Clubs) has unique aspects, they share common needs for flexible, durable, and safe facilities that accommodate a wide range of physical, social, and educational activities for all age groups.

Technical Specifications and Quantities

Space Allocation Formulas

- YWCA General Building Size: Based on a ratio of 1 to 2 sq ft per person to be served. A building for 8,000 people should be approx. 12,000 sq ft.
- Boys' Club Games Room:
  - Cadets or "midgets": 20 sq ft per boy.
  - Juniors & Intermediates: 25 sq ft per boy.
  - Seniors: 30 sq ft per boy.
- Boys' Club Library: Allow 20 to 25 sq ft per boy.
- Boys' Club Woodworking Shop: 45 sq ft per boy (with machine tools); 40 sq ft per boy (without machine tools).
- Boys' Club Small Crafts Room: 35 sq ft per boy.

Gymnasium & Pool Standards

- Gymnasium Size (Boys' Club): Most desirable is 60 by 80 ft (overall inside dimensions), which accommodates a regulation junior high basketball court (42'x74').
- Gymnasium Ceiling Height: Minimum of 20 ft.
- Swimming Pool Length (Boys' Club): 75 ft 1 in is the Amateur Athletic Union (AAU) requirement for competitive pools. 60 ft is the absolute minimum.
- Swimming Lane Width: 7 ft.

- Swimming Pool Depth: Minimum 3 ft; recommended shallow depth is 3 ft 6 in. Slope in shallow area should not exceed 1 ft in 15 ft.
- Diving Board Clearance: Minimum 9 ft deep water for a 1-meter board. A clear ceiling height of 15 ft must be maintained over the board.
- YWCA Locker/Dressing Space: Allow 10 to 15 sq ft per person.
- YWCA Shower Temperature: Water should be thermostatically controlled to 120°F.

Visual Elements Analysis

Figure 1: Typical plan for YMCA building (Page 676)

Description: A detailed floor plan for a comprehensive YMCA facility. Technical Details: The plan is zoned with an "AUXILIARY GYM," "HANDBALL COURTS," and the main "GYMNASIUM" on one side. The other side contains the "SWIMMING POOL" and "LOCKER LOBBY." A central corridor provides access to administrative offices, club rooms, and support spaces.

Figure 2: Oakland Branch, YWCA (Page 679)

Description: A floor plan showing the entrance, offices, and child care area of a YWCA branch. Technical Details: The plan shows a central "RECEPTION WORK" area controlling access to the main Lobby, a "GENERAL OFFICE," and a "CHILD CARE" room with an adjacent outdoor play area.

Figure 5: Orange, New Jersey, YWCA, HPER facilities (Page 682)

Description: A detailed plan of a Health, Physical Education, and Recreation (HPER) unit. Technical Details: The layout shows a central "LOBBY" providing access to a "MULTI-PURPOSE ROOM," a "POOL," and separate "WOMEN'S LOCKERS" and "MEN'S LOCKERS." The locker rooms include dedicated areas for "HAIR DRY," "MAKE-UP," and separate wet (showers) and dry zones.

Figure 8: Semi-recessed gutter (Swimming Pool) (Page 685)

Description: A detailed construction section of a swimming pool edge. Technical Details: Shows a semi-recessed overflow gutter design. The diagram includes dimensions for the "OVERFLOW WASTE FITTING" and the "WASTE COLLECTION HEADER (PITCH TO SURGE TANK)." This design is noted as being acceptable for YWCA pools, as it provides a visible pool edge and is easier to clean than a fully recessed gutter.

Figure 2: Boys' Club building 100-200 (Page 691)

Description: Two plans showing the staged expansion of a Boys' Club.

- (a) Unit one (100 boys): A compact facility with a small Gymnasium (38'x60'), a Games Room, a Crafts Shop, and support spaces.
- (b) Unit two (200 boys): The same plan expanded. The gymnasium is now larger (60'x80'), and a dedicated Library and Club Room have been added. This illustrates the principle of planning for future expansion.

BOQ Implications

- Durable Finishes: The text for all these facility types repeatedly calls for durable, low-maintenance, and vandal-resistant materials. The BOQ must specify items like ceramic tile floors, glazed structural block walls, and solid-core doors with heavy-duty hardware.
- Specialty Flooring: Gymnasiums require sprung maple flooring. Pool decks require non-slip ceramic tile. The BOQ must include these specialized flooring systems.
- Pool Construction: This is a major, specialized construction project. The BOQ must include line items for the reinforced concrete pool shell, extensive plumbing and filtration systems, chemical feeders, heaters, and underwater lighting.
- Flexible Partitions: Multi-purpose rooms often require acoustically-rated, movable or folding partitions to allow for flexible use of the space. These are a significant specialty item for the BOQ.
-

Chapter 6: Governmental and Public (Part 4 of 4)

Overview

This concluding part of the chapter covers a diverse range of public and governmental facilities, each with unique design requirements. It begins with standards for community Recreation Centers, outlining the programming of multipurpose rooms and support spaces. It then transitions to the more socially-oriented Neighborhood Service Centers, focusing on flexible, community-driven design. The section on Embassies provides a highly structured, formulaic approach to space planning based on post size and function. The chapter concludes with pragmatic designs for Post Offices and two critical sections detailing the specific, dimensioned requirements for accessible ramps and public toilet rooms for the handicapped, providing foundational data for barrier-free design.

Key Standards and Codes Referenced

- "Planning Areas and Facilities for Health, Physical Education, and Recreation, rev. 1966," The Athletic Institute, Chicago, Ill.
- "Neighborhood Service Centers," Office of Juvenile Delinquency and Youth Development, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1967.
- "Minimum Physical Security Standards of Foreign Service Office Buildings" (Referenced for Embassy design).
- U.S. Naval Facilities Engineering Command, Department of the Navy, Washington, D.C. (Source for Post Office plans).
- "An Illustrated Handbook of the Handicapped, Section of the North Carolina State Building Code," by Ronald Mace, AIA, and Betsy Laslett, Raleigh, N.C., 1977. (Primary source for accessibility standards).

Section: Recreation Centers & Neighborhood Service Centers (Pages 696-703)

Overview

This section covers community-based service and recreation buildings. Recreation Centers are planned with a focus on providing flexible, durable spaces for a wide variety of activities. Neighborhood Service Centers are presented as a "new" building type, designed as a "place to go for help" and requiring a design process that is highly responsive to the specific needs of the community it serves.

Technical Specifications

Recreation Centers

- Building Size Ratio: The size of the building is based on a ratio of 1 to 2 sq ft per person to be served.
- Social Hall/Gymnasium: Should be at least 90 by 100 ft with a minimum ceiling height of 22 ft to permit a basketball court of 50 by 84 ft.
- Stage: Should be 20 ft deep with a proscenium opening at least two-thirds the width of the room.
- Locker Room Space: Allocate 10 to 15 sq ft per person.
- Dressing Booths: Provide in a ratio of 10 percent of the total number of lockers.
- Showers (Men): 12 shower heads, spaced a minimum of 4 ft apart.

- Shower Temperature: Water must be controlled by a mixing chamber to a maximum of 120°F.

Neighborhood Service Centers

- Population Served: A center serving more than 35,000 people is considered too large for effective communication.
- Service Model: The text describes various models, from fixed storefronts to mobile service buses that travel through rural areas. This highlights that the "facility" is not always a traditional building.

Visual Elements Analysis

Figure 1: Collett Street Recreation Center (Page 696)

Description: A detailed floor plan for a community recreation center. Technical Details: The plan is organized around a central Lobby-Lounge which controls access to all other areas. Key spaces include a large Gymnasium-Auditorium with folding bleachers, a Club Room, a Crafts room, a Ceramics room, and a Social Hall. A kitchen is located to serve both the club room and social hall.

Figure 3: Glenwood Community Center (Page 699)

Description: Another example of a recreation center floor plan. Technical Details: This plan shows a large Gymnasium (92'-0" x 66'-0") with roll-away bleachers. The lobby provides access to a Lobby-Lounge, Club Rooms, and a Game Room. This layout emphasizes clear zoning and circulation control from the central lobby.

Section: Embassies (Pages 704-707)

Overview

This highly structured section provides a formulaic approach to designing U.S. Embassy office buildings. Space standards are based on a post classification system (Class I, II, III, IV) and a standard 75 sq ft basic space module for clerical personnel.

Technical Specifications & Space Standards

- Basic Space Module: 75 sq ft per individual desk/clerical position.

- Preferred Office Proportions: 8 ft 8 in wide by 17 ft 6 in deep. This depth is maintained, and widths are varied to create offices of different sizes (e.g., 150 sq ft, 225 sq ft).
- Minimum Clear Ceiling Heights:
    - Typical Office Space: 9 ft.
    - Classified Conference/Mail/Communications: 10 ft.

Embassy Space Tables (Pages 704-707)

Description: A series of eight tables providing the specific net square footage allocation for every function and office within an embassy, broken down by the four classes of post size.

- Table 1: Ambassadorial Section:
    - Ambassador's Office: 600 sq ft (Class I) down to 450 sq ft (Class IV).
- Table 2: Political Section:
    - Chief Political Section Officer: 375 sq ft (Class I) down to 225 sq ft (Class IV).
- Table 5: Administrative Section:
    - Administrative Officer: 375 sq ft (Class I) down to 225 sq ft (Class IV).
- Table 9: Miscellaneous Functional and Service Areas:
    - Lobby and Reception: 750 sq ft (Class I) down to 450 sq ft (Class IV).
    - Mechanical Equipment: 1,050 sq ft (Class I) down to 600 sq ft (Class IV).

BOQ Implications

- Modular Planning: The use of a strict 75 sq ft module simplifies the quantification of office partitions, ceiling grids, and lighting layouts in the BOQ.
- Security Requirements: The BOQ must include significant costs for specialized security construction, particularly for the "communications complex," which is described as a concrete vault with its own incinerator, requiring enhanced structural and mechanical systems.

Section: Post Offices (Page 708)

Overview

This brief section provides three floor plans for U.S. Post Offices of varying sizes, illustrating the basic workflow and public interface.

Visual Elements Analysis

Figures 1, 2, 3: Post Office Plans (Page 708)

- Description: Three floor plans showing gross areas of 1,500 sq ft, 3,750 sq ft, and 5,300 sq ft.
- Technical Details: All three plans share a common functional layout:
    - A Public Lobby with a service counter.
    - A large, open Work Space behind the counter.
    - A Covered Loading Platform at the rear.
    - Support spaces including a Heater/Utility Room, Toilets, and a Postal Officer's office.

Section: Access Ramps & Public Toilet Rooms for the Handicapped (Pages 709-710)

Overview

This final, critical section provides specific, dimensioned standards for creating accessible environments, based on the North Carolina State Building Code's handicapped section. These are fundamental requirements for all public buildings.

Technical Specifications

Access Ramps (Page 709)

- Minimum Width: 4 ft.
- Maximum Slope: 8.33% (1 inch in 12 inches).
- Handrail Requirement:
    - If slope is 5% (1:20) or less: No handrail required.
    - If slope is greater than 5%: One handrail required.
- Landings:
    - A 5'-0" long straight, level landing is required at the bottom of a ramp.
    - A 3'-0" long intermediate level platform is required at 30'-0" intervals for rest.
    - Level platforms are required at all turns.
- Handrail Extensions: Handrails must extend 1'-0" beyond the top and bottom of the ramp.

Public Toilet Rooms for the Handicapped (Page 710)

- Stall Size: A 5 ft x 5 ft stall is specified as usable by most people.
- Stall Door: A 32 in door opening is required, located diagonally opposite the water closet.
- Water Closet Location: The centerline of the toilet must be 1 ft 6 in from the side wall.
- Grab Bars:
    - Must extend 1 ft 6 in in front of the water closet.
    - Must be mounted 1 ½ in from the wall.
    - Must be mounted 13 in above the toilet seat.
- Standard Fixture Seat Height: 16 ½" - 20".

Visual Elements Analysis

Figure 3: Toilet stall elevation and plan (Page 710)

Description: A detailed, dimensioned plan, elevation, and isometric view of an accessible toilet stall. Technical Details: This single diagram visually consolidates all the key dimensional requirements listed above. It shows the 5'-0" x 5'-0" stall footprint, the 1'-6" offset for the water closet, the 32" clear door opening, and the precise location and extent of the required grab bars. This is a prescriptive, code-level detail.

BOQ Implications

- Accessibility Compliance: The requirements for ramps and accessible toilets are now mandatory in virtually all public construction. The BOQ must accurately reflect these needs:
    - Ramps: Require more square footage than stairs, longer handrails (with extensions), and specific level landings.
    - Toilet Rooms: Require larger stalls, specialized grab bars (with secure blocking in the wall), and often wall-hung toilets with specific clearances, all of which impact cost.
- Sitework: Accessible routes from parking to the building entrance may require extensive ramping, regrading, and specialized paving, which must be quantified in the site work section of the BOQ.

Chapter 8: Transportation (Part 1 of 7)

Overview

This initial part of the chapter introduces the airport as a complex "total city devoted to dynamic movement." It establishes the fundamental operational principles governing airports, emphasizing that all movements—of passengers, cargo, and employees—are regulated by a pre-established schedule. The text highlights the critical importance of designing for flexibility to accommodate rapid technological changes in aircraft, which can alter schedules, payloads, and speeds overnight. The section includes a detailed glossary of airport-specific terminology and extensive visual data on the historical and projected growth trends of aircraft, covering passenger capacity, gross weight, overall length, and wingspan.

Key Standards and Codes Referenced

- While this introductory section is more conceptual, it implies adherence to the requirements of several key governing and advisory bodies:
  - FAA (Federal Aviation Administration)
  - Civil Aeronautics Administration (CAA)
  - Air Transport Association (ATA)
  - Airline Pilots Association (ALPA)
  - International Air Transport Association (IATA)

Section: Introduction & Airport Operations (Pages 921-925)

Overview

This section outlines the primary factors that dictate airport design. It identifies the printed flight schedule as the core regulator of all activity. However, it warns that technology, weather, and mechanical issues create deviations from this schedule, requiring a design that can handle peak conditions plus an overload factor. The key takeaway is that flexibility for future growth and change is the most critical, constant program factor.

Technical Specifications and Quantitative Data

- On-Time Performance Factor: The text notes that even a 10 or 15 percent deviation from the schedule can "raise havoc at an airport," necessitating that the design accommodate an overload factor beyond the planned peak capacity.
- Average Peak Day: A critical metric for planning, defined as the average of the top 37 days (10 percent) of a year in terms of traffic volume.
- Average Peak Hour: The one-hour period during the average peak day with the highest traffic.

Visual Elements Analysis

Figure 1: Aircraft range (Page 921)

Description: A bar chart illustrating the operational range of various aircraft types, categorized as Short Range, Medium Range, and Long Range. Technical Details:

- Short Range & STOL Aircraft: BAC 111, CV-580, Helicopters - typically under 1,000 miles.
- Medium Range: B727, DC-9-30, L1011 - ranges from approximately 1,500 to 3,500 miles.
- Long Range: B747, DC-8 Super 63 - ranges from 4,000 to over 6,000 miles.

Figure 2: Passenger-aircraft capacity growth trend (Page 922)

Description: A line graph showing the dramatic increase in the number of passengers per aircraft from 1930 to 1980. Quantitative Data:

- 1930s (DC-3): Under 50 passengers.
- 1950s (DC-7, L1049G): Approximately 100 passengers.
- 1970s (747): From 400 to nearly 500 passengers (All Economy).
- Future (U.S. SST): Projected at over 600 passengers.

Figure 3: Gross-weight growth (Page 922)

Description: A line graph showing the increase in aircraft gross weight. Technical Details:

- Piston Aircraft (DC-3, DC-7): Under 150,000 lbs.
- Early Jets (707, DC-8): ~300,000 lbs.
- Wide-body Jets (747, L-500): 750,000 to over 1,000,000 lbs. BOQ Implications: Aircraft gross weight is a primary determinant of pavement thickness for runways, taxiways, and aprons. The exponential growth shown here means that all airport paving specified in a BOQ must be designed to accommodate not just current aircraft, but much heavier future aircraft.

Figure 4 & 5: Overall-length and Wingspan growth (Pages 922, 923)

Description: Two line graphs showing the increase in aircraft length and wingspan.

- Overall Length (Fig. 4): From under 100 ft (DC-3) to over 200 ft (747) and approaching 300 ft for the SST.
- Wingspan (Fig. 5): From under 100 ft (DC-3) to nearly 200 ft (747). Design Implication: These dimensions directly control the size of aircraft gate positions, the spacing between gates, the width of taxiways, and the size of hangars.

Section: Design Considerations & Terminal Concepts (Pages 926-933)

Overview

This section outlines the preliminary design process and presents the fundamental architectural concepts for passenger terminals. It emphasizes the need for a comprehensive data bank, including airline statistics, and introduces various historical and contemporary terminal layouts, from consolidated single buildings to decentralized drive-to-gate concepts.

Technical Specifications and Formulas

- This section is primarily conceptual, but Table 1 provides the quantitative framework for all subsequent design decisions.

TABLE 1: Airline Statistical Data Requirements (Page 934)

Description: A critical checklist of the data the architect must obtain from the airlines to program the terminal building. This is the foundational data set for airport design. Key Quantitative Requirements:

1. Estimated Enplaning and Deplaning Traffic:
    - Passengers: Total per year, average day, peak month, peak hour.
    - Cargo & Mail: Total tons per year.
    - Baggage: Total number per year, average day, peak month.
2. Projected Flight Schedule:
    - City pairs, time frame, aircraft type.
3. Aircraft:
    - Number of gate positions.

    - Number and type of aircraft for gate size design.
4. Terminal Building Spaces:
    - Gate lounge: Number and sizes.
    - Baggage claim: Type and size.
    - Amenities area: Size.
5. Automobile Parking Requirements (Airline Experience):
    - Breakdown by public, valet, taxis, limos, car rental.

Visual Elements Analysis

Figures 11, 12, 13: Passenger Flow Diagrams (Pages 926, 927, 928)

Description: Three detailed flow charts illustrating the sequence of activities for enplaning (departing) domestic passengers, deplaning (arriving) domestic passengers, and deplaning international passengers. Technical Details:

- Enplaning Flow (Fig. 11): Shows the path from "People at Home or Office" to "Airport Entrance," through ticketing and security, to the "Gate Lounge."
- International Deplaning Flow (Fig. 13): This is the most complex flow. It shows the critical, federally mandated sequence: from the aircraft to Immigration/Passport Control, then to Baggage Claim, and finally through U.S. Customs. This sequence is non-negotiable.

Figure 17: Terminal concepts (Pages 932, 933)

Description: A series of seven schematic diagrams illustrating the evolution of airport terminal design concepts. Conceptual Types:

- (a) Consolidated Terminal: A simple, single building where all airlines operate. The original and most basic concept.
- (b) Finger Terminal (Consolidated): Piers or "fingers" extend from the main terminal to increase the number of aircraft gate positions.
- (c) Satellite Terminal (Consolidated): A separate terminal building (satellite) is located remotely on the apron and connected to the main terminal by a corridor or transport system.
- (d) Finger Terminals (Decentralized): Multiple, separate finger terminals, often dedicated to one or two airlines.
- (e) Satellite Terminals (Decentralized): Multiple, separate satellite terminals.
- (f) Drive to Gate: A highly linear concept where the roadway allows passengers to be dropped off directly at their departure gate, minimizing walking distance.
- (g) Mobile Lounge: A consolidated terminal with remote aircraft parking. Passengers are transported from the terminal to the aircraft in large, bus-like vehicles ("mobile lounges") that raise up to dock directly with the plane.

BOQ Implications

- Pavement and Site Work: The data on aircraft size, weight, and number of positions directly determines the square footage and required thickness of concrete or asphalt for aprons, taxiways, and runways, which are major cost components in the airport BOQ.
- Terminal Building Area: The statistical data from Table 1 (passengers per hour, number of gates, etc.) is the basis for calculating the total required square footage of the terminal building, which drives the architectural, structural, and MEP costs.
- Flexibility & Expansion: The mandate to design for flexibility means the BOQ should reflect systems that can be easily expanded. This might include modular structural bays, space for future mechanical equipment, and knock-out panels in exterior walls for future connections.

Critical Notes and Warnings

- Flexibility is Paramount: The text repeatedly warns that aircraft technology and airline operations change rapidly. A terminal designed with fixed parameters will quickly become obsolete. All systems must have built-in potential for expansion.
- International Passenger Flow: The sequence of processing international arrivals (Immigration -> Baggage Claim -> Customs) is a mandatory flow dictated by federal law and cannot be altered.
- Decentralization Trade-offs: While decentralized terminals (separate buildings for each airline) offer benefits like more apron space and airline autonomy, they create significant problems for interline transfers and require sophisticated ground transportation systems to connect them.

Chapter 8: Transportation (Part 2 of 7)

Overview

This part of the chapter delves into the practical and logistical systems that define the passenger experience at an airport. It begins by examining the various methods for enplaning and deplaning baggage, stressing the need to design systems based on specific operational requirements rather than just equipment. It then provides a detailed, formula-based approach to calculating the required curb frontage for passenger drop-off and pickup, a frequent point of congestion. The section concludes by illustrating the evolution of passenger loading methods, from walking across the apron to the use of sophisticated jetways and mobile lounges.

Key Standards and Codes Referenced

- "Planning and Design Considerations for Airport Terminal Building Development," Advisory Circular AC 150/5360-7, DOT, FAA, 1976. (Source for data on mechanized claim devices).

Section: Enplaning & Deplaning Baggage and Mail (Pages 929, 930, 931)

Overview

This section outlines the flow of baggage, cargo, and mail through the airport system. It emphasizes that while passengers are the primary focus of the terminal, the handling of baggage and cargo is a critical, parallel operation that directly impacts airline efficiency.

Visual Elements Analysis

Figure 14: Enplaning baggage (Page 929)

Description: A flow chart illustrating the process of getting checked baggage from the curb to the aircraft. Technical Details: The diagram shows multiple points of entry into the system:

- Curb Bag Check
- Counter Bag Check
- Gate Bag Check All these channels feed into a central "Baggage Make-up Area" (labeled as "Transfer to Aircraft"), where bags are sorted and loaded for specific flights.

Figure 15: Enplaning cargo (Page 930)

Description: A flow chart showing the more complex process for handling air cargo. Technical Details: Cargo comes from "Freight Forwarders" or the "Airport Post Depot." It goes through a "Cargo Check-in" and "Bill of Lading/Documentation Clearance." It can then be placed in "Short-Term Storage" or "Long-Term Storage" before being moved to the "Cargo Flight Gate."

Figure 16: Mail cargo (Page 931)

Description: A flow chart illustrating the processing of mail. Technical Details: Mail arrives via "Mail Truck" to the "Airport Post Facilities." It is then sorted, distributed to the city or other airlines, or transferred to the specific airline for enplaning.

Section: Curb Frontage Utilization & Parking (Page 934)

Overview

This is a highly quantitative section that provides the methodology for designing one of the most congested areas of any airport: the terminal curb. It provides a formula for calculating the required linear footage of curb space based on vehicle type, duration time, and passenger volume.

Technical Specifications and Formulas

Working Curb Footage Requirement Schedule (Formula)

- Formula: `(Number of Vehicles) x (Time Duration at Curb) / (Time Period) x (Length per Vehicle) = Curb Footage Required`
- Simplified Formula in Diagram: `35 ft + [ (Number of cars) x (Time at curb in min) / 20 min ] x 35 ft = Total Curb Footage`
- Standard Vehicle Length: The formula assumes an average requirement of 35 linear ft at the curb for each vehicle to allow for maneuvering.
- Peak Load Factor: After calculating the total requirement, the text advises to increase total by 30 percent to compensate for heavy congestion periods.

Duration Schedule in Minutes (Table, if no survey data is available)

Vehicle Type	Enplaning (min)	Deplaning (min)
Private cars	2	3
Valet cars at curb	3	3
Valet queuing	5	5

Rental cars	3	3
Taxis	2	5

Visual Elements Analysis

Figure 6: Curb frontage diagram (Page 952 - from previous upload, but content is on 934)

Description: A schematic diagram showing the design concept of curbside off-loading. Technical Details: Illustrates a multi-lane approach:

- Active Curb Frontage: The lane directly adjacent to the curb for active loading/unloading (Private Vehicles, Taxis, Limos & Buses).
- Valet Queuing Space: A separate, dedicated lane or area for valet car drop-off, which has a longer duration time.
- Through Lanes: Multiple lanes for circulating traffic to bypass stopped vehicles at the curb.

Section: Passenger Loading & Baggage Handling (Pages 940-945)

Overview

This section details the physical systems used to move passengers and their baggage between the terminal and the aircraft. It covers various types of loading methods and the mechanized devices used for baggage claim.

Technical Specifications

Gate Lounge Sizes (by aircraft type)

Aircraft Type	Gate Lounge Size (sq ft)

B-747	6,000
L-1011	4,000
DC-10	4,000
B2702 (SST)	4,000
DC-8	3,500
B-707	3,500
B-727	2,000
B-737	2,000
DC-9	1,500

Baggage Claim Devices (Page 947)

- Theoretical vs. Practical Bag Storage: A critical note states that for all mechanized devices, the Practical Bag Storage Capability is 1/3 LESS than the theoretical or geometric capacity.

Visual Elements Analysis

Figure 22: Typical loading methods (Pages 941, 942)

Description: A series of nine diagrams (a-i) illustrating the evolution of methods for boarding passengers.

- (a) Walk Across Apron: The most basic method.
- (b) Walk Down Stairs: An intermediate method from a two-level terminal.
- (c) Telescoping Jetway: Shows a modern jetway that rotates and telescopes to connect the terminal to the aircraft door. This diagram illustrates a power-in, push-out gate position.

- (d) Power-in, Power-out: Similar to (c), but for a gate where the aircraft can taxi out under its own power.
- (g) Mobile Lounge: A large, bus-like vehicle transports passengers from the terminal to a remote aircraft stand.
- (h) & (i) Wide-body Jetways: Show more complex, multi-bridge jetways designed to service the multiple doors of wide-bodied aircraft like the B-747.

Figure 23: Typical gate lounge (Page 943)

Description: A floor plan of a generic gate lounge. Technical Details: The layout shows a central Control Point where boarding passes are checked. This controls access to the jetway (labeled "AIRCRAFT"). The lounge includes seating, a Last Minute Bag Drop, and a Flight Information display. The circulation path separates arriving and departing passengers.

Figure 24 & 25: Baggage claim systems (Pages 945, 947)

Description: Diagrams of various mechanized baggage claim devices.

- Carousel (Fig. 24c): A rotating circular device.
- Race Track (Fig. 24d): A continuously circulating oval conveyor.
- Pod (Fig. 24e): A system where entire baggage containers (pods) are delivered from the aircraft to the claim area.
- Automated (Fig. 24g): A system of computer-operated carts that deliver baggage to a specific location when a claim ticket is inserted into a call box.
- Flatbed Direct Feed (Fig. 25): A simple, U-shaped stationary bed onto which bags are placed.
- Sloping Bed (Fig. 25): A sloped device (either circular or oval) that uses gravity to help move bags along.
- Quantitative Data (Fig. 25): This diagram includes tables providing the Claim Frontage (linear feet of passenger access) and Bag Storage capacity for devices of different shapes and sizes.
    - *Example (Circular Device)*: A 20 ft diameter circular remote feed device has 63 ft of claim frontage and a practical storage capacity of 94 bags.

BOQ Implications

- Site Paving: The calculation of curb frontage is a direct input for the site work portion of the BOQ, determining the linear footage of curb and gutter, as well as the square footage of concrete or asphalt paving for drop-off lanes.
- Specialty Equipment (Division 11 & 14): This section details major specialty equipment items for the BOQ.

    - Baggage Handling Systems: Includes conveyors, carousels, diverters, and automated cart systems. These are complex, custom-fabricated systems.
    - Passenger Boarding Bridges (Jetways): A major capital expense. The BOQ must specify the number, type, and length of jetways required.
    - Vertical Transportation: Includes elevators, escalators, and moving walks, all of which are significant line items.

Critical Notes and Warnings

- Practical vs. Theoretical Capacity: The note that the practical storage capacity of a baggage claim device is 1/3 less than its theoretical capacity is a critical factor for design. Sizing a device based on its geometric volume alone will result in an undersized system.
- Baggage Room Safety: The text warns that baggage rooms using gasoline-powered tractors require sufficient fresh air ventilation. Sprinkler systems and fire cutoffs are also mandatory safety features.
- Congestion is Inevitable: The text acknowledges that all systems have a breaking point. The goal of the design is to handle the *average peak* efficiently and to provide enough buffer capacity (e.g., the 30% increase in curb footage) to manage intermittent periods of extreme congestion without total system failure.
-

Chapter 8: Transportation (Part 3 of 7)

Overview

This part of the chapter synthesizes the previously discussed design principles into overarching terminal concepts. It outlines five primary models for arranging terminals and gate positions: Simple, Pier, Satellite, Linear, and Transporter. It discusses the functional advantages and disadvantages of each, emphasizing that most real-world airports are combinations or variations of these pure concepts, adapted to specific site and operational needs. The section concludes with a detailed floor plan and site plan of a medium-type air-passenger terminal, illustrating how these concepts and their associated support spaces are integrated into a complete facility.

Key Standards and Codes Referenced

- "Planning and Design Considerations for Airport Terminal Building Development," Advisory Circular AC 150/5360-7, DOT, FAA, 1976. (Source for terminal concepts).

- U.S. Naval Facilities Engineering Command, Department of the Navy, Washington, D.C. (Source for the medium-type air-passenger terminal plan).
- Howard, Needles, Tammen & Bergendoff, Consulting Engineers: Credited as the designers for the medium-type terminal plan.

Section: Terminal Area Concepts (Pages 948-950)

Overview

This section describes the five fundamental architectural concepts for airport terminal design. Each concept represents a different strategy for organizing the relationship between the terminal building, passenger processing, and aircraft gate positions.

Technical Specifications

- Terminal Concepts:
    i. Simple Terminal: A single, common waiting and ticketing area with direct access to an aircraft parking apron. Suitable for airports with low activity (3-6 aircraft).
    ii. Pier Concept (Fig. 1, p. 949): Piers (concourses) extend from the main terminal, with gates arranged along both sides. This is a very common way to expand a simple terminal. A key consideration is the spacing between piers to allow for aircraft taxiing.
    iii. Satellite Concept (Fig. 2, p. 949): A separate terminal building ("satellite") is located remotely on the apron, surrounded by aircraft. It is connected to the main terminal by a surface, underground, or above-grade connector.
    iv. Linear Concept (Fig. 3, p. 950): Aircraft are parked along the face of a long, linear terminal building. This concept offers easy access and potentially short walking distances, especially if the roadway system allows for drop-off near the gate.
    v. Transporter Concept (Fig. 4, p. 950): A consolidated terminal with remote aircraft parking. Passengers are transported between the terminal and the aircraft using vehicles like mobile lounges.

Visual Elements Analysis

Figure 1: Pier concept (Page 949)

Description: A schematic diagram of a pier terminal. Technical Details: The diagram shows a central Terminal building with a long pier extending onto the apron. The pier contains a Public Corridor (2), Departure Lounges (3) at each gate, and Boarding Devices (1) connecting to the aircraft. This layout maximizes the number of gates for a given amount of terminal frontage.

Figure 2: Satellite concept (Page 949)

Description: A schematic diagram of a satellite terminal. Technical Details: A central Terminal building is connected via a long underground or elevated Public Corridor (2) to a separate, circular satellite building. The satellite is surrounded by aircraft and contains multiple Departure Lounges (3) and Boarding Devices (1).

Figure 4: Transporter concept (Page 950)

Description: A schematic diagram of a mobile lounge/transporter system. Technical Details: Passengers are processed in a main Terminal building. A specialized vehicle, the Boarding Device (1), acts as a mobile lounge, picking up passengers at the terminal and driving them across the Apron to a remote aircraft stand.

Section: Medium-type Air-passenger Terminal (Page 951)

Overview

This section presents a complete architectural design for a medium-sized airport terminal, integrating all the functional areas discussed previously into a single, cohesive floor plan and site plan.

Technical Specifications and Quantities

- Building Dimensions: The main terminal building shown has overall dimensions of approximately 80 ft x 118 ft. The aircraft apron is 92 ft deep.
- Key Room Areas (Approximate):
    - Waiting Lounge: ~2,000 sq ft
    - Baggage Claim: ~1,000 sq ft
    - V.I.P. Lounge: ~250 sq ft
    - Kitchenette: ~100 sq ft
    - Mech. Equip. Room: ~280 sq ft
    - Freight: ~400 sq ft

Visual Elements Analysis

Figure 5: Medium-type air-passenger terminal (Floor Plan & Site Plan) (Page 951)

Description: A detailed, dimensioned floor plan and a schematic site plan for a complete medium-sized terminal. Floor Plan Analysis:

- Zoning: The plan is clearly zoned. The public-facing side contains the Waiting Lounge, Check-In, and Baggage Claim. The secure airside contains the gates and the V.I.P. Lounge. Administrative and support functions are grouped together.
- Circulation: A single main entrance leads into the lobby. Passengers check in and move into the main waiting lounge. From there, they access the gates leading to the aircraft apron. Arriving passengers move from the apron into the baggage claim area and exit.
- Support Services: The plan includes all necessary support functions: Office, Kitchenette (for VIP lounge), Vault, Vending Machines, Toilets, Detention, Concessions, Mechanical Equipment Room, and a Plane Crew Ready Room. Site Plan Analysis:
- Layout: Shows a "Y" shaped access road system. One branch leads to the Passenger Access curb at the front of the terminal. The other branch leads to the Service Access road at the back.
- Parking: A large Parking Lot is located directly opposite the main terminal entrance.
- Non-Organizational Vehicle Parking: A separate, dedicated parking area is provided for vehicles not directly associated with the terminal operation (e.g., employee cars). This separation of parking is a key planning principle.

BOQ Implications

- Building Footprint: The provided floor plan gives a clear basis for calculating the gross square footage of a medium-sized terminal, which is the primary driver for architectural, structural, and MEP quantities in the BOQ.
- Terminal Concepts & Cost: The choice of terminal concept has massive cost implications.
  - A Simple or Linear terminal (one building) is the most economical.
  - A Pier terminal adds significant cost due to the long, enclosed concourse structures.
  - A Satellite terminal is even more expensive, requiring a long, often underground or elevated connector with escalators or moving walks.
  - A Transporter system has the lowest building cost but the highest operational cost, as the BOQ must include the purchase and maintenance of a fleet of specialized mobile lounge vehicles.

- Site Paving: The site plan indicates large areas for roadways, loading aprons, and parking lots, all of which must be quantified in the site work section of the BOQ.

Critical Notes and Warnings

- Concept Combinations: The text stresses that real-world airports are rarely a "pure" conceptual type. They are almost always combinations or variations designed to meet specific local needs. For example, a large airport might have a main pier terminal for domestic flights and a separate satellite terminal for international flights.
- Walking Distance: A primary trade-off between terminal concepts is walking distance. Consolidated terminals (simple, pier, satellite) often result in long walking distances for passengers. Decentralized concepts (drive-to-gate) minimize walking distance but can create confusion and transfer difficulties.
- Flexibility in Siting: The choice of site has a profound impact on the terminal concept. A constrained urban site might force a vertical, multi-level design, while an open, unconstrained site allows for a more sprawling, linear, or campus-style plan.

Chapter 8: Transportation (Part 4 of 7)

Overview

This part of the chapter shifts focus from passengers to freight, detailing the planning and design of Airport Cargo Facilities. It treats the cargo center as a critical component of the airport ecosystem, requiring efficient transfer of goods between surface vehicles (trucks) and aircraft. The section outlines the key functional elements, site planning considerations, and building design requirements for air carrier cargo buildings. It emphasizes the need for flexible, clear-span structures that can accommodate a wide variety of freight types and materials handling systems.

Key Standards and Codes Referenced

- "Airport Cargo Facilities," Federal Aviation Agency, Washington, D.C., 1964.
- NBFU (National Board of Fire Underwriters) - recommended National Building Code: Referenced for floor construction load standards.
- U.S. Naval Facilities Engineering Command, Department of the Navy, Washington, D.C.: Source for detailed cargo terminal plans.

Section: Airport Cargo Center & Buildings (Pages 953-956)

Overview

This section establishes the core principles for locating and designing an airport cargo complex. It identifies the four primary functional elements—freight handling, administration, personnel/customer accommodations, and services—and outlines the critical adjacencies and planning considerations.

Technical Specifications and Quantities

Site Location Criteria

1. Taxi Distance: Must be as short as possible from the most used runways.
2. Accessibility: Must be readily accessible by surface vehicles from passenger aircraft loading positions (for combination passenger/cargo flights).
3. Access Roads: The complex must be easily reached from all airport access roads.
4. Expansion: The site must have adequate space for future expansion without encroaching on other airport functions.

Truck Dock & Processing Area Standards

- Truck Station Width: Minimum of 12 ft per truck.
- Building Door Openings: Minimum of 10 ft wide by 10 ft high.
- Canopy Overhang: Minimum of 5 ft to protect freight and personnel from weather.
- Canopy Clearance: Approximately 18 in above the top of the parked freight van.
- Building Floor Heights: Varies from 44 to 47 in above grade.
- Truck Maneuvering Apron: Recommended distance from the loading dock to the nearest obstruction is twice the length of the largest road vehicle expected to use the facility.
- Unloading Rate (Example Calculation): An inbound volume of 90,000 lb of freight to be processed in 3 hours requires an unloading rate of 30,000 lb per hour. If the unloading rate per dock space is 5,000 lb per hour, then `30,000 / 5,000 = 6 truck spaces` are required for this operation.
- Floor Loading (NBFU Code): Floors in office areas with extensive filing systems must be designed to carry a minimum uniformly distributed load of 125 psf.

Special Handling Requirements

- Refrigerated Storage: Required for perishable cargo.
- Temperature Controlled Areas: Needed for live cargo.
- Bonded Storage: Required for customs import/export control.
- Security Accommodations: Required for valuable cargo.

Visual Elements Analysis

Figure 1: Relationships of cargo facilities (Page 954)

Description: A schematic diagram illustrating the ideal site relationship between various cargo buildings and the main airport infrastructure. Technical Details: The diagram shows the Air Carrier Cargo Facilities located adjacent to both the Cargo Loading Apron and the Trucker access road. Separate, but nearby, facilities are shown for Air Freight Forwarders, Air Express, and the Airport Mail Facility. This illustrates a zoned approach, grouping related functions together for efficiency.

Figure 2: Space relationships within buildings (Page 955)

Description: A functional bubble diagram showing the internal organization of a cargo facility. Technical Details: The Processing Area is the central hub. It is served by a Receiving area on one side and connects to Administration and Personnel/Customer Accommodations on the other. This diagram illustrates the core workflow of receiving, processing, and administering cargo shipments.

Figure 3: Building area space requirements (Page 956)

Description: A graph showing the relationship between the volume of cargo handled and the required building area. Quantitative Data:

- A daily cargo volume of 100,000 pounds requires approximately 10,000 sq ft of processing area.
- A daily cargo volume of 300,000 pounds requires approximately 20,000 sq ft of processing area. Design Implication: This graph provides a direct, quantitative tool for programming the size of a cargo facility based on projected freight volumes.

Section: Air Cargo Terminals (Detailed Plans) (Pages 957-958)

Overview

This section provides two detailed, dimensioned architectural plans for air cargo terminals, illustrating the integration of all the required functional spaces and equipment.

Visual Elements Analysis

Figure 1: Small Air Cargo Terminal (Page 957)

Description: A detailed floor plan of a small-to-medium sized air cargo terminal.
Technical Details:

- Building Dimensions: 130'-0" long by 60'-0" deep.
- Zoning: The plan is clearly divided into three zones:
    i. Airside: An Aircraft Loading and Unloading Dock with a ramp leading up to the main floor.
    ii. Landside: A Receiving Loading Dock and a Shipping Loading Dock for trucks.
    iii. Processing Core: A large central area for "Sorting, Accumulation, Storage and Palletization."
- Support Spaces: Includes an Office, Toilet, Mechanical Equipment Room, and a secure Classified Storage area.
- Section A-A: Shows the section through the building, illustrating the ramp from the apron up to the dock height and the roof overhang providing weather protection.

Figure 2: Large Air Cargo Terminal (Page 958)

Description: A detailed floor plan for a large, highly mechanized air cargo terminal.
Technical Details:

- Building Dimensions: 340'-2" long by 128'-10" deep.
- Mechanization: This plan is designed around a complex system of conveyors. It features a central Accumulation Conveyor fed by multiple Weighing Scales at the truck docks. From the main conveyor, freight is moved via Sorting Conveyors into a Built-up Pallet Storage Area or a Bulk Storage Area.
- Workflow: Shows a clear, mechanized flow from the Receiving Truck Docks on the left, through the sorting and unitization process, to the Aircraft "K" Loader positions on the right.
- Support: Includes a Computer Room (with a raised floor for computers), a Maintenance Shop, Refrigerated Storage, and a Security Vault.

- Section A-A: Shows the floor conveyor system in section, with a return loop below the main floor.

BOQ Implications

- Structural System: The text explicitly states that clear-span structures (up to 100 ft) are desirable for cargo buildings to allow for maximum flexibility for forklift and vehicle movement. This requirement for long spans will be a major cost driver in the structural steel or pre-engineered building portion of the BOQ.
- Dock Equipment: The BOQ must include a significant amount of specialized dock equipment, including overhead roll-up doors, dock bumpers, and dock levelers (to accommodate varying truck bed heights).
- Conveyor Systems: For mechanized facilities like the one in Figure 2, the materials handling system itself is a massive and highly specialized component of the BOQ. This includes all conveyors, sorters, scales, and associated controls.
- Specialized Rooms: The BOQ must account for the construction of specialized, insulated rooms like refrigerated storage and secure, reinforced rooms for bonded storage and vaults.

Critical Notes and Warnings

- Flexibility is Key: The design must be planned for expansion in both length and depth, with fixed support facilities located so they do not interfere with future growth.
- Durable Finishes: The text emphasizes the need for durable, low-maintenance finishes. For processing areas, a hardened concrete floor is recommended. For offices and locker rooms, more finished materials like acoustic ceilings and painted masonry are appropriate.
- Safety and Security: Fire protection (sprinklers), protection against pilferage, and security for valuable or bonded cargo are all critical design considerations that must be reflected in the construction.
-

Chapter 8: Transportation (Part 5 of 7)

Overview

This part of the chapter covers two distinct but essential airport support facilities. The first section details the requirements for Airport Service Equipment Buildings, which are essentially large, specialized garages for housing and maintaining the fleet of vehicles needed for airport operations (e.g., snowplows, sweepers). The second, more extensive section, provides a comprehensive guide to Heliport design, covering site selection, classification, layout, and the critical imaginary surfaces that define obstruction-free airspace.

Key Standards and Codes Referenced

- "Airport Service Equipment Buildings," Federal Aviation Agency, Washington, D.C., 1964.
- "Heliport Design Guide," Advisory Circular AC150/5390-1B, DOT, FAA, August 22, 1977.

Section: Airport Service Equipment Buildings (Pages 959-963)

Overview

This section outlines the planning and design of buildings used to store and maintain airport service vehicles. The primary design considerations are functional location, providing adequate space for large and specialized vehicles, and the potential for combining facilities to improve efficiency.

Technical Specifications and Quantities

Space Requirements

- TABLE 1: Representative Number of Stalls and Employees: This is a critical table for programming the size of a service building. It correlates the number of required vehicle stalls and employees with the airport's runway length and average annual snowfall.
  - For airports with runways ≥ 10,000 ft and snowfall ≥ 15 in: Requires 18 stalls and 20 employees.
  - For airports with runways ≥ 10,000 ft and snowfall < 15 in: Requires 5 stalls and 6 employees.
- Equipment and Servicing Stalls: Should be 12 to 14 ft wide and 40 ft long for typical equipment.
- Tandem Storage Stalls: To save space, the stall depth can be extended to 70 ft to accommodate two vehicles in tandem.
- Ceiling Height: Minimum of 17 ft.

- Office Space: 100 sq ft is adequate for the maintenance superintendent at most airports.
- Personnel Accommodations: An allowance of approximately 10 sq ft per employee for a multipurpose lunchroom is adequate.
- Sand Storage: For airports in icy locations, 250 to 300 tons of sand should be stored on site.

Visual Elements Analysis

Figure 1: Service equipment building siting (Page 960)

Description: An isometric diagram showing three potential locations for a service equipment building on an airport site.

- Location 1: The most desirable location, central to the airfield and adjacent to the hangar area, providing easy access to all runways and taxiways.
- Location 2 & 3: Less desirable locations, further from the airfield core.

Figure 2 & 3: Combination and Service Equipment Buildings (Page 961)

- Figure 2: Shows plans for a combined Fire and Rescue Equipment Unit and a Three Stall Service Equipment Building. This illustrates the concept of combining functions in a single structure.
- Figure 3: Shows plans for a large Eighteen Stall Building and a smaller Thirteen Stall Building, demonstrating different scales of facilities. The plan includes a dedicated area for Sand Storage.

Section: Heliports (Pages 963-968)

Overview

This is a comprehensive guide to the design of heliports, covering governmental roles, classification, site selection, and detailed layout criteria for both ground-level and elevated facilities. The design is governed by the operational characteristics of helicopters and the need to provide clear, obstruction-free approach and departure paths.

Technical Specifications and Formulas

Heliport Classification

- Public-Use: Open to the general public without prior permission.
- Private-Use: Restricts usage to the owner or authorized persons (e.g., a hospital heliport for medical flights).
- Personal-Use: Used exclusively by the owner.

Ground-Level Heliport Design

- Takeoff and Landing Area:
    - Recommended Size: Length and width should be at least 1.5 times the overall length of the largest helicopter expected to use the facility.
- Touchdown Pad: The paved, load-bearing surface where the helicopter lands.
    - Recommended Dimension: Equal to the rotor diameter of the largest helicopter.
    - Minimum Dimension (Public-Use): Length/width at least 2.0 times the wheelbase and tread of the helicopter.
    - Minimum Dimension (Private-Use): Length/width at least 1.5 times the wheelbase and tread.
- Peripheral Area: An obstacle-free safety zone surrounding the takeoff and landing area.
    - Recommended Width: 0.25 times the overall helicopter length, but not less than 10 ft (3 m).
- Taxiway Width: Minimum recommended paved width is 20 ft (6 m).
- Parking Position Clearance: Minimum of 10 ft (3 m) between adjacent parked helicopters.

Heliport Imaginary Surfaces (Obstruction Clearance)

- Heliport Primary Surface: An area coinciding in size and shape with the designated takeoff and landing area. No obstructions are permitted.
- Heliport Approach Surface: Begins at the edge of the primary surface and extends outward for 4,000 ft.
    - Slope: 8 to 1 (For every 8 feet of distance, the surface can rise 1 foot).
    - Width: Starts at the width of the primary surface and flares to 500 ft at a distance of 4,000 ft.
- Heliport Transitional Surfaces: Extend outward from the sides of the primary and approach surfaces.
    - Slope: 2 to 1 (For every 2 feet of distance, the surface can rise 1 foot).

Visual Elements Analysis

Figure 1: Relationship of heliport surfaces (Page 964)

Description: A detailed diagram illustrating the key components and imaginary surfaces for a ground-level heliport. Technical Details: The diagram shows a central Takeoff and Landing Area containing a Touchdown Pad. This is surrounded by a Peripheral Area. Two Approach-Departure Paths are shown, each with its associated Heliport Approach Surface (8:1 slope) and Heliport Transitional Surfaces (2:1 slope). A Safety Barrier and Wind Cone are also indicated.

Figure 2: Relationship of heliport surfaces for a minimal "circular" facility (Page 965)

Description: A similar diagram to Fig. 1, but for a circular heliport configuration. Technical Details: This illustrates how the same safety surfaces (primary, approach, transitional) are applied to a circular takeoff and landing area.

TABLE 2: Summary of Recommended Design Criteria (Page 966)

Description: A comprehensive table summarizing all the key dimensional criteria for heliport design, broken down by Public-Use and Private-Use classifications. Key Quantitative Data:

Design Feature	Dimension (Public-Use)	Dimension (Private/Personal-Use)
Takeoff & Landing Area	1.5 x helicopter overall length	1.5 x helicopter overall length
Touchdown Pad	1.0 x rotor diameter	1.5 x wheelbase
Peripheral Area Width	0.25 x helicopter overall length	0.25 x helicopter overall length
Pavement Grades	2.0% maximum	2.0% maximum
Approach Surface Slope	8:1	8:1
Transitional Surface Slope	2:1	2:1

Figure 7: Platform heliport showing lighting and safety net (Page 970)

Description: A plan view of a rooftop or elevated heliport. Technical Details: The diagram shows the Touchdown Pad Boundary surrounded by a Safety Net. The note explicitly states: "Platform heliports shall have two entry-exit points. The heliport perimeter lights and safety net should not project above the level of the touchdown pad." Safety Net Width: A minimum width of 5 ft (1.5 m) is recommended for safety nets on raised touchdown pads.

BOQ Implications

- Specialty Paving: The BOQ for service equipment buildings and heliports must specify heavy-duty pavement designed to support large vehicles (fire trucks) or aircraft (helicopters).
- Heliport Safety Equipment: The BOQ for an elevated heliport must include specialized safety items, particularly the perimeter safety net, which is a custom-fabricated and engineered system.
- Site Work & Grading: The strict slope requirements for heliport surfaces (2.0% max) and approach paths (8:1) require precise grading and extensive earthwork, which must be accurately quantified in the site work section of the BOQ.
- Specialty Lighting: Heliports require specialized lighting, including perimeter lights for the touchdown pad and a heliport identification beacon, all of which are specific line items for the electrical portion of the BOQ.

Chapter 7: Commercial

Part 1: Regional Shopping Centers (Pages 713-729)

Overview

This section, authored by Lathrop Douglass, FAIA, and Victor Gruen, AIA, provides a comprehensive guide to the planning, design, and development of regional shopping centers. It begins with a historical context, tracing the concept from ancient agoras to modern megacenters. The text covers the entire development lifecycle, including economic analysis, site selection, financing, team assembly, schematic planning, and general design criteria. It emphasizes a customer-centric approach, balancing convenience and merchandising potential, and details the critical elements of mall design, traffic management, landscaping, and tenant mix. The goal is to create a unified, functional, and profitable retail environment.

Key Standards and Codes Referenced

- The Community Builders Handbook, Urban Land Institute, Washington, D.C., 1968. (Referenced for the "List of Stores by Locations").
- Federal Communications Commission (FCC) Regulations are mentioned in the context of planning for radio and TV stations, which are sometimes part of a larger commercial development. (This is a cross-reference from later in the chapter but relevant to the overall scope presented in the table of contents).
- While not named, local zoning ordinances and building codes are repeatedly cited as critical documents to be consulted throughout the planning and design process.

Technical Specifications

Types of Shopping Centers

- Neighborhood Center (Suburban):
  - Specification: A row or strip of stores, typically containing a supermarket and a drugstore as anchors.
  - Measurement/Tolerance: Ranging from 20,000 to 100,000 sq ft of space.
- Intermediate or Community-Size Center:
  - Specification: A strip of stores larger than a neighborhood center, usually containing a "junior" department store as the major unit. This type has declined in desirability.
- Regional Center (Suburban):
  - Specification: Contains one to four department stores plus 50 to 100 or more satellite shops. All stores front on an internal pedestrian mall. Parking completely surrounds the building group.
  - Trend: Strong trend toward double-decking of stores and two, three, or even four-level malls to keep walking distances reasonable.
- Renewal Projects (Downtown):
  - Specification: A close integration of department stores, shops, and restaurants on two or more shopping levels. Malls may connect via bridges to other facilities. Parking is normally multi-decked (above, below, or laterally contiguous).

General Design & Planning Criteria

- Column Spacing:
  - Specification: The dimension along the mall is most significant as it dictates store frontages.
  - Measurement/Tolerance: Commonly used spaces are 20 ft, 25 ft, and 30 ft. The 30 ft spacing is considered the most flexible.
- Store Depths:
  - Specification: For one-story stores in the U.S.
  - Measurement/Tolerance: Buildings are typically 120 to 140 ft deep. This can be reduced by 20% to 25% if basements or mezzanines are included.
  - Design Note: A "dog leg" or "ell" shape can be used to wrap a larger store around a smaller one to achieve shallower depths where needed.
- Clear Heights:
  - Specification: Interior clear height from finished floor to the underside of the ceiling structure.
  - Measurement/Tolerance: Varies from 10 ft to 14 ft or more. A height of 12 ft is considered a good average.
  - Requirement: Sufficient space must be maintained above the clear height for air-conditioning ducts, recessed lights, and structural systems.
- Mall Design:
  - Specification: The trend is away from wide, court-type malls toward narrower malls that facilitate comparison shopping.
  - Measurement/Tolerance: Current widths of 30 to 40 ft are more common than widths of 50 ft or more.
  - Max Length: The length of a mall between department stores or other major anchors should generally not exceed 800 ft (preferably less).

Parking & Traffic

- Parking Ratio (Suburban):
  - Specification: Mandatory requirement for leasable store area.
  - Measurement/Tolerance: 5 to 6 car spaces per 1,000 sq ft of leasable area.
- Parking Ratio (Downtown):

    - Specification: Ratio can be lower due to mass transportation and walk-in trade.
    - Measurement/Tolerance: As low as 2.5 to 3 cars per 1,000 sq ft.
- Parking Stall Allocation:
    - Measurement/Tolerance: An allowance of 400 sq ft per stall is recommended, which includes drives, walks, and landscaping. The maximum recommended size for a single parking lot is 800 cars.
- Parking Lane Widths:
    - Specification: Includes stalls on each side.
    - Measurement/Tolerance: 60 to 64 ft in width for 90° parking. 56 to 58 ft in width for angled parking.
- Landscaping Hedges:
    - Specification: Used to conceal large areas of asphalt parking.
    - Measurement/Tolerance: Must be not less than 3 ft high.

Visual Elements Analysis

Figure 1: ONE OF VARIOUS X DEPARTMENT STORE PLANS; 1 OR 2 LEVELS (p. 713)

- Description: This figure presents four schematic plan diagrams for regional shopping centers, illustrating different arrangements of department stores ("anchors") and smaller shops.
- Technical Details:
    - **i.** Classic Department Store Plan: An "L" shape with two department stores at the ends of the L, and shops lining the inside of the mall connecting them. A future department store is indicated, which would turn the "L" into a "U".
    - **ii.** Classic 2 Department Store Plan: A linear or "strip" mall with a department store at each end. Parking is shown surrounding the entire complex.
    - **iii.** Classic 3 Department Store Plan: A "T" shaped mall with three department stores, one at the end of each leg of the T.
    - **iv.** One of Various 4+ Department Store Plans: A cross or "+" shaped mall with a department store at the end of each of the four legs.

- Construction Notes: These are conceptual layouts. The "Future Department Store" callout implies that phased construction and expansion are key considerations in initial planning.
- Relationship to Text: The diagrams visually explain the "anchor" concept described in the "Schematic Planning" section, where major department stores are strategically spaced to generate customer flow past the smaller satellite stores.

Figure 2: [Mall and Parking Sections] (p. 714)

- Description: This figure contains five cross-sectional diagrams illustrating various configurations of one and two-level malls with different parking and basement arrangements.
- Technical Details:
    - **i.** ONE LEVEL MALL AND RETAIL WITH GRADE PARKING: A simple, single-level retail building with surface parking on both sides.
    - **ii.** TWO LEVEL MALL AND RETAIL WITH GRADE PARKING FEEDING EACH LEVEL: A two-story retail structure with a stacked mall. The site is sloped, allowing for grade-level parking to directly serve both the upper and lower levels.
    - **iii.** ONE LEVEL MALL AND RETAIL IN CBD WITH BASEMENT PARKING: A single-level retail mall with a basement underneath dedicated to parking. Access is from the street.
    - **iv.** TWO LEVEL MALL AND RETAIL WITH LEASABLE BASEMENTS AND SUB-BASEMENT PARKING FOR SALES, BASEMENTS FOR SERVICES: A complex two-level mall with two additional sub-levels. The first basement level contains leasable space, and the sub-basement is for parking.
    - **v.** TWO LEVEL MALL AND RETAIL IN SUBURBAN CBD WITH MEZZANINES FOR NON-SELLING AND FEEDING EACH LEVEL: A two-level mall where each primary retail level also has a mezzanine level for non-selling functions.
- Relationship to Text: These diagrams illustrate the "strong trend toward double decking of the stores" and the use of decked parking, as land costs rise and project footprints need to be more compact.

Figure 3: TYPICAL RESERVOIR LANES, RING ROAD, AND PARKING SYSTEM (p. 716)

- Description: A plan diagram showing a recommended traffic circulation system for a shopping center.
- Technical Details:
  - A = RESERVOIR LANES: Stacking lanes for cars entering the site from the main road, allowing traffic to queue without blocking through-traffic.
  - B = RING ROAD: A continuous road around the perimeter of the parking area, distributing traffic to various parking sections.
  - C = PRIMARY PARKING: The main parking field immediately surrounding the stores.
  - D = SECONDARY PARKING: Additional parking located further out.
  - E = FUTURE PARKING RESERVE: An area of land set aside for future parking expansion.
- Relationship to Text: This figure directly illustrates the traffic management principles discussed in the "Traffic" section, emphasizing the need for smooth ingress/egress and customer choice in parking.

Figure 4: TYPICAL SECTION OF 2 STORY MALL... (p. 717)

- Description: A cross-section of a two-level mall.
- Technical Details: The diagram shows the upper mall level extending over the lower mall level, with an open well between them. The lower level is shown as being narrower than the upper level.
- Construction Notes: The caption explains the design's purpose: "showing narrower lower level sometimes used to give better visibility between levels and increase leasable area." The increased leasable area comes from the ability to have kiosks or other small retail units on the wider upper level.
- Relationship to Text: This visualizes the design principles for multi-level malls, specifically addressing the need for visual interconnection between levels to ensure both are equally desirable to tenants and customers.

BOQ Implications

- Cost Estimation Factors:
  - Financing Structure: Development is typically based on a 10% developer investment and a 90% long-term loan from an institution. This makes the project highly sensitive to construction cost overruns, as a 10% overrun can double the developer's required cash investment.

- Land Cost vs. Construction Cost: The decision to use double-decked parking is a direct calculation of land cost versus the structural cost of a parking deck. High land costs justify decked parking.
- Phased Construction: Bidding strategies are critical. If Stage 2 begins before Stage 1 is complete, it may be difficult to secure competitive bids from new contractors. Using multiple subcontractors in each trade is a suggested method to maintain a competitive atmosphere.

- Quantity Calculation Methods:
  - Leasable Area: The market analysis determines the total recommended floor area to be built, broken down by merchandise type. This is the primary driver for the building's size.
  - Parking Spaces: The number of stalls is calculated as a ratio to the gross leasable area (G.L.A.). 5-6 spaces / 1,000 sq ft in suburbs; 2.5-3 spaces / 1,000 sq ft in downtown. Any expansion of G.L.A. requires a proportional increase in parking.
  - Tenant Mix: The "List of Stores by Locations" (p. 720) categorizes tenants by their ideal location ("100 Percent or 'Hot Spot'," "No. 2 Locations," etc.). This list is a tool for estimating the mix of tenant build-out requirements, which will have varying costs. For example, a restaurant has more intensive MEP requirements than a shoe store.
- Labor Considerations: The document outlines the professional "Team" required for a major project, which must be budgeted for: Developer, Architect, Market Analyst, Leasing Agent, Mortgage Broker, Engineers (Mechanical, Structural, Site), Attorney, and Public Relations Advisor.

Critical Notes and Warnings

- Budgetary Control: The text repeatedly warns that an "inviolable budget" is of "utmost importance" due to the highly leveraged financing structure typical of these projects.
- Project Timing: "Success goes to the developer who 'gets there the fustest with the mostest'." Delaying a project can allow a competitor to capture the market.
- Project Sizing: A project that is too large for its trade area cannot be sufficiently rented and may fail. A project that is too small will invite competition.
- Customer Convenience: It is "axiomatic that a shopper rarely goes where there is inconvenience of any sort." This principle must guide all planning, from vehicular access to pedestrian routes within the mall.

- Multi-Level Mall Design: It is "virtually mandatory that each level be as important as every other level." An inferior level will command lower rents and may not economically justify its construction. This requires equal accessibility from parking and strong anchors at the ends of all mall levels.
- Phased Construction: The most critical time for any center is the year it opens and the two subsequent years. The master plan must provide for a "nearly perfect an initial stage as is possible," as the project's long-term success depends on surviving this initial period.

Cross-References

- Within the document: The text frequently directs the reader to figures on the same or adjacent pages (e.g., "Fig. 1," "Fig. 2"). The table of contents (p. 712) shows the scope of the entire "Commercial" chapter, providing context for how this section on shopping centers relates to later sections on individual retail shops, offices, parking, etc.
- External Standards: J. Ross McKeever (ed.), ***The Community Builders Handbook*****, Urban Land Institute, Washington, D.C., 1968, is cited as the source for the store location lists.**
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Part 2: Retail Shops (General Principles and Specific Store Types, Pages 730-744)

Overview

This section, authored by Murray S. Cohen, AIA, transitions from the macro-level planning of shopping centers to the micro-level design of individual retail shops. It establishes the core principles of "merchandising psychology," which involves attracting customer interest and then satisfying it through convenient and efficient store layouts. The section details the functions of storefronts, entrances, and interior displays. A significant portion is dedicated to providing highly detailed specifications and dimensional standards for fixtures, aisles, and layouts for a wide variety of specific retail environments, including apparel, specialty goods, and service-based shops.

Technical Specifications

General Principles of Retail Shop Design

- Merchandise Classification:
    - Impulse/Luxury Goods: High-profit articles, often placed in high-traffic areas to attract customers.
    - Convenience Items: Staple goods stocked for convenience, intended to draw customers who may then make other purchases.
    - Demand Goods: Articles that customers specifically intend to purchase, acting as a draw to the store.
- Shop Sizes & Heights:
    - Specification: Typical dimensions for shops in 100% retail districts.
    - Measurement/Tolerance:
        - Large Cities: 12 to 15 ft wide by 50 to 60 ft long.
        - Smaller Cities: 15 to 18 ft wide by 60 to 80 ft long.
        - Basement Height: 8 to 9 ft in the clear.
        - Ground Floor Height: Approximately 12 ft (if no mezzanine).
        - Mezzanine Height: At least 7 ft 6 in. above floor level. Ceiling height above mezzanine can be as low as 6 ft 6 in. for service space, with 7 ft preferred for public use.
- Aisle Widths:
    - Clerks' Aisle: Minimum 1 ft 8 in.; desirable 2 ft to 2 ft 3 in.
    - Main Public Aisles: Minimum 4 ft 6 in.; average 5 ft 6 in. to 7 ft; usual maximum 11 ft.
    - Secondary Public Aisles: 3 ft to 3 ft 6 in.

Specific Store Type Requirements

- Women's Wear:
    - Layout: Impulse items (bags, gloves, hosiery, jewelry) at the front. Demand items (dresses, coats, suits) at the rear. Fitting rooms and stock areas are often behind the rear display cases.
    - Minimum Area for Nonselling: A workroom for marking merchandise, making alterations, etc., requires a hanging pole, shelving, and a mirror. Minimum area is 4 ft by 6 ft.

- Men's Wear:
  - Nonselling Areas: Stock rooms require space for about 20% of the store's total stock for peak-load seasons. A tailor shop is required if alterations are done on-premises, with water and electrical connections.
- Bookshops:
  - Aisle Widths: Not less than 3 ft. Main aisles not usually greater than 6 ft or 6 ft 6 in.
  - Shelving Height: Maximum height for average adult reach is 6 ft 3 in. to 6 ft 6 in.
- Gift Shops:
  - Shelving Widths: Range from 8 to 12 in., sometimes up to 20 in.
  - Wrapping Table: Usually sufficient at 3 ft 6 in. by 5 ft, with paper rolls of 18, 24, to 30 in. long.
- Barber Shop:
  - Typical Size: A five-chair shop can be accommodated in a 14 ft by 42 ft space.
  - Clearances: See analysis of Figure 18.
- Tailor and Cleaner:
  - Pressing Unit: Vacuum steam unit is 2 ft 6 in. x 5 ft 0 in. Pressing machine is 5 ft 9 in. x 3 ft 0 in. (or 5 ft 0 in., or 6 ft 0 in.). Tables and racks are 2 ft 0 in. wide, requiring 15 linear ft.
  - Handwork Area: Tables are 3 ft 0 in. x 6 ft 0 in. or 2 ft 6 in. x 5 ft 6 in. Finishing board is 4 ft 0 in. x 6 ft 0 in. Hanging rack is 2 ft 0 in. wide, requiring 4.5 linear ft.
- Beauty Shop:
  - Layout: If manicure tables (15 by 30 in., with 5 ft between tables) are in the waiting area, the waiting room proportion may need to be enlarged from the standard 20% of total area.
  - Booth Dimensions: See analysis of Figure 20.
- Shoe-Repair Shop:
  - Booths: Standardized at 1 ft 8 in. wide, with 2 in. armrests between.
- Florist Shops:

- Mechanical Systems: Store temperatures are held at approximately 50°F. Refrigerated cases are kept at 42 to 50°F.
- Refrigerated Cases: Maximum depth for reach-in cases is 4 ft.
- Workroom: Ribbon is stocked in rolls from 1/4 to 10 in. wide. Box tables may be 4 by 8 ft; box shelves 1 to 3 ft deep.

Visual Elements Analysis

Figure 1: Principles of shop design (p. 730)

- Description: A schematic plan showing the merchandising layout of a retail shop based on customer psychology.
- Technical Details: The layout positions merchandise types strategically.
    - Demand/Staple Goods: Located at the rear and along one side, forcing customers to traverse the store.
    - Impulse/Luxury Goods: Placed along the main circulation path and near the entrance to attract attention.
    - Convenience/Service Areas: (Cashier, wrapper, information) are located centrally, near the exit but out of the primary flow, acting as a control point.
- Relationship to Text: This diagram visually represents the "merchandising psychology" of arousing and satisfying customer interest, as described on page 730.

Figure 2: Typical Store Layouts and Fixture Sections (p. 732)

- Description: This figure provides detailed dimensional standards for common retail fixtures and aisle layouts.
- Technical Details - Layouts:
    - Single Aisle Layout: Shows a wall case, a public aisle (5 ft 0 in.), and an island fixture. Total width: 11 ft 0 in.
    - Double Aisle Layout: Shows two wall cases, two public aisles (5 ft 0 in. each), and a center island. Total width: 11 ft 0 in.
    - Alternate Plan (Tables): Shows a layout with tables instead of showcases. Table dimensions: 4 ft 0 in. to 7 ft 0 in. (L) x 2 ft 6 in. to 3 ft 0 in. (W).
    - Fixed Seating (Shoe Stores): Shows a layout with chairs and fitting stools, with an aisle width of 3 ft 6 in. and a total width of 10 ft 9 in.
- Technical Details - Fixture Sections:

- Wall Case: 1 ft 6 in. deep.
    - Clerk's Aisle: 2 ft 8 in. to 2 ft 10 in.
    - Counter Showcase: 1 ft 8 in. to 2 ft 0 in. deep.
    - Public Aisle: 5 ft 6 in. avg.
    - VZ Center Case for Islands: 4 ft 6 in. to 5 ft 0 in. overall width.
- Construction Notes: Diagrams show adjustable shelves, sliding doors, drawers, and glass showcases, indicating standard millwork construction.

Figure 3: Shelving Data, Fixture Dimensions, and Fitting Rooms (p. 733)

- Description: A comprehensive data sheet with tables and diagrams for various retail fixtures.
- Technical Details - Tables:
    - Show Cases & Tall Cases: Provides Height, Width, Length for Haberdashery, Bakery, Millinery, etc. Example: Haberdashery show case is 3 ft 2 in. (H) x 1 ft 10 in. (W) x 4, 6, 8, 10 ft (L).
    - Wrapping Counter: Section shows a 2 ft 10 in. high counter with a width of 6 to 10 ft and a depth of 2 ft 2 in.

○ Shelving Data: This critical table provides standard shelving dimensions for different store types.

S	**Depth**		**DistanceBetween**	**D**

J	Large: 2'0" / Small: 1'0"		1'3" to 1'6"	S
G	General: 1'6" / S		1'8" (lower adjus	O

	tasples: 1'0" to 1'6"		table)	
H	Men's: 1'2"/Women'		1'0"	S

	s: 1' 2"			
L	1' 2"		9", 12", 15"	O
B	8", 9", 10"		10", 1' 2"	O
W	10" to 1		1' 2" ac	S

	'6"		justable	

- **Construction Notes: The fitting/dressing room diagrams show dimensions for different user configurations (customer and fitter, customer only) and specify wood partitions with curtains or doors.**

Figure 5: Determining optimum show-window depths (p. 735)

- Description: A set of three technical diagrams explaining how to determine the optimal depth of a show window based on the human cone of vision.

- Technical Details:
    - Principle: The average human eye sees comfortably within a 60° cone. Objects on display are optimally viewed when they fall within this cone without requiring excessive head/eye movement.
    - Diagram 1 (First Floor): Shows an "Eye Level" at 5 ft 0 in. and a "Sidewalk Line." For a bulkhead height of 1 ft 3 in. to 1 ft 6 in., the optimum viewing plane for locating an object is established. A minimum distance of 3 ft 0 in. from the glass to the viewer is assumed. Louvered lighting fixtures are shown, which may project into the viewing angle if not carefully placed.
    - Diagram 2 (Second Floor): Applies the same 60° cone principle to a second-floor display, where sight lines are limited by the window dimensions themselves.
    - Diagram 3 (Basement & First Floor): Extends the principle to a multi-level display viewed through a single large window, showing separate optimum viewing planes for objects placed on the basement floor and the first floor.
- Relationship to Text: These diagrams provide the technical basis for the design of effective show windows, a key element in "attracting customers."

Calculations and Formulas

- **This section does not contain explicit mathematical formulas. However, it is built upon procedural calculations and dimensional rules of thumb.**
- **Area Calculation: Shop area is calculated as Width x Length. For example, a small city shop is 15 ft x 60 ft = 900 sq ft.**
- **Fixture Count: The number of fixtures (e.g., barber chairs, manicure tables) and their required clearances dictates the overall room size. This is an additive calculation process.**
- **Shelving Capacity: The shelving data table allows for the calculation of total linear feet of shelving required based on stock type and volume.**

BOQ Implications

- Millwork & Fixtures: This section is a foundational resource for a Bill of Quantities for interior fixtures. Every dimension provided for showcases, counters, shelving, wall cases, fitting rooms, and specialty items (e.g., wrapping counters, display tables) is a direct input for costing and manufacturing.
- Material Takeoffs: Specific materials are mentioned that would be part of a BOQ.

- Flooring: Carpeting, linoleum, tile, glass brick.
- Walls: Mirrored walls (florists), wood paneling, plaster.
- Fixtures: Plywood, hardwood, glass, linoleum (for counter tops), metal, plastic trays.

- Labor & Specialized Trades:
    - Electrical: Special show-window lighting, "daylight" fixtures for color matching (men's wear), intense lighting for jewelry stores, general and accent lighting.
    - Mechanical (HVAC & Plumbing): Refrigeration and temperature control for florists; exhaust ventilation for show windows to reduce heat from lights; plumbing (sinks, shampoo basins, sterilizers) for barber, beauty, and tailor shops.
    - Security: Requirements for jewelry stores (vaults, secure display cases) imply costs for specialized security hardware and installation.

Critical Notes and Warnings

- Flexibility: "Flexibility so that fixtures and departments can be moved or modified is part of present-day merchandising." Fixtures should be minimized and adaptable.
- Customer Flow: The layout must be organized in relation to how customers move through a store. Tendencies to turn right, be attracted by doorways, and choose wider aisles should be considered.
- Display Overload: "Every inch of space must not be crowded with goods 'on display,' because such practice causes loss of customer interest."
- Show-Window Design: Glazing that eliminates reflections is highly valuable. Window backs can be open or closed depending on the desired level of privacy vs. interior visibility. Access for window dressing must be easy.
- Lighting: For specialty shops, light intensities are often increased "far above requirements for ordinary vision, in an effort to overcome reflections."

Part 3: Drugstores, Liquor Stores, and Shoe Stores (Pages 745-750)

Overview

This section continues the deep dive into specific retail types, providing detailed architectural and operational standards for drugstores, liquor stores, and shoe stores. It outlines the evolution of these stores, such as the drugstore's transformation into a large variety-type store and the liquor store's adaptation to new market trends and security needs. The content provides specific dimensional data for layouts, fixtures, and departmental organization. A significant focus is placed on customer flow, merchandising strategy, security, and the integration of specialized equipment like refrigeration and inventory control systems.

Technical Specifications

Drugstores

- Storefront: Typically the open or see-through type, with shallow display windows and high platforms.
- Layout Principles:
    - Departmentalization: The interior must be well-organized and grouped.
    - Prescription Department: Usually located in the rear of the store to force customers past impulse-buy items. Often elevated one or two steps for better control and visibility of the entire store.
    - Tobacco Section: Often located in the rear for the same reason as prescriptions, but some operations place it at the front cashier.
    - Luncheonette & Cosmetics: Typically located at the front.
    - Work Area: The prescription work area is divided into a "wet" and "dry" area with a worktable, stainless-steel sink with hot/cold water, and a refrigerator.
- Fixture Specifications: Selling is primarily from open displays, gondolas, and continuous wall shelving, similar to supermarkets. This includes a curtain wall and continuous light cornice at the top of the shelving.

Liquor Stores

- Layout & Operational Trends (Future-focused):
    - Refrigeration: Use of "Zoned and cold wall refrigeration" and "refrigerated gondolas" to hold merchandise at correct temperatures (37°F to 61°F). Walk-in coolers are to be eliminated.

    - Inventory & Security: Perpetual inventory systems, electronic air filters, automatic check-out systems, and electronic pilferage detection systems (e.g., "sensormatic" with a sensitized dot in price tags) are key trends.
- Storefront & Security:
    - Type: Usually a completely open, see-through type, often mandated by state laws requiring the interior to be visible from the street.
    - Security: Must have an overhead rolling grille or folding gate for after-hours protection. A comprehensive alarm system is required for all openings.
- Interior Layout & Fixtures:
    - General Layout: Self-service with open shelving, but with sufficient clerks available. The center of the floor is kept free, using portable gondolas or islands.
    - Shelving: Similar to supermarket shelving with label holders.
    - Wine Display: Inexpensive wines are on shelves. Other wines are stored lying down in racks, with an upright display bottle for label visibility. Sloping shelves are an alternative. An illuminated wine chiller is considered a "must."
    - Beer/Mixers: Located at the rear/side, stored and displayed in reach-in refrigeration, preferably built into the wall.
    - Cashier/Office: Counter is generally toward the rear. The office should be located to allow control over deliveries and a view of the cashier and store entrance.
- Material Specifications:
    - Flooring: Carpeting with a foam backing (to reduce bottle breakage) or non-polish floor tile in the sales area. Hard floor covering in storage areas.

Shoe Stores

- Storefront: See-through type with a large, enclosed show window.
    - Show Window Depth: 4 ft 6 in. to 5 ft 0 in.
    - Show Window Platform Height: 2 ft 0 in. above the floor.
- Interior Layout:
    - Seating: Must be maximized. Chairs should be comfortable and have arms to provide separation.

    - Children's Area: A raised platform, accessible by steps, is highly desirable for fitting children's shoes.
    - Stock Storage: Exposed shelving in the sales area should not be higher than can be reached without a stool. Concealed stock room shelving can extend up to 10 ft 0 in. and may be arranged in two levels ("library stacks").
- Lighting & HVAC:
    - Show Window Lighting: Predominantly incandescent. An exhaust system is needed to reduce heat buildup.

Visual Elements Analysis

Figure 22: Drugstore (p. 745)

- Description: A schematic plan of a large drugstore, demonstrating departmental layout.
- Technical Details: The plan shows distinct areas for "Magazines," "Toiletries," "Drugs," "Tobacco etc.," "Fountain Service," and "Soda Booths."
    - Plan Dimensions Table:
        - Soda Booths (a): 1 ft 4 in. (seat width)
        - Soda Booths (b): 2 ft 0 in. (table width)
        - Soda Booths (c): 4 ft 8 in. min. (booth unit width)
        - Soda Booths (d): 3 ft 6 in. min. (aisle width)
        - Wall case/counter depth (b): 12 ft 6 in.
        - Main aisle (f): 21 ft 6 in.
- Construction Notes: The layout is linear and highly organized, reflecting a variety store concept.

Figure 23: Pharmacy area of drugstore (p. 745)

- Description: A plan and section of a typical prescription department.
- Technical Details: The plan shows a "Counter," "Display," "Work Bench," "REF." (refrigerator), and "Stock Room." A key feature is the "Raised Floor" for the pharmacy area.
- Construction Notes: The pharmacy is elevated, which, as the text notes, provides the pharmacist with better visual control over the entire store. This has structural implications (a raised platform must be built).

Figure 24: Typical liquor store layouts (p. 747)

- Description: Three plans showing layouts for small, semi-self-service, and large liquor stores.
- Technical Details:
    - (a) Small, self-service: A simple layout with an office, refrigerated beer case, wall shelving, island displays, and a counter.
    - (b) Semi-self-service: More structured, with a central cashier's counter creating a defined entry and exit path, improving control.
    - (c) Large self-service: Resembles a supermarket with checkouts, a back bar, and specialized areas like "Gift Pack Island," "Beverage Stacking and Beverage Racks," multiple "Liquor Island" gondolas, and a "Conveyor" for moving stock.
- Relationship to Text: These diagrams visually represent the different operational scales and security levels discussed in the text, from a simple neighborhood store to a large, high-volume operation.

Figure 25: (a) Sock bar. (b) Shoeshine stand. (p. 748)

- Description: Detailed sections of accessory fixtures found in a shoe store.
- Technical Details:
    - (a) Sock bar: A wall-mounted display unit with a light cornice, mahogany and cork materials, and a wood shelf. Overall depth is 1 ft 8 in.
    - (b) Shoeshine stand: A raised platform with a leather seat, hardwood handrail, and a step. The step riser is 1 ft 0 in.
- Construction Notes: These are detailed millwork drawings, indicating specific materials and finishes.

Figure 26: Men's shoe store. (p. 749)

- Description: A collection of plans and elevations for a typical men's shoe store.
- Technical Details:
    - Floor Plan: Shows a store width of 16 ft 0 in. to 20 ft 0 in. It includes a show window, cashier, hose display, seating area, display islands, a work-bench, and a stock room. Aisle between seating rows is 3 ft 0 in.
    - Shelving Sections:
        - Sales room shelving is 7 ft 6 in. high (for 2 boxes high).
        - Stock room shelving is 8 ft 0 in. to 10 ft 0 in. high.

        - A "Double Deck" shelving system using a steel deck reaches a minimum height of 14 ft 6 in.
    - Foot Mirror: A detailed drawing of a weighted floor mirror, 1 ft 4 in. wide and 1 ft 8 in. high.
- Relationship to Text: Provides the specific dimensional context for the general principles of shoe store design described on page 748.

Figure 27: (a) Showcases: open stock shelves (b) Hose counter. (p. 750)

- Description: Detailed millwork drawings for shoe store fixtures.
- Technical Details:
    - (a) Open stock shelves: A section showing a showcase that is 3 ft 2 in. high and 1 ft 10 in. deep. It features a fluorescent light in a metal rail, adjustable glass shelves, and sliding wood doors on the back.
    - (b) Hose counter: An elevation and section of a hosiery sales counter, 3 ft 2 in. high. It includes a hinged access drawer for stock.
- Construction Notes: These are build-to-spec drawings, providing all necessary information for a cabinet maker to construct the fixtures.

BOQ Implications

- Quantity Measurement & Costing:
    - Fixtures: The detailed diagrams of shelving, counters, showcases, and specialty fixtures (e.g., shoe shine stands, foot mirrors) provide the basis for a complete millwork takeoff. Quantities are determined by the linear feet of wall shelving or the number of discrete units (gondolas, counters).
    - Specialized Systems:
        - Liquor Store Refrigeration: The "cold wall" and "refrigerated gondola" concepts imply significant costs for specialized, custom refrigeration systems, far exceeding standard walk-in cooler costs.
        - Security Systems: Costs must be allocated for electronic anti-pilferage systems, comprehensive alarm systems, and heavy-duty physical security like rolling grilles.
    - Flooring: The specification of foam-backed carpet for liquor stores to reduce breakage is a unique material requirement with a specific cost implication.

- Material Waste Factors: The use of standard fixture dimensions (e.g., shelving heights/depths) allows for efficient use of standard material sizes (like plywood sheets), potentially reducing waste. Custom layouts in odd-shaped stores would increase waste.
- Labor Considerations:
    - Millwork: The complexity of the fixtures, with features like integrated lighting, sliding glass doors, and adjustable shelves, requires skilled cabinet makers.
    - Specialized Trades: Installation of refrigeration systems, security systems, and commercial-grade exhaust hoods (for shoe store window lighting) requires specialized labor.

Critical Notes and Warnings

- Legal & Regulatory Compliance: Liquor store design is heavily regulated by local and state authorities. Plans must be checked carefully for requirements like visibility from the street and limitations on entrances.
- Security is Paramount: For liquor stores, security against both external theft (robbery) and internal pilferage is a primary design driver, influencing layout, fixture selection, and the specification of alarm and surveillance systems.
- Adapt to Demographics: Liquor store design must adapt to the "emergence of women as liquor store customers," who are noted to be more critical of layout and more susceptible to impulse buys, requiring a more attractive and well-lit environment.
- Shoe Store Functionality: Dust on shoes degrades merchandise, so show windows must be tightly enclosed. Stock rooms with high shelving ("library stacks") or double-deck systems are efficient but require planning for access (ladders, stairs).

Part 4: Supermarkets and Banks (Pages 751-754)

Overview

This part details the architectural and planning standards for two distinct commercial types: supermarkets and banks. The supermarket section, by Herbert Ross and Egmont Arens, describes the facility as a large-scale, highly efficient emporium of merchandise, focusing on layout, fixture design,

and the critical role of refrigeration. The banks section transitions to a service-oriented environment, outlining the evolution of bank design from imposing fortresses to more open, customer-friendly facilities that must balance security, operational efficiency, and a welcoming public image. It provides a functional breakdown of all spaces within a modern bank, from the public lobby to the high-security vaults.

SUPERMARKETS

Technical Specifications

- Building Size and Area Allocation:
  - Specification: New, free-standing supermarkets.
  - Measurement/Tolerance: Average size ranges from 22,700 sq ft to 31,000 sq ft.
  - Area Ratio: 75% to 80% of total area is devoted to selling space; 20% to 25% is for service areas (storage, prep, etc.).
- Sales and Performance Metrics:
  - Weekly Sales: Varies from $3.10/sq ft to $3.75/sq ft of selling space.
  - Check-out Stands: One check-out stand for each $10,000.00 of projected weekly volume, plus one additional stand for future expansion.
- Parking Ratio:
  - Specification: A ratio of parking area to total store area.
  - Measurement/Tolerance: 3.6 sq ft of parking to 1 sq ft of total store area.
- Structural System:
  - Column Spacing: Columns should be spaced to be kept out of shopping aisles. Assuming a 7 ft 0 in. aisle between 4 ft 0 in. wide shelving islands, a column spacing in a multiple of 11 ft 0 in. is recommended.
- Fixture and Shelving Dimensions:
  - Top Shelf Height: Should not be over 5 ft 3 in. high, allowing a view angle of not more than 15° above the horizontal.
  - Bottom Shelf Height: Minimum height is about 15 in. above the floor.
  - "Super Island" Units: Longest common length is 9 ft. Shelf supports are typically spaced at a norm of 2 ft 6 in.

    - Material Requirements: Shelves for cakes and bread may be 1/2 in. thick plywood. General super-shelving may use 1 1/16 in. boards.

Visual Elements Analysis

Figure 1: Typical free-standing supermarket. (p. 751)

- Description: A detailed architectural floor plan for a 30,000 sq ft supermarket.
- Technical Details: The building is rectangular, 200 ft wide by 150 ft deep. The layout is organized on a grid with clear departmental zones.
    - Rear Service Core: Contains Garbage Storage, Meat Service Area & Cooler, Deli/Delicatessen, Produce Prep Area & Cooler, Dairy, and Frozen Food Storage. A Loading Dock is shown at the rear.
    - Selling Area: The front portion of the store, featuring produce displays, gondolas for groceries (approx. 1,500 lineal feet), a commercial bakery area, and a row of 10 checkouts near the front entrance.
    - Support Areas: Includes Toilets, Lockers, and Mechanical space.
- Construction Notes: The plan demonstrates the key principle of locating refrigerated cases and service departments as close as possible to their associated back-room work areas and coolers to ensure efficient stocking and operation.
- Relationship to Text: This plan serves as the primary visual example for the text, with the provided calculations for area, sales, and checkouts directly reflecting the rules of thumb described by the author.

Supermarket Fixture Diagrams by Egmont Arens (p. 752)

- Description: A page of detailed elevations and sections for various types of supermarket shelving and display units.
- Technical Details:
    - Super-Shelving Section: Illustrates the "easy-to-reach zone" between 15 in. and 5 ft 3 in. from the floor. It shows cans on the bottom shelf designed to be legible while lying on their side.
    - Bottom Shelf Price Tag Mouldings: A detail showing a 1"x3" strip and plywood front for holding price tags.
    - Tumble Display: A bulk display fixture, typically 7 ft 8 in. long, with open or closed sides and a mirrored back. The plan view shows it can be semicircular or rectangular.

    - End Display: An end-cap fixture, shown as symmetrical with an adjustable mirror and shelving. Dimensions are 1 ft 0 in. deep and 7 ft 8 in. long.
    - Check-Out Counter Section: Shows a counter with space for the cashier, a stock area for bags, and a shelf noted as an "important area for small articles or for merchandise subject to 'impulse' buying."
    - Fruit & Vegetable Bins Section: Features a tilted display with a mirrored back to enhance appearance and a note indicating the wall line should be cut lower for ease of restocking.
- Relationship to Text: These visuals provide the specific design details and dimensions for the fixtures mentioned generally in the text, emphasizing merchandising principles like visibility, accessibility, and impulse buying.

BOQ Implications

- Equipment: 50% of total equipment investment is in refrigeration. This is a major budget item and includes walk-in coolers, freezers, and a wide variety of refrigerated display cases (meat, dairy, produce, frozen food, deli). The other 50% includes grocery shelving (gondolas), check-out counters, and bakery equipment.
- Construction: A centralized refrigeration system is required, involving a bank of compressors and condensers in a dedicated mechanical room with extensive refrigerant piping running to individual cases throughout the store. Raised platforms for departments like the pharmacy would be a structural item.
- Material Takeoffs: Large quantities of grocery shelving (gondolas and wall units), check-out stands, and specialized fixtures for produce and bakery departments. Flooring must be highly durable (e.g., VCT or polished concrete).

BANKS

Technical Specifications

- Architectural Philosophy: Shift from fortress-like, aloof structures to inviting, open designs using glass, color, and art. Emphasis on flexibility, drive-in/walk-up facilities, and multi-use spaces (e.g., community meeting rooms).

- Space Descriptions (Functional, not dimensional):
  - Public Spaces: Lobby, Tellers, Loan Officers Platform, Check-writing Desks.
  - Secure Public Access: Safety Deposit Vault, which must include coupon booths and a conference room (sized for 10-20 people).
  - Operations (Non-Public): Bookkeeping, Proof Department, Data Processing (requires special AC and false floors for cables), Mail Room, Fireproof Records Vault.
  - High-Security (Staff Only): Money Vault.
  - Specialized Services: Drive-in and walk-up teller windows, Trust Department, Auditorium/Meeting Room (sized for 200-300 people).
  - Executive Suite: Offices for senior management, board room.

Visual Elements Analysis

Figure 1 & 2: Bank Vaults (p. 754)

- Description: Four highly detailed architectural plans for bank vaults, provided by Mosler Safe Co., showing single-aisle and double-aisle configurations.
- Technical Details:
  - Vault Plan A (Single-Aisle):
    - Dimensions: 8 ft 0 in. min. inside clear width; 14 ft 0 in. inside clear length.
    - Components: Labeled sections for "Cash Vault" and "Safe Deposit Vault" containing "Modular S.D. Boxes" and "Modular Lockers." The main aisle is 24.5 in. wide.
    - Area: 112 sq ft inside floor area.
  - Vault Plan D (Double-Aisle):
    - Dimensions: 14 ft 0 in. inside clear width; 14 ft 0 in. inside clear length.
    - Components: Similar components to Plan A but with a more extensive layout facilitated by two aisles.
    - Area: 196 sq ft inside floor area.
  - Vault Plan E (Double-Aisle):
    - Dimensions: 14 ft 0 in. inside clear width; 16 ft 0 in. inside clear length.

        - Components: A larger, more complex arrangement of cash and safe deposit storage.
        - Area: 224 sq ft inside floor area.
- Construction Notes:
    - Walls: Plans specify "Steel Lining" for the vault perimeter.
    - Ventilation: An "Air-Guard Ventilation Port" and an "Emergency Vault Ventilator" are required.
    - Alarms: The "Vault Alarm Control Cabinet" (labeled "A") must be located so as not to interfere with the removal of bond boxes, suggesting it should be recessed into the vault wall.
- Relationship to Text: These drawings provide the exact, buildable specifications for the high-security vault areas described as a core function of a bank. They are the most technically detailed element in this section.

BOQ Implications

- High-Security Construction: The vault is the most significant and specialized cost item. This includes the vault shell (reinforced concrete with steel lining), the vault door, the day gate, and the emergency ventilator. These are supplied by specialized manufacturers like Mosler.
- Specialized Equipment: Safety Deposit Boxes (in modular units), drive-up windows, pneumatic tube systems, night depositories, alarm systems, and surveillance cameras are all critical budget items.
- MEP Systems: Data processing centers require dedicated, redundant air conditioning systems (HVAC) and extensive underfloor electrical and data cabling, necessitating raised flooring systems.
- Interior Finishes: Bank design often calls for high-grade finishes such as stone, wood paneling, and architectural metals to convey an image of stability and permanence, impacting the cost of interior work.

Critical Notes and Warnings

- Circulation and Security: Bank design is a careful balance of providing easy public access while maintaining strict security. The flow must separate public areas, operational areas, and high-security zones.

- Flexibility: The text emphasizes that banking is an evolving business, and facilities must be flexible enough to accommodate changes like the growth of drive-up services or the introduction of new technology.
- Specialized Knowledge: The design of vaults and data processing areas requires consultation with specialized manufacturers and engineers. The architect's role is to integrate these technical requirements into a cohesive and functional building.

Part 5: Restaurants and Eating Places (General Planning, Pages 755-758)

Overview

This section, authored by Lendal H. Kotschevar and Margaret E. Terrell, establishes the core principles of space planning for all types of food service facilities. It emphasizes that space allocation is a critical balancing act between investment costs and operational efficiency. The text provides a systematic approach to planning, starting with the dining area and moving to production, serving, and storage areas. It introduces key metrics and rules of thumb for calculating space needs based on the number of patrons, type of service, menu complexity, and operational policies. The primary goal is to create a layout that ensures customer comfort, efficient workflow, and profitability.

Key Standards and Codes Referenced

- Source Document: The content of this section is based on ***Food Service Planning***, **by John Wiley & Sons, New York, 1967.**
- **While not explicitly named, the text implies adherence to health and sanitation codes, especially in the discussion of sanitation areas, dishwashing, and storage.**

Technical Specifications

Dining Area Space Requirements

- Place Settings:
  - Adults: 24 in. of table space per person.
  - Children: 18 to 20 in. of table space per person.

- Booth Dimensions:
    - Overall Width: A complete booth unit (two benches and a table) is commonly 5.5 ft wide.
    - Table Length: Tables for booths should not be longer than 4 ft for ease of service.
- Table Dimensions:
    - Small Square Tables: 24 in. or 30 in. square (noted as economical but uncomfortable for large people).
    - Cafeteria Tables: Must be sized to accommodate standard trays (e.g., 14 in. x 18 in. trays). A 48 in. square table works well for four such trays.
- Counter Dimensions:
    - Counter Width: 16 in. (min) to 24-30 in. (max).
    - Linear Feet per Seat: 20 to 24 in. per seat.
    - Space Depth per Linear Foot of Counter: 8.5 to 11 ft is required to accommodate the counter, a public aisle (3-4 ft), and employee aisle space (2.5 ft).
- Aisle Space:
    - Minimum Passage: 18 in. between the backs of chairs.
    - Table Spacing: Tables should be spaced 4 to 5 ft apart to allow for chairs and passage.
    - Main Aisles: Must be sized according to the width of mobile equipment (bus carts, etc.).
- Serving Stations:
    - Small Substations: 20 to 24 in. square and 36 to 38 in. high.
    - Central Stations: Approximately 8 to 10 ft long x 27 to 30 in. wide x 6 to 7 ft high.
- Working Height:
    - A height of 34 in. is commonly used for work tables.

Production and Support Area Space Requirements

- Hospital Production/Service Areas:

    - Measurement/Tolerance: 20 to 30 sq ft per bed. This need reduces as the number of beds increases (e.g., 30 sq ft/bed for a 50-bed hospital vs. 20 sq ft/bed for a 200-bed hospital).
- Work Area Aisles:
    - Single Worker Aisle: 36 in. wide.
    - Multi-Worker/Passing Aisle: 42 in. wide.
    - Aisle with Mobile Equipment: 48 to 54 in. wide.
    - Main Traffic Aisle: 60 in. wide minimum.
- Receiving and Storage:
    - Receiving Dock: 8 ft deep x 12 ft long is sufficient for an average operation.
    - Floor Loading: Canned goods stacked 6 cases high on flat trucks have a bearing weight of 250 to 300 lbs per sq ft.
    - Storage Aisles: 36 in. (narrow) to 48 in. (preferred).
    - Refrigerated Storage: Doors should be a minimum of 42 in. wide. Aisles inside walk-ins should be 42 in. for single-side storage or 42 in. for passage between two sides of storage.
- Dishwashing Area:
    - Space Allocation: For basket-type machines, the clean dish area should occupy 60% of the total table space, and the soiled dish area should occupy 40%.
- Pot and Pan Washing Area:
    - Minimum Area: 40 sq ft for the smallest unit.
    - Aisle Width: The free work aisle between sinks and other equipment should be 4 ft wide.

Visual Elements Analysis

Figure 1: Flow diagram showing functional relationships. (p. 758)

- Description: This is a block-style flow diagram illustrating the ideal functional relationships and workflow within a comprehensive food service facility.
- Technical Details: The diagram traces the primary path of food and the secondary paths of materials and waste.

    - Primary Food Flow: Starts at "Delivery yard and receiving area", moves to storage ("Common storage," "Refrigerator storage," "Vegetable storage"), then to preparation ("Meat preparation," "Vegetable preparation"), then to cooking ("Bake shop," "Cook's unit," "Salad and Sandwich unit"), and finally to the "Serving area" and "Dining rooms".
    - Secondary Flows:
        - Dishwashing: A loop is shown from the "Dining rooms" to "Dishwashing" and back to the "Serving area."
        - Pot Washing: A loop connects the cooking units (Cook's, Salad/Sandwich, Bake Shop) to the "Pot and pan washing and utensil" area.
        - Waste Management: All preparation and washing areas feed into waste streams leading to the "Can and truck washing" and "Garbage can storage" areas, which are located near the delivery/receiving area for easy removal.
- Relationship to Text: This diagram is the definitive visual guide for the entire section. It graphically represents the principle of linear workflow, the importance of adjacency between related functions (e.g., storage near prep), and the need to manage ancillary flows like dishwashing and waste removal without crossing primary production lines.

Calculations and Formulas

Dining Area Capacity and Size

- Formula (Implicit): `Total Dining Area (sq ft) = Number of Seats × Square Feet per Seat`
- Variables:
    - Number of Seats: Determined by analyzing peak demand, customer turnover rates, and acceptable vacancy rates.
        - Turnover: The number of times a seat is occupied per hour. Varies by meal (breakfast is fastest) and service type (cafeteria is faster than deluxe table service). Patrons bussing their own tables speeds turnover by 10%.
        - Vacancy Rate: A percentage of seats that will remain unfilled even at peak load. Typically 20% for table service, 12-18% for cafeterias.

    - Square Feet per Seat: See Table 1. Varies by operation type.
        - Cafeteria (commercial): 16-18 sq ft/seat
        - Counter service: 18-20 sq ft/seat
        - Table service (hotel, club): 15-18 sq ft/seat
        - Banquet (minimum): 10-11 sq ft/seat

Kitchen Area Size

- Formula (Implicit): **`Total Kitchen Area (sq ft) = Max. Meals per Hour × Square Feet per Meal`**
- Variables:
    - Max. Meals per Hour: The peak production volume of the facility.
    - Square Feet per Meal: See Table 3. This value is inverse to the number of meals served (economy of scale).
        - Example (Restaurant, 400-800 meals/hr): 5.0-3.6 sq ft/meal.
        - Example (Hospitals, 400-800 meals/hr): 11.0-4.5 sq ft/meal.

Storage Area Size

- Common Storage (Dry Goods):
    - Rule of Thumb: For a one-month supply to serve 100 people three meals daily, 45 cases of 6/10 cans are needed. 3 cu ft is estimated per stack, including aisle space.
- Refrigerated Storage:
    - Rule of Thumb: 15 to 20 cu ft of refrigeration is needed per 100 complete meals served. Or, 1 to 1.5 cu ft of usable space for every three meals served.
    - Weight Capacity: About 45 lbs of frozen food can be stored per cubic foot. About 30-35 lbs of refrigerated food can be stored per cubic foot.

BOQ Implications

- Equipment: The text identifies numerous specific equipment categories for the BOQ:
    - Dining: Tables, chairs, booths, counters, service stations.
    - Serving: Mobile carts, cafeteria counters (hot/cold sections), back bars, tray slides.

    - Production: Ranges, ovens, steamers, kettles, fryers, broilers, mixers.
    - Storage: Walk-in refrigerators, freezers, fixed shelving, mobile bins, dollies.
    - Sanitation: Conveyor-type dishwashers, pot washing sinks (3-compartment), garbage disposals, can washers.
- Construction Materials: The need for depressed floor slabs for walk-in coolers, durable/non-slip flooring in kitchens, and special wall finishes (tile or equivalent) are key construction cost factors.
- MEP Systems: Extensive plumbing (drains, hot/cold water, sinks), electrical (for all equipment), and ventilation (especially exhaust hoods over cooking equipment) are required.

Critical Notes and Warnings

- Avoid Generic Planning: The authors repeatedly warn against using simple area ratios (e.g., kitchen is 1/3 of dining) and insist on a detailed analysis of the specific menu, service type, and volume.
- Workflow is Paramount: The layout must be designed for a forward flow of work to minimize cross-traffic and backtracking. Main thoroughfares should not pass through individual work centers.
- Plan for Flexibility: Consider future needs and the possibility of expansion. Design choices should be made regarding on-site processing (e.g., meat cutting vs. buying portion-ready meats) as this heavily impacts space requirements.
- Balance Cost and Function: Ample space is needed for efficiency, but excessive space increases building and maintenance costs. The planner must find the optimal balance.

Part 6: Restaurant Seating (Pages 759-762)

Overview

This section provides a highly detailed and technical breakdown of dimensional standards for restaurant seating layouts. Authored by Fred Lawson, it moves from general planning principles to specific, quantifiable spatial arrangements. The content is presented almost entirely through diagrams and tables, offering minimum, desirable, and comfortable dimensions for various configurations of tables, chairs, booths, and

banquettes. It covers arrangements for different party sizes and considers the critical space requirements for both public circulation and service access, ensuring that layouts can be optimized for capacity, customer comfort, and operational efficiency.

Key Standards and Codes Referenced

- Source Document: The diagrams and data are explicitly credited to Fred Lawson, *Restaurant Planning and Design*, The Architectural Press, Ltd., London, 1973.

Technical Specifications

This section is composed almost entirely of technical specifications presented visually. The key dimensional data is summarized below. (Note: All dimensions are in feet and inches).

Table and Chair Seating Dimensions (from Figs. 1, 4)

Parameter / Aisle Type	Absolute Min.	Desirable Min.	Comfortable
Ap - Public Circulation	3'-0" to 4'-6"	3'-6" to 5'-0"	3'-9" to 5'-0"
As - Service Aisle	3'-0" to 4'-6"	3'-6" to 5'-0"	4'-0" to 5'-6"
B - To Wall Clearance	1'-8" to 2'-0"	2'-0" to 2'-6"	2'-0" to 3'-0"
C - Between Units (chair back to chair back)	1'-8" to 3'-6"	2'-3" to 4'-0"	2'-4" to 4'-0"
L - Perimeter per seat (circular tables)	1'-10"	2'-0"	2'-2"

Booth Furniture Heights (from Fig. 5)

Parameter	Absolute Min.	Desirable Min.	Comfortable
H - Overall Height	**3'-0" to 3'-6"**	**3'-6"**	**4'-0"**
S - Seat Height	**1'-5" to 1'-6"**	**1'-5" to 1'-6"**	**1'-6"**
T - Table Height	**2'-5"**	**2'-5" to 2'-6"**	**2'-6"**
W - Table Width	**1'-8" to 2'-0"**	**2'-0" to 2'-2"**	**2'-4" to 2'-6"**
Seat Depth	**1'-4" to 1'-5"**	**1'-5" to 1'-6"**	**1'-6" to 1'-8"**
Splay (backrest angle from vertical)	**0" to 3"**	**2" to 3"**	**3.5" to 4"**

Visual Elements Analysis

Figure 1: Seat groupings around rectangular and circular tables. (p. 759)

- Description: A series of plan-view diagrams showing different module sizes for seating arrangements based on party size and table shape.
- Technical Details:
  - 2-Person Tables: Rectangular tables shown with modules of 5'3" x 5'3". Circular tables with a module of 6'3" x 6'3".
  - 4-Person Tables: Rectangular tables shown with modules of 7'6" x 8'6" (waitress service) or 7'6" x 9'6" (self-service). Circular tables with a module of 8'0" x 8'0".
  - Diagonal Arrangement: Shows 4-person tables set at a 45-degree angle within a module of 10'6" x 10'6".
- Relationship to Text: These diagrams provide the specific spatial modules needed to implement the general planning guidelines from the previous section, allowing a designer to lay out a dining room grid.

Figure 2: Banquette seating arrangements... (p. 759)

- Description: Plan and section diagrams illustrating standards for continuous bench (banquette) seating.
- Technical Details:
  - Single Banquette: Shows a module depth of 5'0" (from wall to back of chairs) with service access of 5'0".
  - Double Banquette: Shows two back-to-back banquettes with an overall module depth of 11'0" and service access of 4'6".
- Construction Notes: This implies custom millwork for the banquette benches. The dimensions guide the construction and the spacing for tables and chairs opposite the bench.

Figure 4 & 4 (continued): Table and chair units. (pp. 760-761)

- Description: A comprehensive set of diagrams detailing clearance and spacing requirements for various table and chair layouts, including linear arrangements, circular tables, and bench seating.
- Technical Details: These figures are information-dense, providing specific dimensions for dozens of scenarios. The key data has been extracted into the "Technical Specifications" table above. The diagrams visually represent how to apply these dimensions, showing clearance for public circulation, service aisles, space between units, and clearance to walls. For example, the space between two rectangular tables in a row (back of chair to back of chair) is shown to range from an absolute minimum of 1'8" to a comfortable 2'4".
- Construction Notes: A note for Figure 4 states, "Lower range only if chairs, etc., do not project into aisle," a critical qualifier for using minimum dimensions. A note on Figure 4 (cont.) states, "For seating units for more than 4 persons, round tables are usually recommended."

Figure 5: Booths. (p. 762)

- Description: Detailed plans and a section for various booth seating configurations (2-person and 4-person).
- Technical Details:
  - 2 Persons Side by Side: A layout noted as "not ordinarily recommended." Requires a module of 3'6" x 3'0".
  - 2 Persons Face to Face: A standard small booth. Requires a module of 2'0" x (4'10" to 5'8").

- 4 Persons: A standard large booth. Requires a module of (3'6" to 4'0") x (4'10" to 5'8").
    - Booth Furniture Heights: The sectional diagram provides precise heights and depths for the seat, table, and backrest, as detailed in the "Technical Specifications" table above.
- Relationship to Text: This figure provides the specific, buildable dimensions for constructing and laying out one of the most common types of restaurant seating.

BOQ Implications

- Furniture, Fixtures & Equipment (FF&E): This entire section is a primary source for the FF&E schedule.
    - Quantity Takeoff: The layouts allow a designer to determine the exact number of tables (by size and shape) and chairs required for a given floor area and target capacity.
    - Specification: The dimensions provided are the basis for specifying or procuring furniture. Standard vs. custom furniture can be decided based on how well off-the-shelf items fit these dimensional standards.
- Custom Millwork: The specifications for booths and banquettes (seat height, depth, back splay, overall height) are direct inputs for a millwork contractor's shop drawings and cost estimate.
- Cost Estimation: The choice between "Absolute Minimum," "Desirable," and "Comfortable" layouts has a direct impact on the budget.
    - Higher Density (Minimum Dims): Lower cost per seat in terms of floor space, but potentially lower revenue due to customer discomfort and service inefficiency.
    - Lower Density (Comfortable Dims): Higher cost per seat in terms of floor space, but can support higher menu prices and improve customer turnover due to a better experience.
- Labor Considerations: The provision of adequate service aisle (`As`) **widths is critical for staff efficiency. A layout with minimum, tight aisles will slow down service, potentially requiring more staff to cover the same number of tables, which is a long-term operational cost.**

Critical Notes and Warnings

- Hierarchy of Dimensions: The distinction between Absolute Minimum, Desirable Minimum, and Comfortable is the most critical takeaway. Designing to absolute minimums is a significant compromise that can negatively affect both customer experience and staff function.
- Aisle Function: It is critical to distinguish between public circulation paths and service aisles, as they have different spatial requirements to prevent conflicts between guests and staff.
- Layout Recommendations: The document explicitly states that side-by-side 2-person booths are "not ordinarily recommended," guiding designers away from an inefficient layout. It also recommends round tables for parties larger than four.
- Practical Application: These are not just abstract numbers; they are the fundamental building blocks for creating a functional and profitable dining space. Every dimension impacts traffic flow, service speed, seating capacity, and customer comfort.

Part 7: Food Bars, Serving Units, and Liquor Bars (Pages 763-765)

Overview

This section provides highly specific dimensional standards for the functional components of food and beverage service areas. It details the spatial requirements for various types of counters, including straight and curved food bars, and back-of-house serving units like sideboards, carts, and tray stands. A significant portion is dedicated to the detailed layout of liquor bars, covering everything from patron and staff clearances to the precise heights of the bar, foot rails, and backbar cabinetry. The information is presented through technical diagrams and comprehensive tables, serving as a practical guide for designing efficient and ergonomic service environments.

Technical Specifications

Food Bar Dimensions (from Fig. 6)

- General Clearances:

R	Description	Absolute Min.	Desirable Min.
X	Counter Width	1'-6" (No equip.) / 2'-0" (With equip.)	2'-0" / 2'-6"
Y	Back Bar Width	2'-0" (1 person) / 2'-6" (2+ persons)	2'-3" / 2'-9"
Z	Counterman's Aisle	1'-10"	2'-0"
E	Stool to Bar	9"	1'-2"
A	Public Aisle	3'-6"	4'-6"
B	Stool to Wall	1'-0"	1'-2"
C	Stool Center-to-Center	1'-10"	2'-0"

- **Variations in Shape: For curved bars, the usual minimum for aisle `A` is 2'-6" to 3'-6", aisle `B` is 2'-6" to 4'-6", and aisle `C` is 2'-9" to 5'-6".**
- **Floor Level Dimensions:**

Ref.	Floor Type	Range of Dimensions
S	Level & Dropped Floor	1'-6" to 2'-6"
H	Level Floor	7" to 10"
K	Dropped Floor	2'-4" to 2'-10"
W	Level & Dropped Floor	2'-4" to 2'-8"

Serving Unit Clearances (from Fig. 7)

- Serving Table (& Sideboard):
  - Dimensions: Typical width is 10" x 20" to 42".
- Serving Cart:
  - Stored Area: Approx. 38" x 21.5" x 35".
- Tray Stand:
  - Stored Area: Approx. 5" x 20" x 34".
- Clearance Table for all Serving Units: | Ref. | Description | Absolute Min. | Desirable Min. | Comfortable | | :--- | :--- | :--- | :--- | | As | Service only | 2'-0" | 2'-6" | 3'-0" to 3'-6" | | Ap | Public circulation | 2'-0" | 2'-6" | 3'-0" | | C | Clearance to adjacent units | 2'-0" | 2'-3" | 2'-6" |

Liquor Bar Dimensions (from Fig. 8)

- Bar Layout Clearances: | Ref. | Description | Abs. Min. | Des. Min. | Comfortable | | :--- | :--- | :--- | :--- | | Ap | Public aisle | 3'-6" to 4'-6" | 4'-0" to 5'-0" | 4'-6" to 6'-0" | | B | Stool to wall | 1'-0" to 1'-6" | 1'-2" to 1'-6" | 1'-4" to 1'-6" | | CC | Stool, cent. to cent. | 1'-9" to 2'-0" | 2'-0" | 2'-2" to 2'-6" | | E | Stool to bar | 9" to 1'-0" | 1'-0" | 1'-1" to 1'-2" | | X | Back bar | 1'-6" to 1'-8" | 1'-8" to 2'-0" | 2'-0" to 2'-3" | | Y | Bartender's aisle | 2'-0" to 2'-2" | 2'-6" | 3'-0" | | Z | Bar | 2'-3" to 2'-6" | 2'-5" to 2'-6" | 2'-8" to 2'-9" |
- Bar Height Dimensions:

R	Description	Usual Min.	Usual Max.
B	**Bar Height**	**3'-6"**	**3'-9"**
B	**Back Bar Height**	**3'-6"**	**3'-9"**
S	**Stool Seat Height**	**2'-4" to 2'-6"**	**2'-7"**
X	**Foot Rail Height**	**7" to 10"**	**7" to 10"**

- **Other Specifications:**
  - **Bar Length: Allow 1 ft 8 in. to 1 ft 10 in. per person for stand-up bars; 2 ft for each stool.**
  - **Service Bars: Usually 6 to 8 ft long for one bartender; 10 to 12 ft long for two bartenders. No footrail or counter overhang is required.**
  - **Curved Bars: Radius `R` should be at least 2 ft.**

Visual Elements Analysis

Figure 6: Food bars. (p. 763)

- Description: A set of diagrams providing plan and section views for food bar counters.
- Technical Details:
    - Standard (straight) Type Plan: Shows a linear arrangement with the back bar, counterman's aisle, and the main counter with stools. Labeled dimensions (X, Y, Z, Ap, etc.) correspond directly to the values in the associated table.
    - Variations in Shape Plan: Illustrates a curved counter, noting that dimensions for clearances `A`, `B`, **and `C` vary based on the curve.**
    - **Level Floor & Dropped Floor Sections: These two cross-sections show the ergonomic differences in bar construction. The "Dropped Floor" design lowers the working floor for the staff, allowing them to work at a comfortable height while the patron-facing bar remains at standard height. Dimensions `S` (stool height), `H` (footrest height), `K` (dropped floor depth), `X`, and `Work` (work surface height) are clearly labeled.**
- **Relationship to Text: The diagrams provide the visual context for the highly specific dimensional data in the tables, making it possible to design and build a functional food bar.**

Figure 7: Serving units. (p. 764)

- Description: Four simple plan diagrams for different types of mobile or freestanding serving units.
- Technical Details: Each diagram shows a basic plan (`L` **x `W`) with clearances for service (`As`), public (`Ap`), and to adjacent units (`C`).**
    - **Serving Table: A simple rectangle.**
    - **Serving Cart: A rectangle with a corner radius `R` indicating its turning path.**
    - **Tray Stand: A small rectangular unit.**
    - **Water Cooler: A rectangular unit.**

- **Relationship to Text: These diagrams visualize the space footprint and necessary operational clearances for common back-of-house equipment, supporting the data in the tables.**

Figure 8: Liquor bars. (p. 765)

- Description: A set of plan and section diagrams detailing the construction and layout of a commercial liquor bar.
- Technical Details:
  - Straight Type Plan: Similar to the food bar, shows the back bar, bartender's aisle, bar with stools, and footrail (`cc`**).**
  - **Curved Type Plan: Shows a curved bar with a minimum radius `R` of 2 ft.**
  - **Bar Heights Section: A detailed cross-section showing the relationship between the bar (`B`), back bar (`BB`), stool (`S`), foot rail/step (`H`, `P`), and an overhead cabinet (`CAB.`). This diagram provides the vertical dimensions necessary for construction.**
- **Relationship to Text: These diagrams and their corresponding tables provide a complete dimensional standard for designing liquor bars, covering both horizontal clearances and vertical heights for patron comfort and bartender efficiency.**

BOQ Implications

- Custom Millwork: This is the primary cost driver. All bars, back bars, and service counters described are custom-built fixtures. The provided dimensions are essential for the millwork contractor's takeoff and bid.
- Materials: The BOQ would need to itemize materials such as:
  - Bar top (hardwood, stone, specialty laminates).
  - Bar face/die (wood paneling, upholstery, tile).
  - Foot rail (typically brass or stainless steel, including brackets).
  - Back bar cabinetry and shelving.
- Plumbing and Electrical: The designs imply the integration of underbar equipment. This requires costing for:
  - Sinks (3-compartment sinks, hand sinks).
  - Ice bins and soda guns.
  - Beer taps and drainage systems.

    - Under-counter refrigerators and glass washers.
    - Electrical outlets for blenders, cash registers, and lighting.
- Structural: The "Dropped Floor" option for a food bar requires significant structural work, including a depressed concrete slab and additional drainage, which is a major cost factor compared to a level floor design.

Critical Notes and Warnings

- Ergonomics and Efficiency: The distinction between "Level Floor" and "Dropped Floor" designs for food bars highlights the importance of staff ergonomics. A dropped floor improves the working posture of the staff but has higher initial construction costs.
- Clearance is Non-Negotiable: The detailed tables providing "Absolute Minimum," "Desirable," and "Comfortable" clearances are critical. Using absolute minimums can severely hinder service flow and patron comfort.
- Service-Only Bars: The text provides specific design guidance for service bars (for waiters), noting they are typically shorter and lack patron-facing features like overhangs and footrails, which simplifies construction.
- Adherence to Dimensions: For layouts to be functional, key dimensions like the minimum radius of a curved bar (2 ft) or the center-to-center spacing of stools (1'10" to 2'0") must be respected.
-

Part 8: Nondining Spaces (Pages 766-767)

Overview

This section details the planning and design requirements for essential non-dining areas within a food service operation. It covers sanitation facilities, employee accommodations (lockers, lounges, toilets), and guest-facing services such as cashier stations, check rooms, and telephone facilities. The text provides specific dimensional standards, placement advice, and operational rules of thumb to ensure these support spaces are efficient, hygienic, and convenient for both staff and patrons. The goal is to integrate these functions seamlessly into the overall facility design without compromising the primary dining experience.

Technical Specifications

Sanitation Areas

- Pot and Pan Section:
  - Minimum Area: 40 sq ft for the smallest unit.
  - Aisle Width: A free work aisle between sinks and equipment should be 4 ft wide.
- Miscellaneous Sanitation:
  - Requirement: A dedicated, drained area is needed for washing mobile equipment. A separate closet or mobile unit should house emergency cleanup equipment (broom, mop, etc.).

Employee Facilities

- Locker and Lounge Area:
  - Locker/Cupboard Depth: Minimum 20 in. from front to back to allow garments to hang straight.
  - Lounge Cot/Daybed Size: A cot should be provided in the women's room, measuring 36 in. by 6 ft.
- Employee Toilets and Showers:
  - Fixture Ratios:
    - Wash Bowl: 1 for every 8 to 10 workers.
    - Women's Toilet: 1 for every 12 to 15 women.
    - Men's Toilet: 1 urinal and 1 toilet stool for every 15 men.
  - Compartment Size: Approximately 3 ft by 4.5 ft to 5 ft.
- Time-Recording Equipment:
  - Clock Recorder: Approx. 18 in. wide x 12.5 in. deep x 18 in. high.
  - Card Rack (50 cards): Approx. 1.5 in. x 2.75 in. x 34.5 in.

Guest Facilities

- Check Room:
  - Coat Capacity: The Albert Pick Co. estimates that 5 garments can be hung per linear foot on each side of the rack type diagrammed.
  - Coat Trees: Occupy approximately 20 in. x 20 in. of floor space, are 72 in. high, and accommodate 8 garments.

    - Umbrella Racks: Considered "desirable."
    - Overshoe Racks: Considered "undesirable."
  - Telephone Facilities:
    - Ratio: 1 booth per 50 seats is the usual ratio.
- Cashier's Desk and Counter Dimensions (from Fig. 9 Table):

Ref.	Description	Usual Minimum
S	**Cashier's Aisle**	**2'-0" to 2'-6"**
Ap	**Public Aisle**	**3'-6" to 5'-0"**
L	**Length**	**4'-0" to 8'-0"**
Width	**Width**	**2'-0" to 2'-4"**

  - **Check Room Clearances (from Fig. 9 Table): | Ref. | Description | Abs. Min. | Des. Min. | Comfortable | | :--- | :--- | :--- | :--- | | Ap | Public Aisle | 3'-0" | 4'-0" | 6'-0" | | As | Attendant's Aisle | 2'-6" | 2'-9" | 3'-3" | | B | Hanger to Wall | 1'-0" | 1'-6" | 1'-9" | | C | Counter Width | 2'-0" | 3'-0" | 5'-0" | | G | Gate Width | 1'-6" | 1'-9" | 2'-0" | | W | Unit Width | 1'-10" | 2'-0" | 2'-0" |**

Visual Elements Analysis

Figure 9: Nondining spaces. (p. 766)

- Description: This figure provides two key diagrams detailing the layout and critical clearances for a cashier's station and a check room.
- Technical Details:
    - CASHIER'S DESK and COUNTER: A plan view showing the counter (`L` **x** `Width`**), the cashier's aisle (**`S`**), and the public aisle (**`Ap`**). The diagram is keyed to the table of "Usual Minimum" dimensions.**
    - **CHECK ROOM: A plan view showing a complete check room layout. It includes a counter (**`C`**), a gate flap door (**`G`**), hanging racks for coats, a public access aisle (**`Ap`**), and an attendant's working aisle (**`As`**). Dimensions are clearly labeled and correspond to the detailed table of clearances.**
- **Construction Notes: The check room design incorporates fixed hanging racks and a counter, implying standard construction methods. The "gate flap door" is a specific hardware callout.**
- **Relationship to Text: These diagrams provide the specific, buildable layouts that correspond to the functional descriptions in the text. The cashier diagram illustrates the preferred location relative to exits, and the check room diagram provides a tangible example of how to apply the capacity and clearance rules of thumb.**

Calculations and Formulas

- Employee Toilet Fixture Calculation:
    - Procedure: The number of required fixtures is calculated based on the total number of staff per gender, using the ratios provided. For example, a facility with 30 female employees would require:
        - `30 workers / (8-10 workers/bowl)` **= 3 to 4 wash bowls.**
        - `30 workers / (12-15 workers/toilet)` **= 2 toilets.**
- **Check Room Capacity Calculation:**
    - **Formula:** `Total Capacity = (Linear Feet of Racks × 2 sides) × 5 garments/foot`
    - Example: A check room with a single 10-foot-long rack (as diagrammed) would have a capacity of `(10 ft × 2) × 5 = 100 garments.`

BOQ Implications

- Equipment and Fixtures: The BOQ would include line items for all specified equipment:
    - Employee lockers, benches, cots.
    - Time clock recorder and card racks.
    - Check room hanging racks and numbering systems.
    - Coat trees and umbrella stands.
    - Telephone booths or enclosures.
- Construction Materials:
    - Flooring/Walls: Sanitation areas require impervious, easily cleanable surfaces (e.g., quarry tile, epoxy floors, FRP wall panels).
    - Partitions: Soundproof partitions are recommended for separating employee lounges from other areas. Standard toilet partitions are required.
- Plumbing: Extensive plumbing is required for employee toilets and showers, as well as floor drains and sinks in sanitation areas.
- Labor Considerations: The design of these "back-of-house" areas directly impacts long-term operational costs.
    - Efficiency: Locating employee facilities conveniently reduces travel time and non-productive labor hours.
    - Hygiene: Providing proper sanitation areas is crucial for health code compliance and reducing cross-contamination, which avoids costly shutdowns or liability.

Critical Notes and Warnings

- Employee Circulation: "An employee entrance should be so located that the employees may go directly to the dressing rooms without passing through the dining room or production area." This is a critical principle for both hygiene and security.
- Check Room Economics: "It is generally considered uneconomical...to provide check rooms capable of accommodating garments for the peak load." This is because many patrons (especially women) do not check coats. The capacity should be based on a realistic estimate, not maximum potential occupancy.

- Cashier Location: The "preferred location for the cashier's desk or counter...is on the right hand side of the door when leaving, in order to avoid cross-traffic and resulting congestion."
- Code Compliance: The text mentions that booth furniture dimensions may be subject to local codes, reinforcing the need for the designer to consult with authorities having jurisdiction.

Part 9: Kitchens (General Principles, Workflow, and Waste Disposers, Pages 768-770)

Overview

This section marks a deep dive into the technical and operational design of commercial kitchens. It introduces a modern, efficiency-driven philosophy of kitchen planning, emphasizing that a kitchen's layout is paramount to its success and profitability. The authors advocate for an industrial engineering approach focused on minimizing work and traffic flow, contrasting it with outdated, inefficient methods. The section covers the primary forward flow of food (from receiving to the customer) and critical peripheral flows like dishwashing and waste management. It also provides highly specific dimensional standards for aisle widths and detailed guidance on the strategic selection and placement of food waste disposers in various work areas.

Key Standards and Codes Referenced

- Source Document: The content is drawn from the ***Kitchen Planning Magazine*****, vol. 7, no. 4, fourth quarter, 1970, and the *****Harcbrace Encyclopedia of Professional Kitchen Planning*****.**
- **While not explicitly named, the principles discussed imply strict adherence to Health and Safety Codes, particularly concerning waste disposal, sanitation, and separation of work areas.**

Technical Specifications

Aisle Space Guides (from table on p. 770)

- Work Aisle Widths:
    - Specification: Aisle for a single person working.

- Measurement/Tolerance: 24 in. to 38 in. (Note: "Keep to minimum").
- Specification: Aisle for two persons working back-to-back.
- Measurement/Tolerance: 42 in.
- Specification: Clearance for personnel passing stationary equipment.
- Measurement/Tolerance: 30 in. plus the distance the equipment projects into the aisle.

- Traffic Aisle Widths:
  - Specification: Aisle for two persons to pass each other.
  - Measurement/Tolerance: 30 in.
  - Specification: Aisle for one truck and one person (one-way traffic).
  - Measurement/Tolerance: 24 in. plus the maximum width of the truck.
  - Specification: Aisle for two trucks to pass (one-way traffic).
  - Measurement/Tolerance: 20 in. plus the maximum width of the truck.
  - Specification: Aisle for two trucks to pass (two-way traffic).
  - Measurement/Tolerance: 30 in. plus the sum of the truck widths.
- Multi-Usage Aisle Widths (Not Recommended but sometimes necessary):
  - Specification: Personnel passing one worker at their station.
  - Measurement/Tolerance: 42 in.
  - Specification: Personnel passing two workers at their stations (back-to-back).
  - Measurement/Tolerance: 48 in.
  - Specification: Trucks passing two workers at their stations.
  - Measurement/Tolerance: 60 in. plus the width of the truck.

Specialized Workstation Dimensions

- Vegetable Preparation Sink:
  - Specification: A desirable two-compartment sink setup.
  - Measurement/Tolerance:
    - Trimming/Disposing Compartment: 24 in. by 36 in. by 6 in. deep.
    - Rinsing Compartment: 16 in. by 24 in. by 12 in. deep.
- Recirculating Water Trough (for Waste Disposal):
  - Performance Criteria: Requires 65 to 70 gallons per minute of recirculated water to function effectively.

Visual Elements Analysis

Figure 1: Ward galley. Work-flow rendering for a hospital food service program. (p. 769)

- Description: This is a large, isometric workflow diagram illustrating the "Cold distribution and ward heating method" for a hospital meal service. It traces the entire process from bulk storage to final tray assembly at a decentralized ward galley.
- Technical Details:
  - Workflow Path: The process begins at bulk storage (Dry Storage, Refrigerator, Freezer) and moves to a Pre-preparation area. From there, it splits into hot and cold food production lines.
  - Cold Line: Cold food items are prepared and placed onto a tray at the "TRAY ASSEMBLY" line. A "REFRIG. TRANSPORT CART" moves the assembled cold trays.
  - Hot Line: Hot food is cooked and then portioned onto plates, which are then sent "HOT FOOD PLATE TO OVEN".
  - Final Assembly (Ward Galley): At a decentralized location (the "Ward Galley"), the refrigerated transport cart delivers the cold trays. A reconstitution oven heats the hot food plates. The hot and cold components are combined at the "2 SHELF RECON." station before being delivered "TO PATIENT."
- Construction Notes: This diagram highlights a specific operational strategy that heavily influences facility design. It requires a central production kitchen and multiple, smaller, well-equipped "ward galleys" on patient floors. Each galley must have electrical power for a reconstitution oven, refrigeration for carts, and space for assembly.
- Relationship to Text: This figure provides a powerful visual example of the "continuous process, always moving forward" philosophy mentioned on page 768. It shows how complex workflows can be broken down into logical, linear steps to improve efficiency and maintain food quality.

BOQ Implications

- Equipment:

    - Material Handling: The emphasis on workflow implies a significant budget for material handling equipment, such as dollies, trucks, carts, rolling racks, elevators, and dumbwaiters. Advanced systems like overhead monorails and floor-buried cable carts are mentioned as high-tech options.
    - Waste Disposal: The BOQ must account for various types of food waste disposers, from simple sink-mounted units to complex assemblies like cone bowls with scrap blocks and recirculating water trough systems.
    - Specialized Sinks: The two-compartment vegetable preparation sink is a specific item to be quantified.
- Structural:
    - Floor Levels: The need to eliminate door saddles and ensure walk-in refrigerators are at floor level requires careful planning of concrete slab depressions.
    - Clearances: High ceilings are needed to accommodate equipment and ventilation hoods.
- Labor & Cost:
    - Operational Efficiency: The entire section argues that a well-planned kitchen with efficient aisles and workflows reduces labor costs, which is a primary driver of modern design. The initial investment in a better layout and more equipment is justified by long-term savings.
    - Cost of Inefficiency: The text warns that poorly designed aisles (too wide or too narrow) lead to wasted steps and reduced productivity. Perimeter aisles are identified as being particularly inefficient in their use of floor space.

Critical Notes and Warnings

- Challenge Tradition: The text explicitly states that the answer "It's always been done this way" is no longer acceptable. Designers must question every step of the process to find efficiencies.
- Security and Supervision: "Receiving areas, therefore, should be open and visible to management." This is crucial to prevent theft. Supervisor offices should be elevated or strategically located to provide a commanding view of operations.
- Aisle Design is Critical: The text strongly advises against placing main traffic paths through work areas, as this is inefficient and dangerous. Perimeter aisles are also discouraged because they are long and serve only one side.

- Holistic Planning: A kitchen cannot be designed in isolation. The architect must consider the entire workflow, from the delivery truck to the customer's table and back to the dishwashing station. This includes secondary flows like waste and utensils.
- Food Waste Disposal: The selection of a food waste disposer is not a simple choice. The designer must ask a series of operational questions (e.g., what kind of waste will be handled? how many operators will use it?) to select the appropriate system, whether it's a simple sink unit, a cone bowl for leafy greens, or a high-volume trough system.

Part 10: Kitchens (Specific Preparation Areas and Workflow, Pages 771-772)

Overview

This section provides a detailed analysis of the primary food production departments within a commercial kitchen: the main cooking area, meat preparation, salad preparation, vegetable preparation, and sandwich stations. It emphasizes that the layout of each department must be dictated by its specific function and its relationship to other areas. The text introduces key trends, such as the increasing use of pre-portioned meats, which significantly impacts space requirements. Detailed ergonomic and operational standards are provided, particularly for the sandwich station, to ensure maximum efficiency, good posture, and streamlined workflow for the staff.

Technical Specifications

Main Cooking Area

- Layout Principle: The layout varies greatly by installation type (e.g., table service vs. cafeteria).
- Equipment Placement Rules:
    - **i.** Broiler: Should be placed at the end of the cooking line, away from traffic.
    - **ii.** Fryers: Can be located near the broiler or at the far end of the range battery. Requires sufficient worktable space and a draining area.
    - **iii.** Steam Table/Serving Area: Should be near the broilers and fryers if located in the main cooking area.

iv. Aisle Space: The space between the cook's table and the cooking equipment must be at a minimum but must provide for the full opening of range ovens, steamers, etc. Greater space is required if traffic or carts are anticipated.
v. Ventilation: All heat-producing equipment must be vented to an effective exhaust hood.
vi. Cleaning Access: Equipment placed against a wall should have 1 to 2 feet of clearance behind it for cleaning.
vii. Access Breaks: Extended cook's tables or equipment lines should have breaks for cook access.
viii. Plate Warming: Traditionally placed in front of the cook's table, but the trend is toward placing them where they are directly accessible to servers.

Meat Preparation

- Operational Trend: There is a major trend toward purchasing meat in a ready-to-cook state (pre-portioned, pre-cut).
- Space Impact: This trend decreases meat storage space requirements by up to 40% and reduces the need for a large, on-site butcher shop.

Sandwich Station

- Counter Height: The recommended height for the work counter is 36 in. This allows the worker to maintain good posture.
- Ergonomics - Reaching Area: The comfortable reaching area for a worker is 16 inches from each elbow in all working directions.
- Counter Top Material:
    - Material Requirements: Hard maple or a synthetic rubber-plastic composition is preferred. If a metal top is used, a large cutting block should be placed on it.
    - Construction Detail: The countertop should project at least 1.5 inches beyond the front of the unit to prevent crumbs from falling on shelves or door gaskets below.
- Equipment:
    - Food Waste: A food-waste container should be recessed into the right-hand side of the counter for "as you go" cleaning.
    - Filling Containers: Containers for fillings are more accessible if they are tilted slightly forward toward the worker.

    - Dish Dispenser: A self-leveling dish dispenser, recessed into the counter, allows serving plates to "pop" into position. These are available with hot or cold controls.
    - Sinks: A double-compartment sink should be located adjacent to the sandwich center.

Visual Elements Analysis

Figure 2: Movement through traffic aisle at the cafe/bar kitchen facilities, Hotel Commodore. (p. 771)

- Description: A floor plan of the main cooking and service area for a hotel kitchen.
- Technical Details: The plan is annotated with area designations: 1. Warewashing, 2. Waiters' Pantry, 3. Cold Food Preparation, 4. Hot Food Pick-up, 5. Hot Food Preparation, 6. Checking Area. The layout shows a central island for hot food preparation (5**) and pickup (**4**), surrounded by a traffic aisle. The cold food prep (**3**) and pantry (**2**) are on one side, with warewashing (**1**) on the other, demonstrating a clear separation of functions while maintaining close adjacencies.**
- **Relationship to Text: This figure illustrates a real-world application of the principles of departmental layout, showing how different functional zones are organized around a central workflow path.**

Figure 3: Flow chart of the main cooking area. (p. 771)

- Description: A block flow diagram showing the inputs and outputs of the main cooking area.
- Technical Details: The diagram shows "MEAT PREP," "VEG. PREP," and "REFRIGERATION" feeding into the "MAIN COOKING" area. The output from main cooking flows to "SERVING (WAITER/CAFETERIA)" and "POT WASHING."
- Relationship to Text: This visualizes the central role of the main cooking area, receiving prepared ingredients and sending finished food to service and used pans to sanitation.

Figure 4: Flow chart of the meat preparation area. (p. 771)

- Description: A block flow diagram showing the process flow for meat preparation.

- Technical Details: The flow starts at "GARBAGE/STORAGE" and "MEAT REFRIG," moves to "MEAT PREP," and then sends the finished product to "MAIN COOKING" or "SANDWICH PREP."
- Relationship to Text: This illustrates the changing function of the meat prep area as described in the text, where it primarily converts stored meat into a state ready for final cooking.

Figure 5: Salad Preparation Flow Chart. (p. 772)

- Description: A flow chart showing the relationship of the salad preparation department to other kitchen areas.
- Technical Details: The diagram shows that "VEG. PREP." and "DRY STORAGE" are inputs to "SALAD PREP." The output from salad prep moves to "SERVING FACIL." (Serving Facilities).
- Relationship to Text: This visually demonstrates the critical decision point mentioned in the text: the location of the salad department depends on its relationship to its inputs (vegetable prep) versus its output (the serving line).

Figure 6: Vegetable Preparation Flow Chart. (p. 772)

- Description: A flow chart showing the inputs and outputs for the vegetable preparation department.
- Technical Details: The diagram shows "DRY STOR." (Dry Storage) and "VEG. REFRIG." (Vegetable Refrigeration) as inputs. The output from "VEG. PREP." flows to "SALAD PREP.," "MAIN COOKING," and "SANDWICH PREPARATION."
- Relationship to Text: This chart clearly illustrates that vegetable preparation is an upstream process that provides essential ingredients for multiple downstream cooking and assembly stations.

BOQ Implications

- Equipment: This section specifies numerous items for the BOQ:
    - Main Cooking Line: Broilers, fryers, ranges, steam tables, plate warmers, exhaust hoods.
    - Sandwich Station: Custom counters, recessed food waste containers, self-leveling dish dispensers (hot/cold models), toasters, grills, double-compartment sinks.
- Materials:

    - Countertops: Specific callouts for hard maple or synthetic rubber-plastic composite for sandwich stations.
- Labor and Operational Costs:
    - Reduced Labor: The text directly links the trend of purchasing ready-to-cook meats to a reduction in on-site labor costs for butchers. This is a critical factor in financial planning for the operation.
    - Efficiency: The ergonomic specifications for the sandwich station (counter height, reach distances) are designed to maximize worker efficiency and reduce fatigue, directly impacting labor productivity.

Critical Notes and Warnings

- Cook-to-Order vs. Batch Cooking: The text notes that vegetables should be cooked in small batches close to serving time to maintain quality. Meats, however, may be prepared in large batches due to longer processing times. This operational difference must be reflected in the layout.
- Locational Strategy: The location of preparation departments (like salad prep) is not arbitrary. It must be a strategic decision based on the specific operational model of the kitchen. The designer must determine whether it is more efficient to be close to the source of ingredients or close to the point of service.
- Ergonomics in Design: The detailed specifications for the sandwich station highlight the importance of designing workspaces around the human body to improve speed and reduce strain. Tilting containers and defining a comfortable reach zone are key examples.
- Waste Management Integration: Efficient waste management is not an afterthought. A food waste container should be designed directly into the workflow of a workstation, as shown in the sandwich station example.

Part 11: Kitchens (Bake Shop, Refrigerated Storage, Dishwashing, Pot Washing, Page 773)

Overview

This section details the functional requirements and layout principles for four critical kitchen support departments: the Bake Shop, Refrigerated Storage, Dishwashing, and Pot Washing. It emphasizes modern operational trends, such as the use of freezers in baking and the strategic relocation of

dishwashing areas based on workflow rather than tradition. The text provides specific warnings and recommendations, including critical clearances for equipment, ideal adjacencies between departments, and methods for controlling noise and improving sanitation. The goal is to design these essential support areas to maximize efficiency, maintain food safety, and integrate smoothly with the primary production workflow.

Technical Specifications

Bake Shop

- Layout Requirement: Requires sufficient clear space in front of the oven to remove baked goods with a peel.
- Critical Clearance: The clear space in front of a bake oven must be at least as deep as the bake oven is from front to back.
- Equipment Adjacency: The proof box and baker's table should be near the oven. The mixer, pastry stove, and kettle should be near the baker's table.
- Operational Equipment: A "sharp freezer" (a freezer capable of both freezing and storing items) is noted as necessary for modern operations that utilize frozen prepared goods. Mobile racks are used to transfer goods to serving areas.

Refrigerated Storage

- Freezer Location: It is a key recommendation that the freezer storage should open into a refrigerator rather than directly into the warmer kitchen. This improves efficiency and prevents condensation and icing on the freezer door.
- Alternate Location: An alternative location for the freezer is near the main cooking area, which is useful when cooks frequently need to access ready-to-cook frozen foods.

Pot Washing

- Sink Specification:
  - Minimum: A two-compartment sink is the absolute minimum.
  - Recommended: A three-compartment sink is preferable.
  - Additional Feature: A grease or skimmer compartment between the first two washing compartments is also recommended for better sanitation.
- Functional Requirement: A relatively large storage area for soiled pots is required, as they are often not washed at the same time they are received.

Dishwashing

- Acoustic Control: The dishwashing room requires noise-absorbing surfaces to lower the "objectionably high" noise level.
- Ventilation and Lighting: The room must be well-ventilated and well-lit.
- Location Principle: The trend is away from the traditional location adjacent to the dining room and toward a location that is near the point of dish usage (i.e., the serving and preparation areas). This is made possible by the increasing use of vertical and horizontal conveyors.

Visual Elements Analysis

Figure 7: Bake Shop Flow Chart

- Description: A block flow diagram showing the inputs and outputs for a bake shop.
- Technical Details: "DRY STORES" and "REFRIGERATED STORAGE" are shown as inputs into the "BAKE SHOP". The primary output is to "SERVING FACILITIES". A cyclical flow is shown to and from "POT WASHING" for cleaning used pans and utensils.
- Relationship to Text: This diagram visually reinforces the text's statement that the bake shop must be located near storage areas and the pot washing station. It also shows that its proximity to serving facilities is less critical if mobile racks are used for transport.

Figure 8: Refrigerated Storage Flow Chart

- Description: A block flow diagram illustrating the central role of refrigerated storage.
- Technical Details: The diagram shows a flow from "RECEIVING" to "REFRIGERATED STORAGE". From storage, items are distributed to "MEAT PREP," "VEG PREP," and "MAIN COOKING."
- Relationship to Text: This supports the principle that refrigerated storage should be located close to the preparation departments it serves to minimize travel time for high-frequency movements of goods.

Figure 9: Dishwashing Flow Chart

- Description: A flow chart showing the central path of soiled and clean dishes.
- Technical Details: Soiled dishes from "DINING AREAS" and used utensils from "VARIOUS PREP DEPARTMENTS" are sent to "DISH WASHING". Clean dishes

are then routed to "SERVING FACILITIES" for reuse. Waste from the process goes to "GARBAGE STORAGE".
- Relationship to Text: This illustrates the modern concept of locating the dishwashing area near its point of use (serving facilities) rather than just its source (dining areas). It also highlights its role in handling items from preparation areas.

Figure 10: Pot Washing Flow Chart

- Description: A flow chart illustrating the cyclical nature of pot and pan washing.
- Technical Details: Soiled pots, pans, and utensils from the "BAKE SHOP," "MAIN COOKING," and "SERVING FACILITIES" are sent to "POT WASHING". After cleaning, they are returned to their respective departments.
- Relationship to Text: This diagram visually explains why the pot washing area needs to be centrally located relative to all major production and service departments, as it is a shared resource for all of them.

BOQ Implications

- Equipment:
    - Bake Shop: Bake ovens (deck, convection), proof boxes, mixers, pastry stoves, steam-jacketed kettles, baker's tables, mobile racks, and a "sharp freezer."
    - Dishwashing: Commercial conveyor-type dishwashers, separate glass washers, silver burnishing machines, horizontal/vertical conveyors.
    - Pot Washing: Multi-compartment stainless steel sinks (minimum 2, preferably 3), potentially with integrated grease traps/skimmers.
- Construction Materials:
    - Acoustic Treatment: The requirement for a sound-absorbing dishwashing room implies costs for acoustic ceiling tiles, sound-rated wall assemblies, or specialized wall panels (e.g., FRP panels over sound-dampening board).
    - Flooring: Kitchen areas require durable, non-slip, and hygienic flooring (e.g., quarry tile with epoxy grout), with floor drains in dishwashing and pot washing areas.
- MEP Systems:

  - Plumbing: Extensive plumbing for multi-compartment sinks, disposals, dishwashers, and floor drains.
  - Ventilation: High-capacity exhaust hoods are required over bake ovens and in the steamy dishwashing and pot washing areas.

Critical Notes and Warnings

- DO NOT Share Sinks: The text issues a strong warning: "The practice of utilizing the same sinks for pot washing and vegetable or salad preparation...is not recommended." This is a critical health code and operational efficiency issue.
- Bake Oven Clearance: The requirement for clear space in front of an oven equal to its depth is a critical safety and operational clearance that must not be overlooked in space planning.
- Freezer Placement: The recommendation to have freezers open into a cooler is a key energy efficiency and maintenance principle, preventing icing and reducing thermal shock.
- Noise Control in Dishwashing: The text explicitly calls out dishwashing as a source of "objectionably high" noise and mandates that the room be designed with noise-absorbing surfaces. This is critical for the comfort of all other kitchen and dining room staff.

Part 12: Kitchens (Personnel Functions and Schematic Layouts, Page 774)

Overview

This section, authored by Max Fengler, provides a detailed breakdown of the classic European kitchen brigade system, defining the specific roles and responsibilities of each type of chef and kitchen staff. This functional hierarchy is the basis for organizing the physical layout of a large, high-standard kitchen. The section then presents three schematic kitchen plans, each designed for a different scale of operation (e.g., high-standard hotel restaurant, multi-venue hotel, large restaurant with catering). These plans serve as visual case studies, illustrating how the principles of workflow and departmentalization are applied to create efficient, high-capacity kitchen environments.

Technical Specifications

This section does not provide numerical specifications but instead focuses on the functional specifications of personnel roles and the spatial specifications of kitchen layouts.

Kitchen Personnel and Their Functions (The Brigade System)

- Chef de Cuisine (Kitchen Chef): Head of the kitchen; responsible for purchasing, cost control, menu creation, personnel supervision, and hygiene.
- Sous-chef (Assistant Kitchen Chef): Represents the Chef de Cuisine in his absence and takes on some of the chef's duties in large organizations.
- Saucier (Sauce Cook): Prepares all sauces, the meals that accompany them, and all fish dishes. Responsible for work at the kitchen range. In medium-sized kitchens, this role may be combined with the Sous-chef.
- Rôtisseur (Roast, Fry, and Grill Cook): Manages roasting, frying, and grilling. In large restaurants, a separate Grilladin may also be present.
- Entremetier (Soup, Vegetable, and Side-dish Cook): In large restaurants, a separate Potagier prepares soups and broths.
- Garde-manger (Pantry Chef): Supplies ready-to-cut meat and fish, cold appetizers, hors d'oeuvres, and salads. In large kitchens, this is divided between the Hors d'oeuvrier (appetizer cook) and the Boucher (butcher).
- Pâtissier (Pastry Chef): Makes cookies, cakes, ice cream, and other desserts. In large kitchens, this role is subdivided among the Glacier (ice cream maker), Confiseur (fine pastry cook), and Boulanger (baker).
- Commis (Junior Cook): Assists the chefs of various sections.
- Salad Man/Girl: Produces and serves salads and may be responsible for the smorgasbord.
- Casserolier: Cleans, cares for, and services all pans and cooking equipment.
- Kitchen Boy: Cleans the kitchen and assists with dish preparation.
- Contrôleur: In charge of supplies, placement, storage, and inventory bookkeeping.
- Gouvernante: Accepts goods, supervises the "economat" (dry storage), linen, and cleaning materials.
- Argentier: Responsible for the care of silver.

Visual Elements Analysis

Figure 1: Hotel or restaurant kitchen or French restaurant of high standard.

- Description: A schematic kitchen plan for a high-standard restaurant, serving 200-300 persons per mealtime.
- Technical Details:
  - Capacity: Hotel: 100-200 persons/menu. Restaurant: 200-300 persons/mealtime (11:30-1:30).
  - Layout Type: Linear arrangement with large installations in the rear.
  - Waiter's Passageway: Tangential (along one side of the kitchen).
- Spatial Organization: The plan shows a clear workflow. Waiters enter, pass the dish return (2**), move along the main cooking line (6, 7), pick up cold items (5) and pastries (4), and then exit. The bulk preparation areas (meat 10, vegetable 9) and storage are at the rear.**

Figure 2: Hotel or restaurant kitchen.

- Description: A more complex kitchen layout designed to serve multiple venues, including a main restaurant, an outdoor restaurant, and private dining areas.
- Technical Details:
  - Capacity: Can handle a 200-seat restaurant with three full sittings, plus a 100-guest hotel and other venues (totaling 400 guests).
  - Layout Type: Linear arrangement with large installations in the rear.
  - Waiter's Passageway: In the center. This is a key difference from Figure 1.
- Spatial Organization: The central waiter's passage acts as a spine. On one side are the hot kitchen stations (6, 7**), and on the other are the cold kitchen (5) and pastry (4). This allows for efficient service to multiple dining areas that may be located on opposite sides of the kitchen.**

Figure 3: Large restaurant kitchen for restaurants with many private party and conference facilities...

- Description: A large-scale kitchen plan designed for a high-volume restaurant with significant catering and banquet functions.
- Technical Details:
  - Capacity: 800-1,000 persons (e.g., a 200-seat restaurant with fourfold re-occupancy).
  - Layout Type: Linear arrangement with fitted berths for large apparatus.
  - Waiter's Passageway: Tangential, with a food buffet situated in front.

- Spatial Organization: This layout is designed for high-volume production. A key feature is the food buffet, which allows for both waiter service and potentially guest self-service for banquet operations. The kitchen itself is a long, linear design with deep "berths" or alcoves for housing large-scale cooking equipment, allowing for mass production of food for banquets. Waiters have access to beverages and other items from both inside the kitchen and from the dining room side, increasing service speed.

BOQ Implications

- Staffing and Labor Costs: The detailed breakdown of the kitchen brigade provides a clear basis for estimating the labor budget for a large-scale food service operation. The number and type of specialized chefs required will be a primary driver of operational cost.
- Equipment: The schematic plans, while not dimensioned, indicate the scale and type of equipment needed.
    - Figure 1 & 2: Require standard high-end restaurant equipment (ranges, broilers, ovens, etc.).
    - Figure 3: Requires larger, higher-capacity equipment. The mention of "fitted berths for large apparatus" and a "food buffet" implies custom-fabricated or very large pieces of equipment suitable for banquet production (e.g., large roasting ovens, roll-in proofers, large steam-jacketed kettles, extensive hot and cold holding units for the buffet).
- Space Planning and Construction:
    - Zoning: The plans clearly delineate functional zones (hot kitchen, cold kitchen, pastry, dishwashing, etc.), which informs the architectural layout, including the placement of walls, doors, and circulation paths.
    - MEP Systems: The layout dictates the placement of plumbing (drains, sinks), electrical (power drops for equipment), and extensive ventilation (exhaust hoods over all cooking lines). The large scale of these kitchens implies very high-capacity MEP systems.

Critical Notes and Warnings

- Function Dictates Form: The section powerfully illustrates the principle that the physical layout of a kitchen is a direct reflection of its operational needs and the structure of its staff. The classical brigade system, with its specialized roles, requires a departmentalized kitchen design.

- Workflow is Key: All three plans, despite their differences in scale and configuration, adhere to the core principles of linear workflow. Raw goods come in at the back, are processed through preparation and cooking stations, and move forward to the waiter pickup areas. Soiled dishes follow a separate path to the dishwashing area.
- Waiter's Passageway Strategy: The choice between a tangential (side) and central waiter's passageway is a critical design decision.
  - A tangential path is simpler and works well for a single dining area.
  - A central path is more complex but more efficient for serving multiple dining venues on different sides of the kitchen.
- Scalability: The progression from Figure 1 to Figure 3 shows how kitchen design scales up to handle increasing volume and complexity. A simple linear kitchen evolves into a more complex, multi-functional production facility with specialized features like buffets and large-scale equipment berths.

Part 13: Kitchens (Detailed Layouts and Legends, Page 775)

Overview

This section provides a master legend that decodes the functional areas shown in the schematic kitchen layouts from the previous and current pages. It also presents four additional detailed layouts: three for different types of high-capacity restaurant kitchens and one for a compact snack bar. These diagrams serve as critical case studies, illustrating how kitchen design principles—such as workflow, departmentalization, and the configuration of the waiter's passageway—are adapted to meet the specific operational demands of varying service styles and patron volumes. The layouts range from a simple linear design to a complex, symmetrical plan for a very large establishment.

Key Standards and Codes Referenced

- Architectural Drawing Standard: A scale of 1:300 is specified for the kitchen layouts (Figs. 1 to 6), indicating these are schematic or preliminary design drawings.

Technical Specifications

Legend for Restaurant and Hotel Kitchen Layouts (Figs. 1 to 6)

This legend defines the numbered functional zones shown in the kitchen plans.

1. **Waiters' passageway - meal and beverage counter - dish return**
2. **Dishwashing area (dishes, glasses, silver)**
3. **Beverages - preparation and serving**
4. **Pastry (cookies, cakes, ice cream, dessert) - preparation and serving**
5. **Cold kitchen (cold appetizers, salad, fish) - preparation and serving**
6. **Warm kitchen - saucier/rôtisseur area (sauces, roasts, grill, fish) - preparation including large apparatus area and serving**
7. **Warm kitchen - entremétier area (soups, vegetables, entrées) - preparation including large apparatus area and serving**
8. **Pot and pan washing - casserolier area**
9. **Vegetable preparation**
10. **Meat preparation**
11. **Vegetable cold storage**
12. **Meat cold storage**
13. **Economat (dry storage)**
14. **Beverage cold storage**
15. **Linen, dish, cleaning supplies storage**
16. **Staple goods storage**
17. **Goods acceptance and control**
18. **Empty goods and garbage collecting rooms**

Legend for Snack Bar (Fig. 7)

1. Meal and beverage serving counter
2. Dishwasher
    - 2a. Dish return
3. Beverage buffet with mixer, toaster, ice-cream container, etc.
4. Oven and small pastry station

5. Garde-manger
6. Saucier/Rôtisseur
    - 6/7. Range
7. Entremétier
    - 7a. Cooking vat and high-performance steam cooker
    - 6/7b. Warming cupboard and warm serving counter with warming lamps
8. Pot and pan washing
9. Storage, empty goods, office; instead of cold storage rooms - cold storage and freezer cupboards
10. Employees' toilets

Visual Elements Analysis

Figure 4: Restaurant kitchen especially suited for city or excursion restaurants.

- Description: A kitchen plan with a capacity similar to Figure 1 from the previous page.
- Layout Type: Tangential waiter's passageway.
- Spatial Organization: This is a long, linear kitchen. The cooking, roasting, grilling, and frying apparatus (`6`, `7`) **are planned as continuous "wall structures," meaning they are banked against the back wall. The waiter's path is a straight line along the front of the kitchen, allowing for efficient pickup. Support functions like dishwashing (`2`) and preparation (`9`, `10`) are located at the ends to avoid disrupting the main service flow.**

Figure 5: Restaurant kitchen.

- Description: A plan for a very busy city restaurant with a high turnover rate.
- Capacity: Approximately 600 persons (calculated as 150 seats with fourfold re-occupancy).
- Layout Type: Waiter's passageway in the center.
- Spatial Organization: This is a highly efficient "double-loaded" or "gallery" kitchen. The central corridor for waiters separates the hot kitchen stations (`6`, `7`) **on one side from the cold kitchen (`5`) and pastry (`4`) on the other. This compact design minimizes travel distance for waiters and allows for high-speed service.**

Figure 6: Large restaurant kitchen for restaurants with many auxiliary rooms...

- Description: A very large and complex kitchen plan suitable for a highly frequented city restaurant or an excursion spot with conference rooms and a snack bar.
- Capacity: 1,000-1,200 persons.
- Layout Type: Tangential waiter's passageway with a central serving area.
- Spatial Organization: This is the most complex layout shown. It features a symmetrical arrangement, with the cold kitchen (5) **and pastry (4) departments mirrored on both sides of the central hot kitchen (6, 7). This allows the kitchen to serve multiple, large venues simultaneously. A key feature is the central serving area, which acts as an island pass-through, and a buffet and dishwashing zone located "in front" (i.e., closer to the dining room), which optimizes flow for both regular service and banquets.**

Figure 7: Snack bar (Pub, tavern, bistro, café, or restaurant).

- Description: A compact kitchen designed for a 55-60 seat establishment with high turnover and a focus on ready-to-serve items.
- Operational Assumption: Relies on daily delivery, thus requiring minimal storage space.
- Spatial Organization: This layout integrates all functions into a very small footprint. The cooking line (6/7, 7a)**, prep areas (5), beverage service (3), and dishwashing (2) are all in close proximity, often directly behind the main service counter (1). It is designed for maximum efficiency with minimal staff who must perform multiple roles.**

BOQ Implications

- Equipment Takeoff: The legends provide a direct checklist for all major equipment zones needed in a kitchen BOQ. For example, a "Beverage buffet" (Item 3 in Fig. 7) would require line items for a mixer, toaster, and ice-cream container. "Warm kitchen - saucier/rôtisseur area" (Item 6) implies the need for ranges, ovens, broilers, grills, and sauté stations.
- Custom Fabrication: Layouts like Figure 6, with a "central serving area" and symmetrical design, would require significant custom stainless steel fabrication for counters, pass-through shelves, and integrated warming lamps to achieve the desired workflow.

- Specialized Equipment: The callout for a "high-performance steam cooker" (Item 7a in Fig. 7) is a specific equipment type that would be included in the BOQ. The provision for a buffet in Figure 6 implies costs for hot and cold wells, sneeze guards, and decorative finishes.
- Space vs. Cost: The snack bar layout (Fig. 7) demonstrates a low-cost approach for a small operation by minimizing storage space and relying on daily deliveries. This reduces the capital cost of construction and large refrigeration units but increases daily operational dependency on suppliers.

Critical Notes and Warnings

- The Waiter's Path is Critical: The analysis of these figures shows that the design of the waiter's passageway (tangential vs. central) is a fundamental decision that dictates the entire kitchen's efficiency and ability to serve one or multiple dining areas.
- Design for the Operation: Each layout is explicitly tailored to a specific type of operation. A high-turnover snack bar has a fundamentally different design from a large, multi-venue hotel kitchen. The architect must understand the business model before starting the design.
- Symmetry for Scale: For very large operations serving multiple areas, a symmetrical layout (as in Fig. 6) can be a powerful tool for organizing complex workflows and duplicating service capabilities.
- Storage Strategy: The snack bar example highlights that storage is a flexible component of kitchen design. Operations with daily deliveries can drastically reduce their storage footprint, which is a key strategy for high-cost urban locations.

Part 14: Kitchens (Self-Service & Automat Layouts, Page 776)

Overview

This section presents two specialized kitchen and service layouts designed for high-volume, quick-service environments such as department stores, office buildings, and highway restaurants. These designs move away from traditional kitchen models and instead focus on systems of finishing, assembly, and self-service. The first layout is for a "re-thermalization" kitchen

that relies entirely on pre-prepared meals delivered from an external source. The second is a high-capacity "finger-bar" layout that combines a staffed service counter with self-service automats to achieve maximum customer throughput.

Self-Service Restaurant (Fig. 8)

Overview

This layout illustrates a finishing kitchen suitable for a department store or office building. The key principle is that there is no independent production. The kitchen's function is to receive, store, re-heat, and assemble meals that are prepared externally using systems like deep-freeze, boil-in-the-bag (Nacka), or Régéthermic.

Technical Specifications (Legend Items)

- 1d. Self-service buffet with grill and fry unit: The main customer-facing service line.
- 1e. Salad dressings, spices, cutlery reserves: Ancillary items for the buffet.
- 1f. Cashier: The final transaction point.
- 2. Dishwasher / 2a. Dish return: The sanitation loop.
- 3/4. Sandwich unit, cakes, ice cream, coffee, beverages: A separate station for cold items and beverages.
- 5a. Cold preparation table: Assembly area for cold food items.
- 6/7. Defrosting, warming-up apparatus front, serviceable on two sides: The core re-thermalization station, featuring equipment like convection ovens or specialized systems (Nacka, Régéthermic). "Serviceable on two sides" indicates a pass-through design.
- 11. Cold storage and storage: Size varies based on the rhythm of delivery.
- 11a. Refrigerator front, serviceable on two sides: A pass-through refrigerator for cold items.
- 11b. Delivery, empty goods, intermediary storage, personnel cloakroom: Back-of-house support zone.
- 12. Kiosk: A dual-purpose sales point serving both internal customers and street traffic.

Visual Elements Analysis

- Description: The plan shows a linear workflow designed for speed and efficiency.

- Workflow: Pre-prepared items are brought in through the delivery area (`11b`**) and held in storage (`11`). They are moved to preparation/assembly tables (`5a`) or directly to the re-thermalization units (`6/7`). The pass-through design of the ovens (`6/7`) and refrigerator (`11a`) allows staff to load from the back (kitchen side) and serve from the front (buffet line side), minimizing cross-traffic. Customers move along the buffet line (`1d`), make selections, and pay at the cashier (`1f`).**
- **Spatial Organization: The layout is clearly zoned into back-of-house (storage/delivery), preparation/re-therm, and front-of-house (self-service buffet). The inclusion of two entrances (`E1` from the street, `E2` from the building) indicates a design intended to capture multiple customer streams.**

BOQ Implications

- Specialized Equipment: The primary cost is not in traditional cooking equipment but in high-cost re-thermalization systems (e.g., high-speed convection ovens, Régéthermic or Nacka compatible units) and extensive freezer/refrigeration capacity.
- Custom Fabrication: The self-service buffet line (`1d`**) would be a custom-fabricated unit with integrated hot and cold wells, a grill/fry station, and sneeze guards.**
- **Operational Cost: This model has a lower on-site labor cost for skilled chefs but is entirely dependent on the cost and reliability of an external commissary or food supplier.**

Critical Notes

- Dependency: The success of this model is completely tied to the logistics of its external food supply chain.
- Pass-Through Design: The use of "serviceable on two sides" equipment is the key to the layout's efficiency, creating a true production line from back to front.
- Limited Flexibility: While efficient for its intended purpose, this kitchen cannot be easily adapted to produce meals from raw ingredients without a complete redesign and addition of new equipment.

Restaurant with Finger-Shaped Bar and Automats (Fig. 9)

Overview

This layout is designed for maximum speed and capacity in high-traffic locations like passersby restaurants, large cafeterias, and highway service areas. It features long, "finger-shaped" service counters to maximize the number of customers that can be served at once, supplemented by self-service "automats" (vending machines) for pre-packaged items.

Technical Specifications (Legend Items)

- 1. Service passage for U-shaped or finger-shaped counter: The main staff work aisle.
- 1d. Automats for self-service: Vending machines for dispensing food.
- 2. Connection of two fingers with dishwasher: A centralized, high-capacity dishwashing station serving two counter "fingers."
- 4/5. Salad and ice cream preparation / 4/5a. Cold counter: The cold food production and service area.
- 6/7. Frying pan, soup cooker, etc. / 6/7a. Warm counter (bain-marie, fryer, grill plates): The hot food production and service area.
- 11. Economat, cold storage, and freezer space: The central back-of-house storage and receiving area.
- G. Guest rooms with standing room and seats: The customer dining area, noting the use of disposable dishes.

Visual Elements Analysis

- Description: The plan shows two long, parallel "finger" counters extending from a central kitchen core. This shape dramatically increases the linear footage of the service counter.
- Workflow: The central kitchen core (`4/5`, `6/7`) **produces hot and cold food, which is placed on the warm (`6/7a`) and cold (`4/5a`) counters for service. Staff work in the service passages (`1`) behind the counters. Customers can access the staffed counters or the self-service automats (`1d`). A large, centralized dishwashing station (`2`) is positioned to efficiently receive soiled dishes from both counters.**
- **Spatial Organization: The design maximizes the service interface while consolidating production and sanitation into a central, efficient core.**

BOQ Implications

- Specialized Equipment: A key component is the bank of Automats (`1d`), which are specialized heated or refrigerated vending machines.
- Custom Fabrication: The long, finger-shaped counters are large, custom-fabricated units requiring extensive stainless steel work and integrated service equipment (bains-marie, refrigerated wells, fryers).
- High-Volume Equipment: The entire kitchen must be equipped with high-capacity cooking and dishwashing equipment to support the rapid turnover.
- Operational Cost: The note about "disposable dishes" indicates a significant and continuous operational expense for consumables, which is a trade-off for eliminating a portion of dishwashing labor and breakage costs.

Critical Notes

- Design for Speed: This layout sacrifices traditional dining ambiance for pure speed and volume. It is a mass-feeding model.
- Hybrid Service Model: It combines staffed service with automated self-service, offering flexibility and the ability to operate with reduced staff during off-peak hours.
- Centralization is Key: Consolidating production and especially dishwashing into a central core is essential to making the finger-layout efficient.
-

Part 15: Kitchens (Specialized International Layouts, Page 777)

Overview

This final section on kitchens presents three distinct, highly specialized layouts from international contexts, each designed to meet a specific set of service demands and operational constraints. The layouts include a multi-purpose highway restaurant, a large-scale central production kitchen for a hotel or catering operation, and a compact urban café/tearoom. These case studies illustrate advanced applications of kitchen planning, demonstrating how workflow, equipment selection, and spatial organization are tailored to diverse business models, from high-volume traveler service to the efficient use of pre-cooked meals in a high-cost urban setting.

Figure 10: Restaurant for Travelers (Highway or Busy Intersection)

Overview

This layout is designed for a high-traffic location serving multiple customer types simultaneously. It combines a quick-service snack area, a standard restaurant, and a high-end grill into one facility, all supported by a single, linear kitchen. The design prioritizes speed and diversity of service.

Technical Specifications (from Legend)

- Capacity:
  - Snack Area (G1): 45-50 seats (throughput of 200 persons/hour).
  - Restaurant (G2): 80 seats (two- or threefold re-occupancy).
  - Grill (G3): 40 seats (one- or twofold re-occupancy, high standard service).
- Equipment:
  - `6/7a`: **Cooking and frying apparatus, specified as 2 vats, 1 pan.**
  - `11a`: **A cupboard group, both cooled and not cooled, for day storage.**
  - `12`: **A kiosk facing the street.**
  - `17b`: **An elevator to a cellar for main storage.**
- **Service:**
  - `1a`: **A dedicated service corridor for snacks, cold meals, and pastry.**
  - `1/3`: **A self-service station for waiters to access beverages.**

Visual Elements Analysis

- Description: The plan shows a long, linear kitchen (`2` **through** `11a`**) running parallel to three distinct, sequential dining areas (**`G1`**,** `G2`**,** `G3`**).**
- **Workflow: A service corridor (**`1a`**) acts as a primary artery, allowing staff to move from the production areas (hot kitchen** `6/7`**, cold kitchen** `5`**, pastry** `4`**) to the various dining rooms without interference. This linear design is highly efficient for serving multiple menus from a single production core. The separate street-facing kiosk (**`12`**) creates an additional revenue stream.**
- **Spatial Organization: The key strategy is the segregation of dining experiences to capture different markets, all while leveraging a single, efficient production kitchen. Storage is located in a cellar, accessed by an elevator (**`17b`**), a common solution for space-constrained sites.**

BOQ Implications

- Equipment: Requires a diverse set of equipment to support three different menus, including high-speed snack equipment, standard restaurant ranges, and a high-quality grill. An elevator (`17b`) **is a significant mechanical cost.**
- **FF&E: Requires furnishing three different dining areas with distinct styles (snack bar stools, restaurant tables, high-end grill seating).**
- **Labor: The layout allows for specialized staff to be assigned to different sections of the production line, improving efficiency during peak hours.**

Critical Notes

- **This is a model for maximizing revenue in a high-traffic location by offering tiered service levels.**
- **The linear kitchen with a dedicated service corridor is the most efficient way to serve multiple, adjacent dining rooms.**
- **The use of a cellar for main storage is a key design decision that frees up ground-floor space for revenue-generating activities.**

Figure 11: Large Hotel/Restaurant or Catering Kitchen

Overview

This layout illustrates a large-scale, high-capacity production kitchen designed to function as a central hub for a hotel with multiple restaurants, auxiliary rooms (e.g., conference rooms), garden/terrace service, and potentially outside catering ("production for other organizations").

Technical Specifications (from Legend)

- Capacity: 800-1,000 persons.
- Service Points:
    - `1a`**: A dedicated meal and beverage serving link to a garden or terrace.**
    - `1b`**: Access to auxiliary rooms.**
- **Storage:**
    - `3a`**: A "day cellar" for beverage cold storage.**

Visual Elements Analysis

- Description: A classic "gallery" or central-passageway kitchen layout.

- Workflow: The central waiter's passageway (`1`) **acts as the main spine. All hot food production (`6`, `7`) is located on one side, while all cold food (`5`), pastry (`4`), and beverage (`3`) production is on the other. This clear separation allows for high-volume, non-conflicting workflow.**
- **Spatial Organization: This is a powerhouse kitchen designed for efficiency at scale. Its central location allows it to serve multiple venues effectively. The direct links to the garden (`1a`) and other rooms (`1b`) show it is designed as a central commissary.**

BOQ Implications

- Heavy-Duty Equipment: Requires institutional-scale, high-capacity equipment throughout all departments to handle the 800-1000 person capacity.
- Custom Fabrication: The long, double-sided service line in the central passageway would require extensive custom stainless steel counters, shelves, and warming units.
- Vertical Transport: The "day cellar" (`3a`) **implies the need for a dumbwaiter or elevator for frequent beverage restocking.**

Critical Notes

- **This is a model of a centralized production kitchen. Its purpose is to efficiently produce food for a wide variety of outlets from a single, highly organized facility.**
- **The central corridor layout is optimal for this type of high-volume, multi-venue operation.**

Figure 12: Café-Restaurant with Tearoom

Overview

This layout is for a compact restaurant in a busy urban district, characterized by long hours of continuous service and an "extensive use of precooked meals." The kitchen is a finishing and assembly station, not a full production facility.

Technical Specifications (from Legend)

- Capacity: Approximately 150 seats.
- Operational Model: Relies heavily on pre-cooked meals with minimal storage.

- Key Equipment:
  - `3`: **Beverage buffet with mixer, toaster, ice cream container.**
  - `4a`: **A dedicated pastry oven.**
  - `5`: **A sandwich assembly unit.**
  - `6`: **Defrosting and heating equipment, soup vats. This is the core of the re-thermalization process.**
  - `11`: **"Day stores" with staple goods located in a cellar.**

Visual Elements Analysis

- Description: A very compact kitchen organized for assembly-line style finishing of meals.
- Workflow: The layout is designed for speed. Waiters access the service area (`1`) **which is directly supplied by distinct stations: the beverage buffet (`3`), the pastry station (`4`), the sandwich unit (`5`), and the hot food re-therm line (`6`, `7`).**
- **Spatial Organization: The kitchen is extremely small relative to the seating capacity. This is achieved by outsourcing the primary cooking and relying on frequent deliveries to "day stores," a typical strategy for high-rent urban locations.**

BOQ Implications

- Equipment Focus: The BOQ will de-emphasize large ranges and ovens and instead focus on specialized finishing equipment: high-speed re-thermalization units, soup warmers, sandwich prep tables, and extensive beverage equipment.
- Reduced Footprint: The minimal size of the kitchen and storage areas significantly reduces construction and real estate costs.
- Operational Costs: This model shifts costs from on-site skilled labor and raw ingredients to higher-cost pre-prepared food products and dependency on a reliable delivery network.

Critical Notes

- **This design is a prime example of a "finishing kitchen" whose efficiency comes from a streamlined assembly and re-heating process.**
- **It is a model perfectly suited for operations with long hours and a diverse menu where it would be unprofitable to staff a full production kitchen for the entire day.**

- **The success of this layout is entirely dependent on the quality and logistics of its external food suppliers.**

Chapter 8: Transportation (Part 6 of 7)

Overview

This part of the chapter details the architectural and engineering requirements for two specialized types of transportation hubs. The first section covers STOL (Short Takeoff and Landing) Ports, which are compact airfields designed for aircraft that can operate from much shorter runways than conventional planes. The design is driven by the need to fit into dense urban environments, often on elevated structures. The second section provides a comprehensive guide to Seaplane Terminals, covering the unique requirements for water-based operations. It details water lane dimensions, approach zones, and the design of onshore and offshore facilities like ramps, piers, and hangars.

Key Standards and Codes Referenced

- "Planning and Design Criteria for Metropolitan STOL Ports," Federal Aviation Administration, Department of Transportation, Washington, D.C., 1970.
- Civil Aeronautics Administration, U.S. Department of Commerce, Washington, D.C. (Source for seaplane standards).

Section: STOL Ports (Pages 972-977)

Overview

This section outlines the design criteria for STOL Ports, facilities designed for aircraft requiring very short runways. The key challenge is integrating these compact airports into dense metropolitan areas, often on elevated structures or floating platforms, to provide efficient short-haul air transportation.

Technical Specifications and Quantities

TABLE 1: Design Criteria for Metropolitan STOL Ports (Page 974)

Description: A comprehensive table summarizing all the key dimensional criteria for STOL Port design. Key Quantitative Data:

Design Item	Recommended Criteria
Runway Length (at sea level, 90°F)	1,500 to 1,800 ft
Runway Width	100 ft
Runway Safety Area Width	200 ft
Taxiway Width	60 ft
Pavement Strength	150,000 lb gross weight on dual tandem gear
Approach/Departure Surface Slope	15:1 (steeper than conventional airports)
Transitional Surface Slope	4:1
Clear Zone Length	750 ft

- Parallel Runways Separation: For simultaneous VFR (Visual Flight Rules) operations, the minimum separation between centerlines should be 700 ft.
- Runway Capacity: A single STOL runway equipped with a Microwave ILS has an IFR (Instrument Flight Rules) capacity of approximately 45 operations per hour.
- Elevated STOL Port Structure Width: A 300-ft width is recommended. If a parallel taxiway is needed, the structure should be at least 400 ft wide.
- Floating STOL Port: Presented as a viable alternative for many metropolitan areas.

Visual Elements Analysis

Figure 1: Dimensional criteria (STOL Port) (Page 972)

Description: A detailed plan view showing the key dimensions of a STOL runway and its associated safety areas. Technical Details: The diagram shows a 1,500 ft runway (labeled "300'") with 100 ft of overrun on each end. The runway is 100 ft wide. The total safety area is 300 ft wide. A parallel taxiway is shown 200 ft from the runway centerline. A "POTENTIAL MICROWAVE ILS SITE" is also indicated.

Figure 2 & 3: Protection surfaces (STOL Port) (Pages 973)

Description: Detailed plan, section, and isometric diagrams of the imaginary surfaces that define the obstruction-free airspace around a STOL Port. Technical Details:

- Approach/Departure Surface: Has a slope of 15:1.
- Transitional Surface: Has a slope of 4:1.
- Clear Zone: An area 300 ft wide at the runway end, extending out for 750 ft. No objects are permitted in this zone.
- Longitudinal Profile: Shows that the approach/departure surface extends out for 8,500 ft from the end of the clear zone.

Section: Seaplane Terminals (Pages 978-983)

Overview

This section provides a detailed guide to designing facilities for water-based aircraft. It covers the requirements for both the water operating area (landing lanes, taxi channels) and the onshore facility (ramps, docks, hangars, and administrative buildings).

Technical Specifications and Quantities

Water Landing Area Standards (Table 1, Page 976)

Description: A table providing the minimum dimensions for water landing lanes based on the type of operation.

Length (ft)	Width (ft)	Depth (ft)	Remarks

2,500	200	3	Minimum for limited small floatplane operation.
3,500	300	4	Minimum for limited commercial operation.
5,000	500	10	Minimum for extensive commercial operation.
10,000	700	15	Unlimited. Approaches should be 50:1 or flatter.

- Elevation/Temperature Correction: The text notes that these lengths must be corrected for site conditions. Length increases by 7% for each 1,000 ft of elevation and 0.5% for each degree (F) above standard temperature.
- Taxi Channel Width: Minimum of 125 ft; 150 ft is preferred.
- Turning Basin Radius: Minimum of 125 ft.
- Anchor Line Length: Should be at least six times the maximum water depth.

Onshore Facility Standards

- Onshore Space Formula: The text provides a sample calculation for a facility with 15 water-based and 6 land-based aircraft, resulting in a total required area of 29,580 sq ft or approximately 0.7 acres.
- Ramp Width: Minimum of 15 ft for small twin-float or amphibian aircraft.
- Ramp Slope: Should not be greater than 7 to 1 (14.3%). Slopes less than 10 to 1 (10%) are often too long and costly.
- Gangway Slope: Maximum slope ratio is 2.75 to 1.

Visual Elements Analysis

Figure 4: Water-borne aircraft dimensional data (Page 979)

Description: A critical table providing the key dimensions of various floatplanes and amphibians, essential for sizing all facilities. Technical Details: Gives minimum and maximum dimensions (in ft-in) for overall length (A), wingspan (B), float length (G), float spacing (F), hull beam (K), etc., for different weight groups of aircraft.

Figure 5: Various types and arrangements of floats (Page 980)

Description: A series of plans and elevations showing different types of floating docks. Technical Details: Illustrates simple finger floats, U-shaped floats, and larger pier-like structures. A key detail is the Ramped Ends on some floats, which make it easier for seaplanes to taxi up onto the dock.

Figure 6 & 7: Seaplane Slipway and Onshore/Shoreline Development (Pages 981)

- Figure 6: A plan of a seaplane slipway (ramp), showing a 1'-6" walk on either side of the ramp itself.
- Figure 7: A typical site plan showing the relationship between the onshore and shoreline facilities. The plan includes a Club Building, Service Deck, Observation Terrace, Hangars, an Automobile Parking Area, and a shoreline with a Pier, Float, Gangway, and a Marine Railway for hauling aircraft out of the water.

BOQ Implications

- Specialized Paving/Structures: STOL Ports, especially elevated ones, are massive structures. The BOQ will be dominated by structural steel or reinforced concrete.
- Marine Construction: Seaplane terminals require specialized marine construction. The BOQ will include items like driven piles for piers, floating dock systems with anchoring hardware, and concrete or timber-plank ramps extending into the water.
- Dredging: The BOQ for a seaplane terminal may include a significant line item for dredging to achieve the required water depths for landing lanes and taxi channels.
- Geotechnical Investigation: The text emphasizes the importance of understanding site conditions. The project budget (soft costs) must include an allowance for professional soil borings (for STOL ports) and hydrographic surveys (for seaplane terminals) to inform the design.

Critical Notes and Warnings

- Steep Approach Paths: Both STOL Ports (15:1) and Seaplane Terminals (20:1 or 40:1) have much steeper approach/departure paths than conventional airports. This is a defining characteristic and requires careful obstruction analysis.
- Water Level Fluctuation: For seaplane terminals, the design must account for variations in water level. If the change exceeds 18 inches, floating docks and hinged gangways are necessary.
- Wind and Current: The orientation of water lanes and the design of anchorage systems are critically dependent on local wind and water current conditions.

Chapter 8: Transportation (Part 7 of 7)

Overview

This concluding part of the chapter details the architectural and logistical requirements for ground-based transportation hubs. The first section covers Bus Terminals, outlining the different functional types (intercity, airport, commuter) and providing specific design criteria for pedestrian flow, seating, ticketing, and bus loading platforms. The second section provides an in-depth guide to planning Truck Terminals, focusing on the complex operational analysis required to determine the number of dock doors, the size of accumulation space, and the layout of the yard for efficient truck maneuvering.

Key Standards and Codes Referenced

- "Pedestrian Planning and Design," by John J. Fruin, Ph.D. (Primary source for pedestrian flow data).
- "How Big is a Truck—How Sharp Does It Turn," The Operations Council of American Trucking Association, Inc., Washington, D.C., 1974.
- "Shipper-Motor Carrier Dock Planning Model," The Operations Council of the American Trucking Associations, Inc., Washington, D.C.

Section: Bus Terminals (Pages 984-989)

Overview

This section outlines the functional elements and planning criteria for different types of bus terminals. It emphasizes the importance of understanding pedestrian flow and providing adequate space for queuing, waiting, and circulation.

Technical Specifications and Quantities

Pedestrian Design Criteria

- TABLE 1: Nominal Capacity - Escalators and Moving Walks (Page 986):

Type of Unit	Speed - 90 fpm (Capacity, persons/min)	Speed - 120 fpm (Capacity, persons/min)
32-in. escalator	63	84
48-in. escalator	100	133
24-in. walk		60
30-in. walk		120

- Corridor Flow Volume:
  - Maximum practical flow: 25 persons per foot width of corridor per minute (PFM).
  - Normal walking speed (no conflicts): 7 PFM or less.
  - Commuter terminal standard (some conflicts): 10 to 15 PFM.
- Queuing Area Occupancy:
  - Minimum (no circulation): 5 sq ft per person.
  - With movement: 10 or more sq ft per person.
- Seating Rule of Thumb: For an intercity terminal, provide one seat for every three passengers during the peak period.

Bus and Platform Geometrics

- Bus Dimensions (40' Scenicruiser): 40'-0" L x 8'-0" W x 10'-1" H. Minimum outside turning radius is 48'-4".
- Bus Roadway Widths: 10-ft single lanes are sufficient; 11-ft lanes are preferable. Double-lane runways should be at least 20 to 22 ft wide.
- Sawtooth Loading Berths (Fig. 4a):
  - 45° Angle: Requires 25' berth width.
  - 30° Angle: Requires 13' berth width.
- Berth Length Required vs. Tail-Out (Chart, Fig. 5): This chart shows that a 40' bus with only 1 foot of "tail-out" (the distance it can project into the driveway) requires a 92-foot long berth. With 5 feet of tail-out, the required berth length drops to 56 feet.

Visual Elements Analysis

Figure 1: Terminal types (Page 984)

Description: Four diagrams illustrating the different functional types of bus terminals.

- (a) Urban Located Intercity Terminal: A major hub in the downtown core.
- (b) Airport-City Bus Terminal: Connects the city center to the airport.
- (c) Urban-Suburban Commuter Terminal: A rapid transit feeder station.
- (d) Suburban-Interstate Terminal: A "park and ride" facility adjacent to an interstate highway.

Figure 4: Bus loading plans (Page 988)

Description: Diagrams showing different types of bus loading platforms.

- (a) Sawtooth Loading: The most common type, where buses park at an angle to the platform.
- (b) Parallel Loading: Buses park parallel to the platform. This requires excessive amounts of space and is generally inefficient as buses can be blocked in.
- (c) Stepped Parallel: An improvement on parallel loading that provides more space for maneuvering.

Section: Truck Terminals (Pages 990-997)

Overview

This is a highly analytical section that treats the truck terminal as a specialized facility for freight consolidation and distribution. The entire design process is driven by a rigorous, data-driven analysis of the workload, including the volume of freight, number of trucks, and time constraints for loading and unloading.

Technical Specifications and Formulas

Design Year Planning Base

- The text outlines a 7-step process to establish the design basis for a new terminal, starting with a 5-year forecast. The core of this process is to determine the "design year daily volume" in pounds.

Dock and Yard Dimensions

- Dock Height: 48 to 52 in for road trailers; 44 in for city trucks.

- Apron Space: The area in front of the dock required for maneuvering.
    - General Rule: Apron length should be twice the total length of the tractor-trailer.
    - TABLE 2: Quantifies this requirement. A 55 ft long tractor-trailer requires a 62 ft apron and a 117 ft total dock approach length.
- Stall Width: 10 ft minimum, 12 ft recommended.
- Service Roads: 23 ft wide for two-direction traffic.
- Ramp Grade: Maximum of 3 percent for pulling away from a dock.

Formulas for Calculating Number of Doors and Accumulation Space

- Number of Doors Required for Unloading: `Total lbs to be stripped ÷ Stripping rate (lbs/hr/door) = Number of Doors`
    i. *Example*: 60,000 lbs/hr to be stripped ÷ 4,000 lbs/hr/door = 15 doors required.
- Accumulation Space Calculation:
    i. Determine the maximum accumulated volume of freight (in pounds) during the peak hour.
    ii. Convert this volume to cubic feet.
    iii. Multiply the cubic feet by a storage space utilization factor of 2.5 to 3.0 to account for access aisles and separation of shipments.
    iv. Divide the total required cubic feet by the overall stacking height to get the required square footage of accumulation space.

Visual Elements Analysis

Table 1: Loading and Unloading Rates (Page 991)

Description: A critical data table providing the baseline productivity rates for dock operations. Rates are based on a one-man operation:

Shipment Type	Average Pounds	Pounds per Hour
Very small shipments	150	2,000-4,000
Average shipments	500	5,500-6,500
Unit loads (pallets/skids)		22,000-30,000

Conveyor loading		9,000-11,000

Figure 8: Truck Types and Dimensions (Page 996)

Description: A series of diagrams showing the dimensions of various truck types.
Technical Details:

- 27' Doubles: Shows two 27-foot trailers connected by a dolly, with a total overall length of 65'.
- 40' Semitrailer: Shows a standard tractor-trailer with an overall length of 49'-10".

Figure 9: Typical Semitrailer Measurements (Page 997)

Description: A table providing the key dimensions for different semitrailer configurations.

- Conventional Semitrailer: Length: 32-45 ft. Dock Height: 48-54 in.
- Doubles Semitrailer: Length: 22-28 ft. Dock Height: 48-54 in.
- City Delivery Semitrailer: Length: 20-28 ft. Dock Height: 48-52 in.

BOQ Implications

- Pavement: Both bus and truck terminals require vast areas of heavy-duty paving. The BOQ must specify the correct thickness and reinforcement (e.g., "6-in. concrete slab reinforced with 6 by 6 in. No. 8 gauge welded wire mesh") to withstand the heavy, concentrated loads of these vehicles.
- Dock Construction: The BOQ for truck terminals is heavily focused on the loading dock. This includes the concrete dock structure itself, and specialized equipment such as:
  - Dock Levelers: Self-leveling steel plates to bridge the gap between the dock and the truck bed.
  - Dock Shelters/Canopies: For weather protection.
  - Dock Bumpers: Wood, steel, or rubber bumpers to protect the dock edge.
  - Overhead Doors: Sized for truck access (8'-10' wide x 8'-9'4" high).
- Pedestrian vs. Vehicle Separation: In bus terminals, the need to separate pedestrians from buses may require the construction of underpasses or overpasses, which are significant structural items for the BOQ.

Critical Notes and Warnings

- Data is Paramount for Truck Terminals: The text repeatedly emphasizes that a truck terminal cannot be designed without a thorough, data-driven analysis of the

specific freight workload. Using generic assumptions will lead to an inefficient and costly facility.
- Traffic Flow is Critical: For both bus and truck terminals, the design of on-site roadways is crucial. The text recommends counter-clockwise circulation for large vehicles because it makes left-hand turns easier for drivers.
- Safety at the Dock: Dock design must prioritize safety. The text recommends avoiding pits and ramps where possible. If ramps are necessary, they must have very shallow grades (3% max) to prevent accidents.

Chapter 9: Industrial

Part 1: Industrial Parks (Pages 1001-1006)

Overview

This section provides a comprehensive guide to the physical site planning and design of industrial parks. It outlines the key considerations a developer must address, including site layout, platting techniques, building setbacks, vehicular access for both automobiles and trucks, and the integration of rail service. The guidelines emphasize maximizing land use flexibility to accommodate a variety of future tenants while adhering to practical engineering and infrastructure standards. The section also delves into the specifics of road design, utility placement, and estimating traffic generation, highlighting the importance of early and thorough coordination with public agencies and railroad companies.

Key Standards and Codes Referenced

- Industrial Development Handbook, ULI–The Urban Land Institute, Washington, D.C., 1975. (Source for general planning principles).
- Special Traffic Generator Study–Industrial Generations, Report no. 2, Dover, Delaware: State of Delaware, Department of Highways and Transportation, 1973. (Source for parking ratio data).
- Manual of the American Railway Engineering Association (AREA). This is cited as the standard for best construction practices for all railroad tracks and appurtenances.
- National Cooperative Highway Research Program, Report 121, "Protection of Highway Utility." (Source for Traffic Generation Vocabulary).
- The text makes frequent reference to consulting with local zoning ordinances, community reviewing agencies, and state public service commissions for specific requirements.

Technical Specifications

Site Planning & Layout

- Building Setbacks:
  - Front Setback: Varies from 0 ft to 50 ft or more.
  - Front Parking Driveway (One Side): 40 to 45 ft should be provided.
  - Front Parking Driveway (Both Sides): 60 to 65 ft should be provided.
  - Side and Rear Setbacks: Typically range from 0 to 15 ft.
- Lot Dimensions:
  - Popular Depth: 200 to 300 ft.
  - Large Lot Depth: 500 to 700 ft.
- Building Coverage:
  - Warehouses: Can often achieve above 50% site coverage.
  - Offices/Light Manufacturing: Typically in the 30% range due to larger parking needs.
- Building Dimensions: Most structures fall within a square to a 2:1 ratio of length to width.

Truck Loading & Maneuvering

- Dock and Maneuvering Depth:
  - Minimum for Warehousing: 85 ft.
  - Recommended for 45-ft Trailers: 129 ft.
  - Configuration (Fig. 1):
    - Maneuvering Area for Counter-clockwise Flow: 40 ft minimum.
    - Maneuvering Area for Clockwise Flow: 100 ft minimum.
    - Loading Area for 55-ft Tractor/Trailer: 55 ft.
    - Loading Area for 65-ft Tractor/Trailer: 65 ft.

Roads and Streets

- Cul-de-sac Streets: Should end in a paved turnaround with a 100 ft diameter to accommodate large trucks.
- Roadway Section (Fig. 2):
  - Right-of-Way (R/W): 44 ft.
  - Pavement Width: Two 11 ft lanes.
  - Pavement Type: 7 in. Non-Reinforced Concrete Pavement on a 4 in. Rolled Stone Base over Compacted Subgrade.
  - Shoulder Width: 4 ft.
  - Pavement Cross Slope: 0.02 ft/ft (2%).
  - Shoulder Slope: 0.05 ft/ft (5%).
  - Turf/Embankment Slope: 3:1.

    - Utility Easement: 10 ft for roadway maintenance and utilities.

Rail Service

- Right-of-Way/Easement: Requires about 15 ft from the centerline of the spur track to the rear property line. A 40 ft easement or R.O.W. is shown in diagrams.
- Turnout Curve: An allowance of 150 ft is needed to bring a rail from the lead track to a point parallel with a building.
- Dock Height: 3.5 to 4.0 ft above the top of the rail.
- Track Curvature (Rule of Thumb): Minimum radius of 350 to 400 ft.
- Track Gradients (Rule of Thumb): Maximum permissible gradient along spur tracks is 1.5% to 2%.
- Clearances: Design must conform to railroad and public service commission requirements for horizontal and vertical clearances to structures. A minimum of 10 minutes is shown between a rail service door and the point of switch.

Visual Elements Analysis

Figure 1: Truck loading and maneuvering configuration. (p. 1001)

- Description: A plan view diagram illustrating the spatial requirements for semi-trailer truck access to a loading dock.
- Technical Details: The diagram shows a truck backing into a loading bay from a maneuvering area. It specifies minimum maneuvering area depths based on the direction of traffic flow: 40 ft min. for counter-clockwise and 100 ft min. for clockwise. It also specifies loading area depths based on vehicle length: 55 ft for a 55-ft truck and 65 ft for a 65-ft truck. A "Waiting Area" is shown adjacent to the loading dock.
- Construction Notes: This diagram provides the critical dimensions a site planner needs to ensure that truck circulation is feasible, which is fundamental to the design of logistics and warehousing facilities.

Figure 2: Utility and pavement relationship in an industrial park... (p. 1002)

- Description: A detailed cross-section of a typical industrial park road within a 44-ft right-of-way.
- Technical Details: This drawing meticulously lays out the integrated infrastructure. The road consists of two 11-ft concrete lanes with 4-ft shoulders. The sub-base is specified as 4-in rolled stone. Slopes for drainage are clearly marked. Utility locations are specified in the easement: Water, Gas, and Telephone are grouped on one side; Electrical and Sanitary Sewer are on the other. A Force Main is also indicated.

- Construction Notes: The integration of utilities within the road easement is a key planning principle shown here. The specification of pavement thickness and base material provides direct input for construction documents.

Figure 3 & 4: RAIL SERVED BUILDING LAYOUT. (p. 1003)

- Description: Two comparative site plans showing different methods of providing rail access to an industrial building.
- Technical Details:
  - Fig. 3 (Rail in R.O.W.): Shows the lead track within a 40-ft public Right-of-Way. The building is set back from the spur track. This layout achieves a building coverage of 52% of the site.
  - Fig. 4 (Rail in Easement): Shows the lead track within a 40-ft private easement on the property. This requires a larger building setback (38.5 ft vs. 18.5 ft in Fig. 3) and results in a lower building coverage of 46%. A critical note states this layout requires an easement on the adjacent property for the turnout curve.
- Construction Notes: These plans illustrate a critical trade-off. Placing the rail in a public R.O.W. maximizes land use for the building but may offer less control. Placing it in an easement provides more control but consumes more of the buildable area. Both plans show a 200 ft deep building on a 300 ft deep lot with 95 ft for truck loading.

Calculations and Formulas

Traffic Generation Calculation

- Procedure: The primary method for calculating traffic is based on empirical data relating land use and employee density to vehicle trips.
- Table 1: Traffic Generation Vocabulary: This table provides the core data for such calculations.
  - Variables:
    - Land Use: Categorized from low-density automated industry (e.g., refinery) to high-density office campus.
    - Density: Measured in Employees per Acre.
    - Traffic Rate: Measured in Vehicle Trips per Acre or Vehicle Trips per 1,000 sq. ft. of Floor Area.
  - Example Calculation: For a "Light service industry" with a typical density of 16 employees/acre, one can expect 16 vehicle trips per day per acre, or 0.8 vehicle trips per day per 1,000 sq. ft. of floor area. A traffic engineer uses these values to model the total traffic load and design the required road capacity.

BOQ Implications

- Site Work & Earthworks: Quantities for site clearing, grading, and excavation for building pads and infrastructure.
- Pavement: BOQ would include square footage of pavement specified as 7-in. non-reinforced concrete and cubic yards of 4-in. rolled stone base and compacted subgrade.
- Utilities: Linear footage of all utility pipes (water, gas, sanitary, storm, force main) by diameter and material. Number of manholes, catch basins, and fire hydrants.
- Railroad Construction: This is a specialized and significant cost item. The BOQ would include linear feet of track (rail, ties, ballast), number of switches/turnouts, and any at-grade plank crossings. This work is often performed by specialized contractors or the railroad itself.
- Landscaping: Square footage of sod or seeding for turf areas and easements.

Critical Notes and Warnings

- Contact Authorities Early: The text repeatedly stresses the need to contact the serving railroad company and local planning/zoning agencies as early as possible. Key decisions about rail access points and road design require their approval.
- Railroad Service is Complex: A developer must investigate factors beyond simple track access, such as "reciprocal switching limits," "frequency of switching service," and "car supply," as these can make a site unattractive to industrial tenants.
- Traffic Management: Minimizing at-grade rail crossings is a key objective to prevent traffic interruptions. For high-density uses, these interruptions are "particularly annoying" and may require costly automatic crossing protection.
- Parking Ratios Vary Widely: The footnote on page 1001 provides a stark warning that parking needs are not uniform. The ratio can vary by a factor of 100 (from 0.21 to 20 spaces/1000 sq.ft.) depending on the employee density of the industry. A one-size-fits-all approach to parking will fail.
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Part 2: Industrial Buildings, General (Pages 1007-1017)

Overview

This section, authored by Francis W. Gencorelli, RA, AIA, outlines a systematic, three-step methodology for planning a new industrial plant. It emphasizes that successful plant design is a collaborative effort between the corporate client and an outside consultant, moving from high-level organizational planning to detailed site analysis and finally to the fundamental layout of the facility. The section provides an exhaustive checklist in the form of a "Plant Site Analysis" questionnaire, covering every conceivable factor from geology and utilities to labor laws and community services. The overarching principle is that a plant must be designed for long-term growth and flexibility, with an initial 25-year master plan guiding the development of a building intended for the first 5 years of operation.

Key Standards and Codes Referenced

- While no specific external standards or codes are named, the entire Plant Site Analysis questionnaire (Figs. 2, cont.) is a de facto standard for due diligence. It implicitly requires investigation of local, county, and state codes regarding:
  - Zoning ordinances
  - Sewage disposal regulations
  - Fire protection requirements
  - Labor laws ("right to work," fair employment, etc.)
  - Tax codes

Technical Specifications

Planning & Layout Principles

- Planning Horizon: The entire plant site should be laid out for a 25-year period. The initial building project should be designed to serve the needs of the next 5 years.
- Layout Concepts:
  i. Product Layout: A linear layout suitable for companies producing a large quantity of a few products.
  ii. Process Layout: A parallel layout suitable for companies producing a great number of products with similar processes.
- Production Line Evaluation Criteria:
  i. Ease of flow of materials
  ii. Degree of flexibility
  iii. Ease of expansion
  iv. Ease of personnel movement
  v. Ease of supervision
  vi. Least initial investment
- Internal Engineering Space: Must be built 100% larger than initially required to accommodate future needs.

Site Rating System (from Table 1)

- Methodology: A weighted scoring system to evaluate potential plant sites. Factors are rated as poor (1), fair (2), good (3), or excellent (4). The score is multiplied by a rating weight.
- Site Element Ratings (Weight):
    - Labor supply and union history: 20
    - Public utilities and water: 12
    - Freight and transportation: 10
    - Tax conditions: 6
    - Site characteristics: 7
    - ... and so on, for a total of 100 points.
- Passing Score: A site should rate 80 percent overall and must rate at least "good" in elements of special importance.

Office Space Standards (from Fig. 4)

- President: 300 sq. ft.
- Comptroller and Senior V.P.: 196 sq. ft.
- Assistant V.P. Management: 150 sq. ft.
- Auditors (Shared Office): 150 sq. ft.
- Accounting: 130 sq. ft.
- Executive Secretary: 85 sq. ft.
- Supervisor (Department Head): 80 sq. ft.
- General Office Space: 60 sq. ft.
- General Office Space (No Outside Contact): 48 sq. ft.

Toilet Fixture Requirements (from Table 2, New York State Labor Code)

- Methodology: A prescriptive table specifying the minimum number of water closets and urinals for men, and water closets and wash basins for women, based on the number of employees.
- Example (MEN): For 81-100 men, 4 water closets and 2 urinals are required. For 401-450 men, 10 water closets and 8 urinals are required.
- Example (WOMEN): For 81-110 women, 5 water closets are required. For 401-425 women, 18 wash basins are required.

Wash Fountain Capacities (from "Wash Fountains Required" table)

- Methodology: Specifies the number of persons that can be accommodated by different sizes and types of circular wash fountains.
- Example:
    - A 54" circular fountain accommodates 8 persons each.
    - A 36" semi-circular fountain accommodates 3 persons each.

Visual Elements Analysis

Figure 1: Organizational chart. (p. 1007)

- Description: A block diagram showing the ideal organizational structure for a new plant planning project.
- Technical Details: The "President" is at the top, overseeing three Vice Presidents (Sales, Research/Control, Plant Management). These executives form the core of the "New Plant Planning Team," which works directly with "Outside Consultants."
- Relationship to Text: This diagram visually represents the "Establishing Liaison" phase, emphasizing the need for a dedicated internal team to collaborate with external experts.

Figure 2 & 2 (cont.): Plant site analysis. (pp. 1008-1016)

- Description: An exhaustive, multi-page questionnaire intended for conducting comprehensive due diligence on a potential industrial site.
- Technical Details: This is not a drawing but a detailed data-gathering instrument. It covers the following categories:
    - Location, Cost, Size, Description: Basic site identification.
    - Soil Structure, Zoning, Transport: Physical and regulatory characteristics.
    - Water Supply, Sewage, Power, Gas: Utility availability and capacity.
    - Local Services, Police/Fire Protection: Community infrastructure.
    - Taxes, Tax Attitude: Financial and political climate.
    - Local Weather, Prevailing Winds, Floods: Environmental factors.
    - State Laws, Natural Resources, Politics: Broader regional context.
    - Adjacent Community Analysis, Labor Population: Human resources and quality of life.
- Construction Notes: This document is a critical pre-construction tool. The data gathered (e.g., soil bearing load, flood history, utility capacity) directly informs the architectural, structural, and MEP design of the plant.

Figure 3: Basic area relationships. (p. 1015)

- Description: A schematic site plan showing the fundamental layout and expansion strategy for a modern industrial plant.
- Technical Details:
    - Fixed Facade: The front of the plant, containing "Administration," "Employee Facilities," "Research and Control," and "External Engineering," is designated as fixed.
    - Expansion Zones: Two primary expansion directions are shown: `Expansion 1` for "Warehousing" and `Expansion 2` for "Manufacturing."

    - Circulation: A clear separation is shown between "Administration Parking" at the front, "Employee Parking" at the side, and "Railroad and/or Truck" access for "Receiving and Shipping" at the rear.
- Relationship to Text: This diagram is a powerful visual representation of the core planning principle: design with a fixed facade and plan for linear expansion of production and warehousing areas to the side and rear.

Figure 4: Office areas. (p. 1015)

- Description: Nine plan-view diagrams showing typical layouts and square footage standards for different types of office spaces within an industrial facility.
- Technical Details: Each diagram shows a furniture layout (desks, chairs, tables) within a dimensioned space, with the total square footage clearly labeled (e.g., "(a) President 300 sq. ft.").
- Relationship to Text: This figure provides the specific spatial standards to be used when planning the "Administration" block of the industrial plant, as called for in the area breakdown list.

BOQ Implications

- Pre-Construction Services: The entire methodology outlined implies significant pre-construction costs for consultants to perform site analysis and fundamental layout studies.
- Site Investigation: The Plant Site Analysis questionnaire dictates the need for geotechnical investigations (test borings), topographic surveys, and utility capacity studies, all of which are cost items.
- Fixture and Equipment Quantities: The tables for toilet fixtures and wash fountains provide a direct method for calculating the number of plumbing fixtures required for the BOQ, based on the projected number of employees.
- Long-Lead Items: The process emphasizes making decisions about manufacturing machinery early. This allows the consultant to establish the fundamental building layout, which in turn allows for early procurement of long-lead structural components (e.g., long-span trusses).

Critical Notes and Warnings

- Liaison is Crucial: The initial step is not site selection but establishing a dedicated internal planning team and hiring outside experts. "The fact that most plant construction will be done by corporate clients makes it imperative that the source of responsibility be clearly established."
- Design for Flexibility and Expansion: The single most repeated warning is to avoid designing a plant only for immediate needs. The design must be flexible

enough to handle changes in product lines and must be oriented on the site to allow for logical, unhindered future expansion.
- Location of Engineering/Utilities: "The single greatest error made in plant design is the placement of the internal engineering facilities." Centralizing utilities is a "false economy" because it blocks future expansion paths. They should be placed linearly along the fixed facade.
- Use Objective Space Standards: The text warns that basing office sizes on "ego-oriented requirements" is a mistake. The designer should use objective functional standards, such as those provided in Figure 4.
-

Part 3: Industrial Plants (General Design Principles, Pages 1020-1025)

Overview

This section, authored by Richard Muther, delves into the fundamental architectural and structural decisions that shape an industrial plant's layout and functionality. It provides a comprehensive checklist of building features that must be considered, including the choice between special-purpose and general-purpose buildings, single vs. multistory construction, and the shape of the building. The text details the specific conditions under which each choice is most appropriate. It provides significant detail on the characteristics of various floor and roof structures, wall systems, and the critical role of column spacing in determining layout efficiency. The section concludes with standards for railroad clearances and freight car dimensions, underscoring the importance of integrating site features into the building design.

Key Standards and Codes Referenced

- Source Document: The content is based on *Practical Plan Layout*, McGraw-Hill Book Company, New York, 1955.
- The text makes implicit reference to local and state regulations regarding railroad clearances.

Technical Specifications

Construction Type & Building Shape

- General-Purpose Building: Recommended when initial cost and resale potential are important, or when product lines are expected to change frequently.

- Special-Purpose Building: Used only when essential for the plant to operate economically (e.g., plants with highly specialized processes).
- Single-Story Construction: Recommended for products that are large, heavy, or inexpensive per pound; when equipment causes heavy floor loads; when large, unobstructed space is needed; and when land value is low.
- Multistory Construction: Recommended for products that are small, light, and valuable; when gravity flow can be used in the process; and when land value is high.
- Square Building Shape: Recommended for maximizing material efficiency (shortest perimeter for a given area) and when frequent layout rearrangement is expected.
- Other/Separate Buildings: Recommended for operations that are dirty, noisy, hazardous (fire/explosion), or not part of the primary production flow.

Ceiling Heights (from Table 1)

Type of Production	Without Overhead Installations	With Overhead Installations
Small-product assembly on benches; offices	9-14 ft	10-18 ft
Large-product assembly on floor	Max. height of product + 75%	Max. height of product + 125%
Small-product forming	Height of machinery + 100%	Height of machinery + 150%
Large-product forming	Height of machinery + 125%	Height of machinery + 125%

Railroad Clearances and Dimensions

- Standard Track Gauge: 4 ft 8.5 in.
- General Clearances (Straight Track, Fig. 9):
    - Horizontal clearance from track centerline: 8 ft 6 in. (some states/railroads require more).
    - Vertical clearance above top of ties: 24 ft (as required by one western railroad).

- Clearances for Curves:
    - Allowance: Add 1 in. per degree of curve plus an additional 2 in. for outside clearances. For inside clearance, add 1.75 in. plus the middle ordinate distance for a 45-ft chord.
- Freight Car Dimensions (from Table 2):
    - Box Car (Typical): Length 41 ft 9 in.; Overall Width 10 ft 8 in.; Overall Height 14 ft 1 in.; Capacity 3,468 cu ft.
    - Flat Car (Typical): Length 53 ft 0 in.; Overall Width 10 ft 3 in.
    - Automobile Car (Typical): Length 52 ft 3 in.; Overall Height 15 ft 1 in.
- Highway Truck Dimensions (from Table 4):
    - Medium Trucks: Height 9.5 ft; Length 34 ft; Width 7 to 7.5 ft.
    - Large Trucks and Trailers: Height 13 ft max.; Length 45 ft; Width 7.5 to 8 ft.
- Average Truck-Bed Heights (from Table 3):
    - 1- to 1.5-ton panel trucks: 40-44 in.
    - Large trucks and trailers: 48-52 in.
    - Largest tandem-wheel semi-trailers: 50-56 in.

Visual Elements Analysis

Figure 1: Features of the one-and-a-half story building. (p. 1020)

- Description: An isometric cutaway view of a "one-and-a-half-story" industrial building, illustrating its key features.
- Technical Details:
    - `(a)`: Rail siding with car floor at plant floor level.
    - `(b)`: Truck tailgate level with plant floor level.
    - `(c)`: Shallow ramps down to a basement and up to the main floor.
    - `(e)`: A balcony/mezzanine for supporting activities.
    - `(f)`: A two-story office building integrated with the plant structure.
- Relationship to Text: This diagram visually defines what the author considers the "most universally economical plant today," combining the benefits of single-story production with the utility of basements and mezzanines for support functions.

Figure 3: Compare materials needed in the side walls... (p. 1021)

- Description: Four plan diagrams used to compare the perimeter wall length for different building shapes with the same floor area.
- Technical Details: Plans `(a)`, `(b)`, and `(c)` are all 10,000 sq ft.
    - Plan `(a)`: A square building (100 ft x 100 ft) with a perimeter of 400 ft.
    - Plan `(b)`: A rectangular building (50 ft x 200 ft) with a perimeter of 500 ft.
    - Plan `(c)`: An L-shaped building with a perimeter of 500 ft.

- Construction Notes: The caption explains that where material saving is of prime importance, the square plan is most efficient because it has the shortest perimeter for a given area.

Figure 4: Basic use and arrangement of basement and balcony. (p. 1021)

- Description: A cross-section diagram showing the typical functions assigned to basements and balconies.
- Technical Details:
  - Basement: Used for medium or heavy material and equipment.
  - Ground Level: Used for medium or heavy material and equipment.
  - Balcony: Used for small or light material and equipment.
- Relationship to Text: This illustrates the principle of locating functions vertically based on weight and bulk, taking advantage of the structural capacity of each level.

Figure 6: Typical types of roof structures. (p. 1023)

- Description: Eight cross-section diagrams showing different types of roof trusses and structural systems.
- Technical Details: The diagrams illustrate the profiles of: (a) Truss, (b) Sawtooth, (c) Monitor, (d) Bowstring truss, (e) Concrete arch, (f) Three-bay high-low gable, (g) High crane type, and (h) Cantilever.
- Relationship to Text: Provides a visual catalog of the roof construction options mentioned in the text, which affect ceiling height, lighting, and the ability to suspend equipment.

Figure 7: Column spacing. (p. 1023)

- Description: Two schematic plans showing how column bay spacing influences the layout of operations.
- Technical Details:
  - Plan `(a)`: Shows large operations aligned with wide bays (`30' bay`) and smaller operations in narrower bays (`20' bay`).
  - Plan `(b)`: Shows a combination of different column spacings to accommodate a varied flow lineup.
- Construction Notes: The diagram illustrates that the layout must be designed in concert with the structural grid. The layout man must "juggle a neat arrangement of machinery...into the column layout."

Figures 9 & 10: Railroad Clearances and Data. (p. 1025)

- Description: Detailed diagrams specifying required clearances for railroad tracks and the dimensions of typical freight cars.

- Technical Details: See "Technical Specifications" above for detailed dimensional data from these figures. Figure 9 provides the critical horizontal and vertical clearances for tracks near platforms and buildings. Figure 10 provides annotated profile and plan views of Hopper, Box, Flat, Gondola, and Automobile cars with their key dimensions.
- Relationship to Text: These figures provide the essential, hard data required for planning any facility that will have rail service, covering the dimensional constraints imposed by the vehicles themselves and the safety clearances required for their operation.

BOQ Implications

- Structural Steel/Concrete: The choice of building shape (square vs. rectangular) and column spacing directly impacts the quantity of structural materials needed. A square building is noted as being the most material-efficient.
- Foundations: The decision to use a basement or not, and the type of equipment to be placed (requiring special foundations for large presses), are major cost drivers for excavation and concrete work. -- Material Handling Equipment: The choice of overhead installations (conveyors, cranes) directly impacts the required ceiling height and the structural design of the roof trusses, which must be designed to carry these suspended loads.
- Specialized Construction: The provision of rail spurs and truck docks at the correct height relative to the plant floor requires significant site work, including grading, retaining walls, and depressed accessways.

Critical Notes and Warnings

- Check Floor Strength: The text warns that floor strength is a critical factor and must be checked with the architect, especially when planning for heavy machinery or high-stacking storage.
- Column Spacing is a Major Constraint: The layout must be planned in harmony with the column grid. "Columns interfere with spotting of machinery, aisles, storage areas, and overhead handling equipment." The designer should use the columns to their advantage by placing non-productive equipment (drains, fire extinguishers) against them.
- Consider All Site Features: External features like rail lines, roadways, and underground tanks can severely limit building placement and expansion. A long-range development plan for the entire site is essential.
- Railroad Clearances are Mandatory: The clearances shown in the diagrams are required for safety and must be adhered to. The text warns that different states

and railroad companies may have even stricter requirements that must be investigated.

Part 4: Research Laboratories (Pages 1026-1037)

Overview

This comprehensive section provides an in-depth guide to the planning and design of research laboratories, emphasizing that these are highly complex and specialized buildings. The content covers the entire planning process, from administrative organization and the classification of lab types to the detailed engineering of utility distribution systems and the ergonomic layout of individual lab modules. Key themes include the critical importance of designing for long-term capability and flexibility, the need for a rigorous "Program of Requirements (POR)" before any design work begins, and the fact that mechanical, electrical, and plumbing (MEP) systems can account for up to 50% of the total construction cost. The section offers a comparative analysis of various layout strategies (e.g., utility corridors, shaft systems) and provides specific, hard-data dimensional standards for benches, aisles, fume hoods, and office spaces.

Key Standards and Codes Referenced

- U.S. Public Health Service (PHS): Provides a classification system for research facilities (Classes A, B, C, D).
- New York State Labor Code: Referenced for minimum toilet fixture requirements (Table 2, p. 1016).
- American National Standard A40.4-1942 & A40.6-1943: Referenced for plumbing backflow prevention methods (air gaps and vacuum breakers).
- NFPA Standard No. 54, Installation of Gas Appliances and Gas Piping: Cited as the standard for gas piping design.
- Other Mentioned Codes for Guidance: American Insurance Association (AIA/NBFU), National Fire Protection Association (NFPA), American National Standards Association (ANSI), American Gas Association (AGA), National Plumbing Code, American Water Works Association (AWWA).
- Source Documents: Content is referenced from articles by Jonathan Barnett in *Architectural Record* (Nov. 1965) and W. R. Ferguson in *Practical Laboratory Planning* (1973).

Technical Specifications

PHS Laboratory Classifications

- Class A: Maximum capability for conversion between scientific disciplines (biology, chemistry). Designed to protect research integrity and reduce personnel hazards.
- Class B: Limited capability for conversion. Suited for disciplines like social sciences or epidemiology; requires major alterations for chemistry or biology.
- Class C: Research support facilities (e.g., animal pens, storage sheds). Non-combustible construction is not required.
- Class D: Special, single-purpose facilities (e.g., hyperbaric chambers, biohazard control) that are inherently unsuited for conversion.

Laboratory Module & Layout Dimensions

- Module Size:
  - A 10 ft module is recommended, based on two 5 ft wide peninsular benches with a 5 ft space between. A 3-m module is the metric equivalent.
  - A 5 ft module can be used to provide greater flexibility for creating rooms of varying sizes (e.g., 15 ft or 25 ft wide).
- Bench Widths:
  - Chemistry Labs: 2 ft 6 in. for wall benches; 5 ft for peninsular benches.
  - Physics Labs: 3 ft and 6 ft widths are sometimes preferred to accommodate equipment.
- Space Between Benches:
  - Ideal: 4 ft 6 in. to 5 ft 0 in.
  - Cramped: 4 ft.
  - Absolute Minimum: 3 ft 3 in. (not recommended for new labs).
  - Student Labs: Should be greater than 5 ft to allow for two people working back-to-back with room for others to pass.
- Bench Space per Person:
  - An accepted standard is 12 to 15 lineal feet of bench per person.
- Laboratory Depth: Has increased from ~16 ft to 24 or 25 ft in modern labs, with some up to 30 ft. A clear depth of 24 ft is recommended for standard peninsular layouts.
- Corridor Widths:
  - An absolute minimum of 5 ft 6 in. is required, but this should be increased if the corridor length exceeds 200 ft.
  - Specific examples from existing labs range from 6 ft to 7 ft 6 in.

Utility System Specifications

- HVAC: Accounts for 25% to 50% of the total facility cost.
- Water Treatment: Water softeners are recommended if temporary hardness is 10 grains/gallon or more, or total hardness is 18 grains/gallon or more.
- Compressed Air & Vacuum:

    - Compressed Air: Required pressure is 40 psig with a flow of 5 scfm at each station.
    - Vacuum: Required performance is 5 cfm at 28 in. Hg at each outlet. Receptor jars are mandatory to protect the vacuum pump.
- Fume Hood (Cupboard) Ducts: Require a diameter of 8 to 12 in.

Visual Elements Analysis

Figure 1: Layout of a three-module, 30-ft by 24-ft laboratory. (p. 1034)

- Description: A detailed floor plan of a standard laboratory unit, demonstrating the integration of workspace, office, fume hood, and services.
- Technical Details:
    - The layout is based on a 10 ft module.
    - It features a peninsular bench and a wall bench, providing ample workspace.
    - An 8 ft 6 in x 6 ft office is located internally.
    - A fume cupboard (hood) is placed at the end of the peninsular bench, away from the main traffic path but near the service duct (`Duct C`).
    - Service ducts (`D1`, `D2`, `C`) are shown integrated into the walls and bench ends.
    - A critical safety feature is the "Knock-out escape panel" (3 ft x 2 ft) at the end of the aisle between benches.
- Construction Notes: The plan specifies a 1 ft hinged panel and a 3 ft door. It shows "clear glass above 3 ft 6 in" for the office partition, providing visibility while maintaining some privacy.

Figure 2, 3, 4, 5: Comparative Laboratory Layouts (pp. 1036, 1037)

- Description: A series of block diagrams illustrating four fundamental layout strategies for research buildings. The legend indicates labs, service labs, and offices.
- Fig. 2 (Off-Center Corridor): Shows labs on one side (e.g., south-facing) and offices/service labs on the other. Good for smaller schemes.
- Fig. 3 (Central Corridor): A more compact layout for larger schemes with labs on both sides of the corridor. The diagram includes a Use Factor calculation: `Assignable Area (6762 ft²) / Gross Area (9447 ft²) = 71%`. This is a critical performance metric.
- Fig. 4 (Double Corridor): An interior loop corridor serves internal labs and service areas, with offices on the perimeter.

- Fig. 5 (Service Corridor): A wide central "service corridor" contains all primary utilities and provides access to labs on both sides. This is noted as being suitable for large, complex schemes.

Figure 4: Comparative study of different teaching laboratory layouts... (p. 1032)

- Description: A set of six schematic diagrams from Hellmuth, Obata, and Kassabaum, evaluating different core and corridor configurations.
- Technical Details: Each diagram is accompanied by a qualitative feasibility analysis.
    - Key Finding: Designs with compact, centralized mechanical cores are rated as "very compact and economical" from a mechanical standpoint, but often result in "excessive corridors" from a circulation standpoint. There is an inherent trade-off between MEP efficiency and circulation efficiency.

BOQ Implications

- MEP Systems: This is the largest and most complex part of the BOQ.
    - Piping: Extensive quantities of specialized piping are required, including acid-resisting pipe (e.g., Duriron, glass), piping for distilled/demineralized water ("block" tin, stainless steel, plastic), and standard pipes for gas, compressed air, and vacuum.
    - HVAC: High-capacity air handling units, extensive ductwork (including dedicated large-diameter fume hood exhausts), and sophisticated control systems.
    - Plumbing Fixtures: Laboratory sinks, emergency showers, eye wash stations, receptor jars, and neutralization sumps for acid waste.
- Laboratory Casework: The BOQ will include linear feet of benches (peninsular and wall), reagent shelves, and storage cabinets. Fume hoods are a major specialized equipment item.
- Architectural/Structural:
    - The cost will be heavily influenced by the chosen utility distribution system. A Utility Floor System has a "very high first cost" due to the need for an entire interstitial service floor.
    - A Utility Corridor also adds significant non-assignable square footage, increasing the overall building cost.

Critical Notes and Warnings

- Plan for Capability, Not Just Flexibility: The building must have the *inherent capability* to support future research needs (e.g., adequate duct space for fume hoods, sufficient power). A flexible layout in a building with inadequate services is useless.

- Standardize Utility Layouts: "Utility services should be laid out with an identical configuration for every floor." This is a crucial principle for ensuring future adaptability. Deletions can be made on floors with lesser needs, but the core capacity should be designed into the system from the start.
- MEP Drives the Design: HVAC and other utility systems can represent 25% to 50% of the total cost. Their design must be considered at the very beginning of the planning process, not forced into a pre-existing architectural shell.
- Safety in Layout: Fume hoods must not block exits. An alternative escape route, such as a "knock-out panel," is a critical life-safety feature in long, narrow labs.
- Avoid Customization for First Occupants: Designing labs around the specific preferences of the initial scientists often leads to costly and difficult modifications for future occupants. A standardized, modular approach is superior for the long-term life of the building.

Part 5: Warehouses (General Principles, Pages 1038-1042)

Overview

This section provides a foundational guide to the principles of modern warehousing, emphasizing a shift from simple storage to efficient distribution. Authored by William Staniar, it establishes that warehouse design must be driven by the economics of materials handling. Key concepts covered include the superiority of one-story buildings for most applications, the importance of maximizing vertical "cube" space, and the critical role of powered handling equipment. The text details various types of handling systems (fork trucks, conveyors, cranes) and layout strategies (straight-line flow). It concludes with a quantitative method for calculating space utilization, differentiating between gross area and net usable storage space.

Key Standards and Codes Referenced

- Source Document: The content is based on *Plant Engineering Handbook, 2d ed.*, by William Staniar, M.E., Editor-in-Chief, McGraw-Hill Book Company, New York, 1959.
- Fire Underwriters: Mentioned as the source for the requirement of leaving 18 in. of clear space under sprinkler heads, a rule that affects allowable stacking height.

Technical Specifications

Building Design & Layout Fundamentals

- Construction Type:
  - One-Story Warehouse: Preferred for most applications due to lower investment per cubic foot, high floor load capacity, greater layout flexibility, and easier supervision.
  - Multistory Warehouse: Considered only when land cost is high, the site is limited, or light-weight products can benefit from gravity flow.
- Stacking Height: Modern warehouses emphasize high stacking, requiring roof elevations sufficient to allow for 18 to 20 ft (and higher) stacking.
- Clear Spans: Modern design generally includes clear spans ranging from 60 to 100 ft.
- Dock and Door Dimensions:
  - Dock Height (Rule of Thumb):
    - For Rail Cars: 3 ft 7 in. above top of rail.
    - For Trucks: 4 ft 4 in. (average) above ground.
  - Door Size: 8 to 12 ft wide and 10 ft high is usually ample for high-stacking equipment.
  - Door Spacing:
    - For Box Cars: 45 ft center-to-center (for standard 40-ft rail equipment).
    - For Truck Delivery: 15 ft center-to-center.
- Aisle Width (Narrow-Aisle Layouts): Right-angle stacking aisles can be reduced to as little as 6 ft using straddle fork trucks.

Materials Handling Equipment

- Tow Conveyor (Dragline Conveyor): Used for sorting and order makeup where maximum flexibility is required.
- Pallet Systems: Includes pallets, skids, bins, racks, and unit loads.
- Wheeled Vehicles: Tractor-trailers and fork trucks.
- Overhead Systems: Monorail, bridge crane, stacker crane.
  - Stacker Crane: Recommended for evaluation in narrow-aisle operations requiring selectivity and maximum vertical height utilization.
- Conveyors: For vertical and horizontal movement of products like cases, boxes, drums, etc.

Visual Elements Analysis

Figure 1: Typical large warehouse layout. (p. 1039)

- Description: A detailed schematic floor plan of a large warehouse designed around a centrally located short-lot/bin-storage area and coordinated by a dragline conveyor system.
- Technical Details:
    - Flow: The layout emphasizes "direct-flow replenishment and stock selection."
    - Zones: Clearly defined areas for "Receiving," "General storage," "Shipping set-out area," "Checking and packing," and "Offices."
    - Access: Multiple "Truck wells" are shown for shipping and receiving, and "Car lot" areas are indicated for rail service.
    - Core: The central area contains bin storage and offices, serviced directly by a "Bin conveyor."
- Relationship to Text: This diagram illustrates a highly organized, conveyor-driven distribution center, reflecting the principles of efficient material movement and zoned storage discussed in the text.

Figure 2: Space utilization — a three-dimension operation. (p. 1039)

- Description: An isometric diagram illustrating the concept of "cubic" space utilization.
- Technical Details: The drawing shows a worker using a fork truck to stack goods vertically, emphasizing that storage space is three-dimensional. It is captioned with the phrases: "Space is vertical," "Not just horizontal," "You pay for this space," "Make the most of it."
- Relationship to Text: This is a powerful visual metaphor for the central theme of the section: modern warehousing is about maximizing the use of the entire building volume (the "cube"), not just the floor area.

Figure 3: Standard pallet patterns. (p. 1040)

- Description: Nine diagrams illustrating different methods for arranging boxes on a pallet to achieve a stable, interlocking load.
- Technical Details: The patterns shown are: Block, Split block, Brick, Row, Split row, and Pinwheel. A note indicates that "Paper or fiber board binders between layers" can be used if necessary for stability.
- Relationship to Text: This provides a visual guide to the practical techniques used in creating stable unit loads, which is fundamental to the pallet-based handling systems described.

Calculations and Formulas

Space Utilization Formulas

- Primary Formula:
  - `Space utilization (%) = Area utilization (%) × Vertical-height utilization (%)`
- Area Utilization:
  - Formula: `(Net storage area / Gross storage area) × 100`
  - Variables:
    - Net Storage Area: Floor space actually occupied by goods.
    - Gross Storage Area: Net storage area plus aisles, shipping/receiving areas, office space, and space lost to columns or irregularities.
- Vertical-Height Utilization:
  - Formula: `(Height utilized / Usable vertical height) × 100`
  - Variables:
    - Height Utilized: The actual height of the stacked goods.
    - Usable Vertical Height: The distance from the floor to the underside of the sprinkler system nozzles (or other lowest obstruction).
- Rule of Thumb for Area Calculation:
  - Formula: `Gross warehouse area ≈ 1.5 × Net storage area` (or `Net storage area ≈ 2/3 × Gross warehouse area`).
  - Purpose: A quick method for estimating the total required building footprint based on the known square footage needed for actual inventory.
- "Honeycombing" Factor:
  - Definition: A term used to describe the loss of storage capacity when space is not fully occupied due to partial withdrawal of inventory.
  - Value: Can reduce the effective capacity of a warehouse to 75% to 90% of its theoretical maximum.

BOQ Implications

- Structural System: The emphasis on high stacking (18-20 ft+) and long, clear spans (60-100 ft) dictates a robust and costly structural steel frame. The high floor load requirements for heavy unit loads and powered equipment demand a thick, heavily reinforced concrete slab.
- Materials Handling Systems: The BOQ for a modern warehouse is dominated by equipment costs. This includes:
  - Racking: Linear feet of pallet racking and shelving.
  - Powered Equipment: Number and type of fork trucks (standard, straddle, stacker crane), tractor-trailer units, and conveyors (dragline, package).
  - Dock Equipment: Dock levelers, dock seals/shelters, and dock boards (steel or lightweight aluminum/magnesium).

- Building Shell: Quantities of insulated wall panels, roofing systems, and large-scale industrial doors (rolling steel or sectional overhead).

Critical Notes and Warnings

- "Cube" over "Square": The most important principle is to think in three dimensions. The goal is maximum utilization of the building's volume, not just its floor area.
- Straight-Line Flow: The text emphasizes that "Straight-line flow is inherently efficient" and should be the guiding principle for laying out the movement of goods from receiving to production/shipping.
- Narrow-Aisle Trade-Offs: While narrow-aisle straddle fork trucks save floor space, the text warns that this is often offset by slower operating speeds and reduced stability for high stacking. A full evaluation of operating costs vs. capital costs is required.
- Flexibility is Key: To accommodate changing needs, storage aids like pallet racks and shelving should be bolted rather than permanently fixed, allowing for easier reconfiguration.
- Analyze Inventory Activity: The "ton-mile" principle states that the most popular and frequently moved items should be stored closest to the shipping dock to minimize travel distance and handling costs. This requires a thorough analysis of inventory turnover.

Part 6: Warehouses, Waterfront (Pages 1041-1046)

Overview

This section provides a specialized guide to the design and construction of waterfront warehouses, which are used for the long-term storage of maritime cargo. It distinguishes these structures from transit sheds (used for short-term handling) and details the unique requirements imposed by their port location. The text covers general dimensions, structural systems (steel, timber, concrete), materials selection for corrosive environments, and the design of essential appurtenances like doors, floors, and lighting. The section includes two detailed case studies—the Port of Long Beach and the Port of Newark—to illustrate the practical application of these design principles.

Key Standards and Codes Referenced

- Source Document: The content is based on *Port Design And Construction*, The American Association of Port Authorities, Washington, D.C., 1964.

- National Board of Fire Underwriters (NBFU): Mentioned as the source for requirements for automatic sprinkler systems.
- ASTM A36: Implied standard for structural steel.
- Alloy 6063-T5: A specific aluminum alloy noted as being successfully used for its corrosion resistance in coastal environments.
- Local building codes are cited as a primary source for determining requirements for wind loads and door spacing.

Technical Specifications

General Dimensions & Layout

- Gross Area: Typically 70,000 to 90,000 square feet for warehouses used in conjunction with transit sheds.
- Clear Height: 22 to 24 ft is considered ample to allow for sprinklers and pendant lights. A minimum of 2 ft of clearance must be maintained between cargo stacks and automatic sprinklers.
- Column Spacing: Bay spacing of 20 to 40 ft appears to be common practice.
- Loading Platforms: Should be provided at truck bed and rail car height. Must be wide enough for easy maneuvering of mechanized equipment.
- Floor Slope: The floor should have a sufficient slope for drainage, ranging from 1/8-in to 1/4-in per foot. A steeper slope (ramp) is sometimes used for ~5 ft inside doorways to prevent rain from driving in.

Doors

- Common Size: 16 ft wide by 16 ft high.
- Larger Doors: Doors 18 or 20 ft wide and high are also used. These larger doors should be motor-operated for rapid opening.
- Types:
  - Vertical Rolling Steel Door: Considered the "finest type," constructed of interlocking steel slats.
  - Overhead Sectional Door: A popular alternative, can be made of wood or metal (often aluminum).
  - Counterbalanced Vertical-Lift Doors: Can be used if eave height is at least 1.5 times the door height.
  - Horizontal Sliding Door: Considered "unwieldy" as it requires large blank wall spaces.

Materials and Construction

- Structural Frame:

- Steel Frames: Often used due to availability and economy. Can be "prefab" lightweight shapes.
    - Timber Frames: Heavy mill construction is noted as a better fire risk than unprotected steel. Glued laminated wood members are becoming popular. "Pole-frame" construction is mentioned as a recent development.
    - Reinforced Concrete: Offers low maintenance, long life, and high resistance to damage. "Tilt-up" concrete wall construction is common.
- Wall Sheathing:
    - Corrugated Metal: Should be a heavier gauge in high-wind areas. Galvanized sheets with a 2-oz coating are recommended over the standard 1.5-oz coating for better corrosion resistance.
    - Compromise Wall: A concrete wall up to a height of 4 or 5 ft with corrugated metal above it.
- Roofing: A "20-year" bonded built-up composition roof is considered the minimum acceptable standard.
- Flooring:
    - Portland Cement Concrete: A light broom finish is preferred over a steel trowel finish to provide a nonskid surface.
    - Asphaltic Cement Concrete: Good wearing surface but susceptible to damage from oil/gasoline drippings, which can be mitigated with sealers.

Lighting

- Artificial Lighting Level: Should not be less than 10 foot-candles.
- Exterior Floodlighting: For night loading operations, the intensity should be at least 1 foot-candle, preferably 2 foot-candles.
- Fixture Types: Incandescent, fluorescent, and mercury-vapor. Mercury-vapor is noted as the most efficient but requires a warm-up time. Color-corrected mercury-vapor lamps are very important if color codes are used on stored cargo.
- Wiring Systems:
    - 120/240-volt three-wire: Standard, adaptable to all lighting.
    - 208/120-volt three-phase: Desirable if considerable motor loads are required.
    - 480/277-volt four-wire: Recommended for large buildings using mercury-vapor or fluorescent lighting, as it allows for significant reductions in wire and conduit size.

Visual Elements Analysis

Figure 1: Typical warehouse, Port of Long Beach, California. (p. 1043)

- Description: A detailed floor plan and transverse section of a large waterfront warehouse.
- Technical Details:
    - Dimensions: 151 ft wide x 727.5 ft long. Gross area: 109,852 sq ft.
    - Structure: Interior columns are structural steel spaced 50 ft apart, with bays spaced 40 ft apart. The exterior and fire walls are 12-in-thick precast reinforced concrete. The roof is a 1.5-in plywood diaphragm over wood joists and steel trusses.
    - Doors: Fourteen vertical rolling steel doors, 16 ft x 16 ft.
    - Access: A rail line (`RAMP`) is shown running along one side of the building.
- Relationship to Text: This figure serves as a case study for a concrete and steel warehouse, illustrating the principles of fire compartmentalization, column spacing, and integrated rail access.

Figure 2: Port Newark, New Jersey. Typical warehouse layout... (p. 1044)

- Description: A site plan showing two warehouse buildings (Building 261 and 262) configured for efficient rail and truck service.
- Technical Details:
    - Dimensions: Buildings are 160 ft wide and vary from 640 to 960 ft long. Column spacing is 40 ft with bents every 20 ft. Minimum clear height is 20 ft.
    - Access: The layout features a central Railroad Side with two tracks running between the two buildings, allowing simultaneous service. The outer sides are designated as the Truck Side, providing complete separation of rail and truck traffic.
    - Doors: Overhead doors are specified as 16' x 16' (Typical).
- Construction Notes: The buildings are constructed of structural steel or timber frames with aluminum roofing and siding. Plastic skylights are used for natural light.
- Relationship to Text: This is a prime example of a layout designed for maximum logistical efficiency by completely separating truck and rail operations, a key principle for high-volume cargo distribution.

BOQ Implications

- Structural Systems: The BOQ will be heavily influenced by the choice of structural system. The options presented (steel frame, heavy timber, tilt-up concrete, prestressed concrete) have vastly different material and labor costs.
- Corrosion Protection: For waterfront locations, the BOQ must include specific, higher-cost materials. This includes:
    - Heavier gauge corrugated metal siding.

    - 2-oz galvanized coating on steel sheets.
    - Alloy 6063-T5 for aluminum components.
    - Specialized corrosion-resistant paints.
- Fire Protection: A complete automatic sprinkler system is a major cost item. The BOQ must also include fire walls, automatic self-closing fire doors, fire hose racks, and chemical extinguishers.
- Site Work: Extensive site work is required for creating loading docks at both truck and rail car height, which involves significant grading, excavation, and the construction of retaining walls and ramps.
- Specialized Lighting: The need for color-corrected mercury-vapor lamps is a specific requirement that affects the cost of lighting fixtures.

Critical Notes and Warnings

- Warehouse vs. Transit Shed: It is critical to distinguish between these two functions. A warehouse is for long-term storage and should not be so close to a berth that it gets used as a short-term transit shed, which would disrupt its intended operation.
- Corrosion is a Major Factor: Standard materials will fail quickly in a saline, industrial, or coastal atmosphere. The designer must specify materials with enhanced corrosion resistance.
- Safety and Protection: Structural columns must be protected from vehicle collisions by encasing them in concrete or surrounding them with steel pipe guards. Sprinkler risers and valves must be protected by cages to prevent damage from stacked cargo.
- Lighting Design is Critical: To ensure safety and efficiency, lighting must be designed to illuminate aisles even when cargo is stacked high. For cargo with color-coded markings, color-corrected lighting is essential, otherwise the markings may be unreadable.
- Door Selection: The text provides a clear hierarchy of door types. The horizontal sliding door is deemed "unwieldy" and inefficient, while the vertical rolling steel door is considered the "finest type." The choice of door directly impacts operational efficiency and space utilization.

Part 7: Airport Industrial Park (Pages 1045-1048)

Overview

This section provides a specialized guide for the physical planning and layout of industrial parks located on or adjacent to airports. It highlights the unique requirements of these developments, which must balance the logistical needs of aviation-related industries with the operational and safety standards of the airport. The text covers site selection relative to airport features like runways and terminals, the critical design of access systems (taxiways, roads, rail), and standards for parking, loading, and building setbacks. The core principle is to create a functional, contiguous industrial area that leverages its airport proximity while maintaining a high-quality, park-like aesthetic.

Key Standards and Codes Referenced

- Primary Source Document: Planning the Airport Industrial Park, Federal Aviation Administration (FAA), Department of Transportation, Washington, D.C., 1965. All principles and specifications are derived from this guide.
- The text makes frequent implicit references to adhering to local ordinances for building setbacks and airport layout plans as the primary controlling documents for any development.

Technical Specifications

Access Systems

- Taxiway Access:
  - Right-of-Way (R.O.W.): A 150-ft R.O.W. is generally sufficient for a service taxiway.
  - Pavement Width: A 50-ft service taxiway is sufficient for business aircraft.
- Railroad Access:
  - Right-of-Way: A 20-ft R.O.W. is sufficient for a single track spur.
- Street System:
  - Secondary Streets: Minimum 24-ft (2-lane) pavement within a 40-ft R.O.W.
  - Primary Feeder Streets: Minimum 48-ft pavement within a 60-ft R.O.W. (allows for future expansion to 4 lanes).
  - Intersection Curb Radii: At least 40 ft to accommodate tractor-trailers.
- Entrance Driveways:
  - Truck Access: Curb radii should be a minimum of 25 ft.
  - Automobile Access: Curb radii should be a minimum of 15 ft.

Off-Street Parking and Loading

- Employee Parking:
  - Ratio: 1 parking space for every 1.3 employees on the combined shifts.
  - Area Allowance: 300 square feet should be allowed for maneuvering and parking each vehicle.
- Visitor Parking:
  - Ratio: 1 parking space for every 15 employees on the main shift.

- Company Vehicle Parking:
    - Ratio: 1 parking space for each company vehicle.
- Truck Loading Docks:
    - Truck Trailer Berths: 14 ft wide by 60 ft deep, with an additional 60 ft of depth for maneuvering.
    - Local Pickup Truck Berths: 10 ft wide by 20 ft deep, with an additional 20 ft of depth for maneuvering.

Building and Site Layout

- Minimum Park Size: Should be at least 50 acres to justify management and planning effort.
- Lot Dimensions:
    - Typical Lot Depths: Range from 150 ft up to 500 ft.
    - Minimum Lot Width: Should be about 100 ft to provide buildable sites for small industries.
- Building Setbacks:
    - Front Setback: A 30-ft setback from the property line is common.
    - Side and Rear Setbacks: At least 25 ft is recommended for fire safety and aircraft clearance.
- Site Coverage:
    - Maximum: Building coverage should be a maximum of 60%.
    - Preferred: 50% coverage is preferable to maintain a park-like quality.

Visual Elements Analysis

Figure 1: Industrial park located on the opposite side of the runway from the terminal. (p. 1046)

- Description: A large-scale site plan showing an industrial park strategically placed across the main runway from the primary airport terminal area.
- Technical Details: The layout shows a dedicated railroad spur and a 150-ft taxiway R.O.W. serving the industrial lots. A road network (U.S. Route 73) provides vehicular access. The industrial park is completely separated from the terminal, general aviation area, and secondary runway.
- Relationship to Text: This figure illustrates the recommended location for an industrial park at a busy air carrier airport, which "diverts industrial traffic from the terminal traffic boulevard."

Figure 2: Industrial park located in the vicinity of the general aviation area. (p. 1046)

- Description: A site plan showing an industrial park situated adjacent to the general aviation and aircraft maintenance areas of an airport.
- Technical Details: The park is laid out on a grid system with road access from U.S. Route 44. It is directly adjacent to the "Aircraft Parking Apron" and "Hangar Area." The plan specifies a 40-ft R.O.W. with 24-ft pavement for internal roads.
- Relationship to Text: This illustrates the alternate location strategy of placing the park near the general aviation area to "keep ground taxi time at a minimum."

Figure 3: Industrial park with taxiway only to lots directly abutting the aircraft movement areas. (p. 1047)

- Description: A plan showing a specific access configuration where a single taxiway provides "through-the-fence" access only to the first row of lots adjacent to the main runway.
- Technical Details: This design limits direct airfield access to premium lots. Other lots in the park only have road and rail access. This creates a tiered system of lots within the park.
- Relationship to Text: Illustrates a compromise solution where providing taxiway access to every lot is deemed unnecessary or too land-intensive.

Figure 4: Industrial park with taxiway into aircraft parking apron surrounded by industrial lots. (p. 1047)

- Description: An alternative layout where a central taxiway leads to a dedicated "Aircraft Parking Apron," which is then completely surrounded by the industrial lots.
- Technical Details: In this model, aircraft taxi to a central point and are then towed or park, with tenants accessing them from their individual lots which face the apron. This consolidates aircraft movement.
- Relationship to Text: This shows one of the "interesting variations for providing access" mentioned in the text.

Figure 5: Industrial park without taxiway access located adjacent to the general aviation area. (p. 1048)

- Description: A plan for an industrial park that has no direct airfield access. Its value is derived solely from its proximity to the airport.
- Technical Details: The park is located next to the general aviation apron and hangar area but is separated by a road (U.S. Route 54) and a landscaping screen. All access is vehicular.
- Relationship to Text: This illustrates the scenario where "no taxiway into the airport industrial park is provided," and its viability depends on its close proximity to the general aviation apron.

Calculations and Formulas

Parking Space Calculation

- Employee Parking:
    - Formula: `Spaces = (Total Employees on Combined Shifts) / 1.3`
    - Example: For 130 employees, `130 / 1.3 = 100` parking spaces would be required.
- Visitor Parking:
    - Formula: `Spaces = (Employees on Main Shift) / 15`
    - Example: For 100 employees on the main shift, `100 / 15 ≈ 7` visitor spaces would be required.
- Total Parking Area:
    - Formula: `Total Area (sq ft) = (Total Number of Spaces) × 300 sq ft/space`

BOQ Implications

- Infrastructure Costs: The primary cost drivers for an airport industrial park are the extensive infrastructure works. The BOQ must include:
    - Airside Pavement: Square footage of taxiway pavement, which must meet FAA standards for aircraft loading.
    - Landside Pavement: Square footage of roadway pavement (asphalt or concrete), plus linear feet of curbs and gutters.
    - Utilities: Trenching and installation for all utilities (water, sewer, gas, electric, storm drainage), which may need to be run long distances to connect to airport or municipal systems.
- Site Development: The large scale (50+ acres) means significant costs for clearing, grading, and establishing drainage for the entire site.
- Phased Construction: The text notes that development is often staged. This means the BOQ and construction contracts must be broken into phases, with costs allocated for mobilizing and demobilizing for each stage.
- Specialty Items: The potential inclusion of a "Park Center" would add significant building construction costs (offices, restaurants, motels) to the overall project budget.

Critical Notes and Warnings

- Coordinate with the Airport Layout Plan: The industrial park must be planned as an integral part of the overall airport development. Its location and land requirements must be established during the creation of the master Airport Layout Plan.

- Separate Traffic: A primary goal is to minimize conflict between industrial park traffic (trucks, employees) and the main airport traffic (passengers, terminal vehicles). Entrances should be separate.
- Access is a Premium: Direct taxiway access is a key selling point. The text notes that this access can be limited to premium lots or that a user charge can be established for its use.
- Aesthetics and Open Space are Important: A key goal is to "retain a feeling of open space." This is enforced through building setback requirements (min. 25-30 ft) and site coverage limits (50-60% max), which directly constrain the buildable area on each lot.
- Long Blocks are Efficient: To reduce the high cost of cross streets and utility intersections, blocks should be designed to be as long as practicable.

Part 8: Industrial Plants, Parking (Pages 1049-1051)

Overview

This section provides a highly focused and data-rich guide to the design of employee parking facilities for industrial plants. It establishes that industrial parking is unique, characterized by long-term occupancy and massive, simultaneous arrival and departure peaks. The text outlines six key design principles, covering everything from stall size and arrangement to access control and amenities. A significant portion of the analysis is dedicated to the "drive-through double stall" pattern, presenting it as a highly efficient, though not widely published, layout for angle parking. The section emphasizes that good design must balance space efficiency with the safety and convenience required to handle large volumes of traffic and pedestrians during brief, intense periods of activity.

Key Standards and Codes Referenced

- Primary Source Document: Parking Facilities for Industrial Plants, Institute of Traffic Engineers, Washington, D.C., 1969.
- ITE Recommended Practice on Industrial Plant Parking (1959): Cited as the source for the older 8 ft 6 in. stall width recommendation.
- Highway Capacity Manual, Special Report #87, 1965, Highway Research Board: Referenced for calculating exit turning movement capacities.
- A Policy on Arterial Highways in Urban Areas, 1957, American Association of State Highway Officials (AASHO): Referenced for design policies on turning radii.

Technical Specifications

Stall and Aisle Dimensions

- Current Vehicle Models: Dimensions cited are 80 in. wide and 218 in. long.
- Recommended Stall Width: 9 ft is the current prevalent practice. 10 ft stalls are used in some 90° visitor lots.
- Recommended Stall Length: 18 ft minimum. 19 ft is recommended for "drive-through" stalls.
- Vehicle Overhangs: A front overhang of 3 ft and a rear overhang of 5 ft are typical values to accommodate.
- Desirable Stall & Aisle Dimensions for Drive-Through Parking (from Fig. 1):

Angle of Parking (α)	Width of Stall (W)	Depth of Stall Perpendicular to Aisle (L)	Width of Aisle (A)	Unit Parking Depth (UPD)	Width of Stall Parallel to Aisle (w)
90°	9'	38'-0"	24'	62'-0"	9'-0"
90°	10'	38'-0"	26'	64'-0"	10'-0"

60°	9'	36'-0"	18'	54'-0"	10'-5"
53°	9'	35'-10"	18'	53'-10"	11'-3"

- Minimum 90° Parking Depth: The minimum reported to the committee was 61 ft, with 62-64 ft being preferred.

Access & Circulation

- Service Roads: One-way, single-lane service roads must be at least 18 ft wide to permit passing of a stalled vehicle.
- Two-Way Gates: Roadway width at gates should be at least 26 ft to facilitate turning.
- Exit Lane Capacity: Exit turning lanes can handle up to 1,500 vehicles per lane per hour of green time.

Parking Area Requirements vs. Location (from Table)

- Methodology: A hypothetical calculation for a plant with 1,600 employees, assuming a car occupancy of 1.3 persons/car.
- Urban Location:
  - Employee Pct. as drivers/passengers: 60%
  - Autos to be parked: 740
  - Approx. Site Area Required: 222,000 sq ft (5.0 acres)
- Suburban Location:
  - Employee Pct. as drivers/passengers: 80%
  - Autos to be parked: 990
  - Approx. Site Area Required: 297,000 sq ft (6.8 acres)
- Rural Location:
  - Employee Pct. as drivers/passengers: 95%
  - Autos to be parked: 1,180
  - Approx. Site Area Required: 354,000 sq ft (8.0 acres)

Visual Elements Analysis

Figure 1: Drive-through lot layout. (p. 1050)

- Description: A comprehensive figure combining a typical lot layout, detailed stall dimensions, and a table of desirable dimensions for drive-through parking.

- Typical Lot Layout: Shows multiple bays of angled drive-through parking with one-way aisles. A "Through street or plant road" runs along the top, with a separate "Commercial vehicles" access lane.
- Details - Typical Stall Arrangement: A detailed plan view of a 60° drive-through parking configuration. It specifies a 36'-0" double stall depth and an 18'-0" aisle width, resulting in a 54'-0" Unit Parking Depth (UPD).
- Table: The table provides the specific dimensional data for creating layouts at 90°, 60°, and 53° angles. This data has been extracted into the "Technical Specifications" section above.
- Relationship to Text: This figure is the central element of the section, providing all the necessary dimensional data and visual context for the "drive-through double stall" pattern, which is presented as a highly effective and space-efficient solution for industrial parking.

BOQ Implications

- Pavement: The primary quantity for the BOQ is the square footage of pavement (asphalt or concrete). The choice of parking angle and unit parking depth (UPD) directly determines the total paved area required for a given number of cars.
- Site Amenities: The BOQ may include costs for amenities designed to improve safety and reduce parking demand. This includes:
    - Linear feet of fencing or other barriers for pedestrian walkways.
    - Covered transit waiting areas or bus shelters.
    - Turnout bays for passenger drop-off.
    - Deciduous trees for screening and shade.
- Drainage: The text notes that lots should be graded for drainage. This implies costs for catch basins, storm sewer piping, and potentially oil/water separators if required by local environmental codes.
- Pavement Markings: Linear feet of painted lines for stalls and directional arrows.

Critical Notes and Warnings

- Industrial Parking is Unique: The designer must recognize that industrial lots are characterized by long-term parking and extreme peak volumes. This is fundamentally different from commercial or retail parking.
- Angle Parking is Preferred: For large industrial lots, angle parking is recommended because it forces one-way traffic, which simplifies control and reduces conflicts.
- Drive-Through Stalls are Highly Efficient: The "drive-through double stall" layout is highlighted as a key strategy. It minimizes backing movements, directs all

traffic in one direction, and is more space-efficient than other angle parking designs.
- Pedestrian-Vehicle Conflict is a Major Hazard: This is a critical safety issue during shift changes. Design solutions include orienting parking aisles to lead directly to the plant, providing separate fenced walkways, and, in the best cases, using grade-separated underpasses or overpasses.
- Amenities Can Reduce Parking Needs: Providing good transit facilities, shuttle buses, and drop-off areas can encourage alternate modes of commuting, potentially reducing the total number of parking spaces the plant needs to build and maintain.
- Noise and Aesthetics Matter: The text notes that landscaping, while potentially causing maintenance issues (falling leaves, sap), can be used to buffer noise and screen parking areas from public view, which is often a requirement in suburban locations.
-

Chapter 10: Recreation and Entertainment (Part 1 of 15: Pages 1053-1063)

Overview

This initial part of the chapter introduces the architectural and planning standards for "Playlots and Playgrounds." It establishes a clear distinction between playlots, which are designed for preschool children (up to 6 years), and playgrounds, intended for school-age children (5-15 years). The section provides comprehensive guidelines on location, size, layout, activity spaces, equipment selection, and surfacing materials for both types of facilities. It emphasizes safety, durability, developmental value, and maintenance as key factors in design and equipment selection. The content draws from multiple sources, including general planning principles, specific recommendations from the National Recreation Association, and detailed construction drawings from various design publications.

Key Standards and Codes Referenced

- National Recreation Association: Provides desirable standards for recreation facilities, including minimum area recommendations and classifications for playlots and playgrounds (p. 1058).
- New York City Department of Parks: Practices from this department are cited as the basis for game area and layout standards (p. 1058).

- New York City Housing Authority: Credited with pioneering efforts in imaginative play equipment in the late 1940s, though some designs (play boat, play airplane) are now considered too expensive and hazardous (p. 1058).
- *A Playground for All Children: Design Competition Program, NYC DCP 76-13, HUD, OPDR, August 1976*: Source for the "Pipe-frame exercise unit" drawing (Fig. 1, p. 1059).

Technical Specifications

Playlots (Preschool Children, up to 6 years)

- Purpose: To provide a necessary play element in multifamily developments and single-family neighborhoods that are remote from elementary schools.
- Location:
  - Proximity: Desirably located within 300 to 400 ft of each living unit served.
  - Accessibility: Should be accessible without crossing a street; walkways should have an easy gradient for strollers and carriages.
  - Siting: Can be included within larger playgrounds if close to housing areas. Ideally located in the interior of a city block.
- Sizing:
  - Area per Child: The enclosed equipment area should be based on a minimum of 70 sq ft per child. This is equivalent to 21 sq ft per family (based on an average of 0.3 preschool children per family). The National Recreation Association (NRA) recommends 48-50 sq ft of open space per child.
  - Minimum Total Size:
    - An enclosed area of approximately 2,000 sq ft will serve about 30 preschool children (approx. 100 families) and accommodates limited equipment.
    - An enclosed area of 4,000 sq ft is required for a full range of equipment, including a spray pool, serving up to 50 preschool children (approx. 165 families).
    - NRA standards suggest a size range of 6,000 to 10,000 sq ft for each 100 preschool children.
  - Active Games Area: A turfed area of at least 40 ft square should be provided.
- Layout and Elements:
  - Enclosure: The intensively used equipment area should be surrounded by a low enclosure with supplemental planting and a single entrance-exit point to control access and ensure safety.

    - Equipment Grouping: Arrange equipment in small, natural play groups with adequate surrounding space. High-capacity, non-turn-taking equipment (climbers, play sculpture) should be near the entrance but not cause congestion. Moving equipment (swings, slides) should be located away from creative play areas (sandboxes, playhouses) and near the perimeter, separated by fences or low walls.
    - Orientation: Swings should be oriented away from the sun and towards the best view. Sliding equipment should preferably face north.
    - Surfaces: Walks must be wide enough for strollers, carriages, and tricycles.
    - Amenities: Must include benches for supervising parents, a step-up drinking fountain, trash containers, and landscape plantings.

Playgrounds (School-Age Children, 5-15 years)

- Purpose: Serves as the primary outdoor play center for kindergarten and school-age children, while also offering recreational opportunities for young people and adults. It should serve both school programs and neighborhood recreational needs.
- Location:
    - Proximity: Should be within ¼ to ½ mile of every family housing unit.
    - Siting: Ideally an integral part of a complete elementary school development. A separate playground should only be developed if a joint school-community function is not feasible.
- Sizing:
    - Recommended Size: A minimum of 6 to 8 acres is recommended to serve approximately 1,000 to 1,500 families.
    - Minimum Size: The smallest functional playground is about 3 acres, serving approximately 250 families (about 110 elementary school children).
    - Expansion Factor: The minimum area should be increased at a rate of 0.2 to 0.4 acres for each additional 50 families.
    - NRA Standard: Recommends 1 acre per 1,000 total population.
- Layout and Elements:
    - Area for Field Games: Must be on fairly level, well-drained land with finished grades not exceeding 2.5% and a minimum grade of 1% on pervious soils.
    - Area Division (General Rule):
        - ~50% Parklike: Includes open turfed areas, shaded quiet areas, and miscellaneous elements.

        - ~50% Active Areas: Includes ⅓ to 1 acre for the playlot, playground equipment area, and paved multipurpose area; and 1¼ acres (for softball) to 4 acres (for baseball) for the field games area.
    - Paved Multipurpose Area: Should be well-lighted for activities like roller skating, dancing, and court games (tennis, handball, volleyball, etc.).
    - Amenities: Must be fully developed with a public shelter, equipment storage, toilet facilities, drinking fountains, wide walks, bicycle paths, benches, and trash containers.

Equipment and Surfacing

- Safety:
    - Specification: Equipment must be free of sharp protrusions (welds, rivets, bolts). It must have sufficient structural strength and be designed to discourage incorrect use.
    - Features: Hand/safety rails are required on all steps and ladders, which must have nonskid treads.
    - Installation: Must be installed per manufacturer's directions over a suitable surface to reduce injury from falls.
- Material Requirements:
    - Metal: All metal parts should be galvanized or made of corrosion-resistant metals.
    - Bearings: All movable bearings should be of an oilless type.
    - Seats: Should be designed as vandal-resistant (e.g., wire-reinforced seats).
    - Surfacing (Turf): Generally considered the best surface for many activities; recommended wherever practicable.
    - Surfacing (Paving):
        - Bituminous Concrete: The most generally used paving material for multipurpose areas and courts.
        - Portland Cement Concrete: Favored for specialized areas requiring permanence and maximum durability (e.g., handball courts).
    - Surfacing (Loose Fill): Sand, sawdust, tanbark, or wood chips are recommended for areas around and under play equipment.
- Performance Criteria:
    - Durability: Must withstand normal play wear and extended periods of outdoor weathering.
    - Maintenance: Should require minimum maintenance. Parts subject to wear should be replaceable. Color should be impregnated into the material if feasible.

    - Drainage: All areas require effective surface or subsurface drainage. Paved surfaces require a minimum slope of 1 inch in 10 feet.

Visual Elements Analysis

Figure 1: Pipe-frame exercise unit (p. 1059)

- Description: A modular, grid-based climbing structure made of pipes, designed for exercise and play. The structure is shown in both plan and elevation views.
- Technical Details:
    - Plan View: Shows a square footprint of 11'-9" x 11'-9". The layout is a 6x6 grid of vertical pipes connected by horizontal pipes.
    - Section/Elevation View: Depicts a pyramidal form, with five levels of horizontal pipes creating tiers for climbing. The base is an 11'-9" square. The structure is set on concrete footings.
    - Surfacing Callout: The base is specified as 1-1/2" asphalt paving tiles over a 2" sand layer, which is on top of a 6" cinder base.
- Construction Notes: The unit is constructed from pipes joined to form a rigid, three-dimensional grid. It is permanently installed in concrete footings. The design appears to be from a 1976 source, emphasizing modular and geometric forms.

Figure 2 & 3: Kindergarten and Play Swings (p. 1060)

- Description: Standard A-frame swing set designs for two different age groups. The drawings provide key dimensions for fabrication and installation.
- Technical Details (Fig. 2: Kindergarten Swing, age 3-6):
    - Frame: 8-foot wide frame per unit. An elevation of two units side-by-side shows a total length of 16'-0" with 4 swings.
    - Height: Top of the horizontal pipe is 6'-0" above finished grade.
    - Footprint: The A-frame legs have a spread of 8'-0" at the base.
    - Installation: Vertical posts are set in concrete footings below grade.
- Technical Details (Fig. 3: Play Swing, age 6-11):
    - Frame: 12-foot wide frame per unit. An elevation of two units side-by-side shows a total length of 24'-0" with 6 swings.
    - Height: Top of the horizontal pipe is 10'-0" above finished grade.
    - Footprint: The A-frame legs have a spread of 8'-0" at the base.
- Relationship to Text: These drawings provide specific construction details for the types of swing sets mentioned in the equipment lists. They demonstrate the scaling of equipment for different age groups.

Figure 4: Slide (p. 1061)

- Description: A highly detailed construction drawing for a playground slide, including plan, elevation, and material callouts.
- Technical Details:
  - Materials: Structure is made of galvanized steel pipe. The slide bed is 18 gauge stainless steel. The handrails are 7/8" standard galvanized pipe.
  - Dimensions: Slide length varies by age: 8'-0" (3-6 yrs), 10'-0" (6-11 yrs), 12'-0" (8-11 yrs). The ladder is set at an angle with a top platform.
  - Installation: The entire structure is supported on pipe legs set in concrete footings of specified dimensions. The bottom of the slide chute requires a galvanized pipe drain in a gravel-filled pit to prevent water pooling.
- Construction Notes: This is a fabricator-level drawing, with details on bolt sizes, lag screws, and specific pipe diameters. It exemplifies the level of detail required for safe and durable equipment construction.

Figure 5 & 5 (cont.): Special Playground Equipment (p. 1062-1063)

- Description: A collection of drawings for unique, imaginative play structures, moving beyond standard swings and slides. These are constructed from materials like corrugated metal pipe (CMP), logs, sewer pipe, and concrete masonry units (CMU).
- Technical Details:
  - Fox Hole: A partially buried 4'-0" diameter corrugated metal pipe structure, 3'-0" high, with openings for entry/exit.
  - Log Pile: A stack of 10" to 12" diameter logs, bolted together, creating a climbing structure approximately 15'-0" long and 3'-8" to 4'-0" high.
  - Tunnel Slide: Made from two sections of 36" sewer pipe, set at a slope on concrete foundations, creating a 12'-4" long tunnel.
  - Balancing Beam: A 14'-0" long, 5"x6" wood beam set 1'-3" above grade on A-frame braces and a concrete footing.
  - Children's Stage: A complex, multi-level platform structure made of concrete masonry units and concrete slabs, designed to facilitate imaginative play. It includes various levels, walls, and openings. Dimensions include an overall plan size of roughly 11'-9" x 27'-0".
- Relationship to Text: These drawings illustrate the "play sculpture" and "play walls" mentioned in the text, providing concrete examples of how to create more creative and engaging play environments. They also highlight the use of non-traditional but durable materials in playground construction.

Calculations and Formulas

This section does not contain mathematical formulas but provides rules and metrics for calculation.

Play Area Sizing Calculation Rules

- Playlot (Enclosed Area):
  - Formula: `Required Area (sq ft) = Number of Children × 70 sq ft/child`
  - Example: For 30 children, Area = 30 × 70 = 2,100 sq ft (consistent with the text's ~2,000 sq ft).
- Playground (Expansion):
  - Formula: `Additional Area (acres) = (Number of Families over 250 / 50) × (0.2 to 0.4 acres)`
  - Example: For a community of 350 families (100 families over the 250 base), the additional area required would be (100/50) × (0.2 to 0.4) = 0.4 to 0.8 acres, to be added to the 3-acre minimum.
- NRA Playground Sizing:
  - Formula: `Required Area (acres) = Total Population / 1,000`
  - Example: For a population of 5,000 people, the required playground area is 5 acres.

BOQ Implications

- Cost Estimation Factors:
  - Site Work: Significant costs in grading, drainage (surface and subsurface), and topsoil.
  - Surfacing: Material choice heavily impacts cost. Turf is aesthetically pleasing but requires costly irrigation and maintenance. Bituminous and Portland cement concrete have high initial costs but lower long-term maintenance. Loose-fill materials (wood chips, sand) under equipment are a recurring cost.
  - Equipment: Costs vary from standard catalog items (swings, slides) to custom-fabricated structures (play sculptures, stages). The note on the NYC play boat/airplane being "too expensive" is a key cost consideration.
  - Amenities: Budget must include fencing, shelters, benches, drinking fountains, lighting, and plumbing for toilets and spray pools.
- Quantity Calculation Methods:
  - Playlot and playground areas are calculated based on the population served (per child, per family, or per 1,000 population).
  - Fencing is calculated by the linear foot around required enclosures.
  - Surfacing is calculated by the square foot or square yard.

    - Equipment is quantified by the unit (e.g., 1 slide, 4 swings).
- Labor Considerations:
    - Skilled labor is required for installing concrete footings, paving, plumbing, and electrical systems.
    - Installation of play equipment must be done according to manufacturer specifications, often requiring certified installers.
    - Landscaping and turf installation require specialized labor.

Critical Notes and Warnings

- Safety Requirements:
    - Safety is the primary consideration and should not be compromised for economy.
    - All equipment must be free of sharp edges, protrusions, or pinch points.
    - Protective surfacing under all climbing and moving equipment is mandatory.
    - Moving equipment like swings must be physically separated from other play areas by fences or walls to prevent children from running into them.
- Common Errors to Avoid:
    - Hazardous Equipment: The text explicitly warns that some older, imaginative play equipment (play boat, play airplane) has proven to be too expensive and hazardous and is no longer used.
    - Improper Siting: Avoid layouts that create congestion or conflict between active and quiet play. Do not orient slides to face the sun.
    - Poor Drainage: Inadequate drainage leads to unusable, eroded, and unsafe conditions. Finished grades must be carefully controlled.
- Special Considerations:
    - Age Separation: Equipment must be scaled and appropriate for the intended age group (preschool vs. elementary).
    - Accessibility: Walkways should be designed to accommodate strollers and tricycles, with gentle gradients.
    - Vandalism: Select durable, vandal-resistant equipment and materials, especially in unsupervised public areas.
    -

Chapter 10: Recreation and Entertainment (Part 2 of 15: Pages 1064-1075)

Overview

This section provides detailed standards and layout diagrams for a variety of popular court and field sports. The specifications are primarily sourced from the "Outdoor Sports Facilities" manual by the Departments of the Army, Navy, and Air Force (1975). Each sport is broken down into its required area, dimensions, orientation, surface materials, drainage, and special construction considerations. The analysis covers racket sports (Badminton, Tennis), court games (Basketball, Handball, Volleyball), field games (Boccie, Croquet), and rink sports (Ice Hockey). The level of detail is sufficient for site planning, layout, and specification of materials and key construction features like markings, nets, goals, and safety elements.

Key Standards and Codes Referenced

- *Outdoor Sports Facilities, Departments of the Army, Navy, and Air Force, Washington, D.C., 1975*: This is the primary source for the technical data and diagrams presented on pages 1064-1117.
- Fig. 51 & 52: Net Post Details (Referenced for Badminton, Deck Tennis, Paddle Tennis, Tennis)
- Fig. 55: Fence Details (Referenced for Handball, Deck Tennis, Paddle Tennis, Tennis)
- Fig. 57: Grading and Drainage Details (Referenced for multiple sports)
- Fig. 58, 59, 60, 61: Surfacing Details (Referenced across all applicable sports for Turf, Concrete, Sand-Clay, and Bituminous surfaces)
- Fig. 62 & 63: Backstop Details (Referenced for Baseball and Softball)

Technical Specifications

Badminton (p. 1064)

- Recommended Area: Ground space is 1620 sq ft minimum to the edge of the pavement.
- Court Dimensions:
  - Singles Court: 17'-0" x 44'-0".
  - Doubles Court: 20'-0" x 44'-0".
  - Clearance: 5'-0" minimum unobstructed area on all sides. A minimum distance of 5'-0" is required between the sides of parallel courts.
- Orientation: Preferred orientation is for the long axis to be north-south.
- Surface and Drainage:
  - Permanent: Concrete or bituminous material with optional protective color coating.
  - Recreational: Turf court is acceptable for general use.

    - Drainage: End-to-end, side-to-side, or corner-to-corner diagonally with a minimum slope of 1 in. in 10 ft. Turf courts require a minimum slope of 2% with adequate underdrainage.
- Markings: All lines are 1-1/2" wide, preferably white. All measurements are to the outside of lines, except for the center service line, which is equally divided.

Basketball (AAU) (p. 1065)

- Recommended Area: Ground space is 448 m² minimum to 540 m² recommended, including clear space.
- Court Dimensions:
    - Playing Court: 14 m x 26 m (45'-11¼" x 85'-3½").
    - Clearance: Unobstructed space of 1 m minimum to 2 m recommended on all sides.
- Orientation: Preferred orientation is for the long axis to be north-south.
- Surface and Drainage:
    - Material: Concrete or bituminous material with optional protective color coating.
    - Drainage: End-to-end, side-to-side, or corner-to-corner diagonally with a minimum slope of 0.02 m in 3.05 m (equivalent to approx. 1 in. in 10 ft).
- Material Requirements:
    - Backboard: Any rigid, weather-resistant material. The front shall be flat and painted white unless transparent.
    - Markings: All lines to be 0.05 m (2") wide. Transparent backboards shall be marked with a 0.05 m wide white line around the border and a 0.45 m x 0.59 m target area.
- Special Considerations: The backboard must be 1.65 m from the support post. The post may be padded for safety.

Basketball (NCAA) (p. 1066)

- Recommended Area:
    - High School: 5040 sq ft minimum to 7280 sq ft maximum.
    - Collegiate: 5600 sq ft minimum to 7980 sq ft maximum.
- Court Dimensions:
    - High School: Recommended court size is 84'-0" x 50'-0" with a 10 ft unobstructed space on all sides (3 ft minimum).
    - Collegiate: Recommended court size is 94'-0" x 50'-0" with a 10 ft unobstructed space on all sides (3 ft minimum).

- Orientation: Preferred orientation is for the long axis to be north-south.
- Surface and Drainage:
  - Material: Concrete or bituminous material with optional protective color coating.
  - Drainage: End-to-end, side-to-side, or corner-to-corner diagonally with a minimum slope of 1 in. in 10 ft.
- Material Requirements:
  - Backboard: Rigid, weather-resistant material. Opaque boards are painted white. Transparent boards are marked with a 3-in wide white line around the border and an 18 in x 24 in target area bounded with a 2-in wide white line.
  - Markings: All lines shall be 2 in wide. Lane space and neutral zone marks must contrast with bounding lines.
- Special Considerations: Backboard support should have a minimum 32-in overhang. The bottom edge and lower sides of a rectangular backboard must be padded.

Biddy Basketball (p. 1067)

- Recommended Area: Ground space is 2,400 to 3,036 sq ft, including clear space.
- Court Dimensions: Playing court is 46'-0" to 50'-0" ideal x 84'-0". A minimum unobstructed space of 3 ft is recommended on all sides.
- Orientation: Preferred orientation is for the long axis to be north-south.
- Surface and Drainage: Concrete or bituminous material with a slope of 1 in. in 10 ft.
- Special Considerations: Backboard support standard should be a minimum of 2 ft (preferably 4 ft) outside the court area. The post may be padded.

Goal-Hi Basketball (p. 1068)

- Recommended Area: Ground space is 1256 sq ft minimum to 2827 sq ft maximum.
- Court Dimensions: The playing court is circular.
  - Outer Court: 20'-0" minimum radius to 30'-0" maximum radius.
  - Inner Court: 10'-0" minimum radius to 15'-0" maximum radius.
- Orientation: Optional.
- Surface and Drainage:

    - Material: Concrete or bituminous may be used, but a resilient synthetic surface is preferred for safety and comfort.
    - Drainage: Minimum slope of 1 in. in 10 ft in any direction.
- Installation: The Goal-Hi standard can be permanently mounted, removable flush-mounted, or portable.

Boccie Ball (p. 1069)

- Recommended Area: Ground space is 1,824 to 2,816 sq ft.
- Court Dimensions: 13'-0" to 19'-6" wide by 78'-0" to 92'-0" long. An additional space of at least 3'-0" on each side and 9'-0" on each end is recommended.
- Orientation: North-south preferred, but of minor importance.
- Surface and Drainage:
    - Material: Preferably turf; a mixture of sand and clay may also be used.
    - Drainage: Recommended slope of 1 percent for turf. Sand-clay surfaces should be level with underdrainage.
- Markings: 2-in wide linen tape held in place with metal pins.
- Special Considerations: An optional low wooden barrier can be provided at the ends and/or sides.

Croquet (p. 1070)

- Recommended Area: Ground space is 3,000 sq ft.
- Court Dimensions: Playing area is 35'-0" x 70'-0", plus a minimum of 2'-6" on each end and side.
- Orientation: Not critical; can be adjusted to local topography.
- Surface and Drainage: Playing surface is to be turf, closely cropped and rolled. Maximum 2 percent slope (preferably level) with adequate underdrainage.
- Material Requirements:
    - Arches: ½-in. dia. steel rod, 3½ in wide, and 9 in above ground when in place.
    - Stakes: Made of steel, 1½ in high, set 1½ in outside the playing line.
    - Markings: Boundary lines are marked with strong cotton twine held by staples. Playing lines may be marked with white chalk or smaller twine.

One-Wall Handball (p. 1071)

- Recommended Area: Ground space is 1665 sq ft plus walls and footings.

- Court Dimensions: Playing court is 20'-0" wide by 34'-0" long. The wall is 16'-0" high.
- Clearance: Requires an 11'-0" minimum surfaced area to the rear and an 8'-6" recommended minimum width on each side. Courts in battery require a minimum of 6'-0" between courts.
- Orientation: Preferred orientation is for the long axis to be north-south with the wall at the north end.
- Surface and Drainage: Smooth concrete with a minimum slope of 1 in. in 10 ft from the wall to the rear of the court.
- Markings: 1½-in-wide lines painted white, red, or yellow.
- Special Considerations: The court area should preferably be fenced with a 10-ft high chain link fence.

Three- and Four-Wall Handball (p. 1072)

- Recommended Area: Ground space for a four-wall court is 800 sq ft, plus walls and footing. Allow an additional 200 sq ft for a three-wall court.
- Court Dimensions: Playing court is 20'-0" wide by 40'-0" long.
- Clearance: A three-wall court requires a minimum of 10'-0" to the rear. An overhead clearance of 20'-0" minimum is required.
- Orientation: North-south with the front wall at the north end.
- Surface and Drainage: Smooth concrete, preferably with a minimum slope of 1 in. in 10 ft from front to rear.
- Special Considerations:
    - Alternate Four-Wall Court: Can be created by adding a minimum 12'-0" high back wall to a three-wall court layout.
    - Fencing: An optional 10-ft-high chain link fence may be provided at the rear of a three-wall court.

Hopscotch (p. 1073)

- Recommended Area: Ground space is 62.5 sq ft.
- Court Dimensions: Playing court is 5'-0" wide by 12'-6" long.
- Orientation: Optional.
- Surface and Drainage: Concrete or bituminous material with a lateral slope of 1 in. in 10 ft and a longitudinal slope of 1 in. in 10 ft minimum.
- Markings: All lines to be 1½ in wide, painted with white or black acrylic paint to contrast with the court surface.

Horseshoes (p. 1074)

- Recommended Area: Ground space is 1,400 sq ft, including clear space.
- Court Dimensions: Playing court is 10'-0" x 50'-0". The pitching distance between pegs is 40'-0".
- Clearance: A 10-ft minimum unobstructed area is recommended on each end and a 5-ft (minimum) wide zone on each side.
- Orientation: North-south.
- Surface and Drainage: Surface should be turf, pitched to the side at a maximum slope of 2 percent.
- Material Requirements:
    - Boxes: To be filled with gummy potter's or blue clay.
    - Pegs: Steel pegs with an elevation and slant of 2 to 3 in.
    - Wood Members: Must be pressure treated with a paintable oil-borne preservative.
- Special Considerations: A 2'-0"-high backstop must be constructed at the end of each box to intercept overthrown shoes.

Ice Hockey (p. 1075)

- Recommended Area: Ground space is 22,000 sq ft, including support area.
- Court Dimensions: Playing rink is 85'-0" wide by 200'-0" long (minimum 185'-0"), plus an additional 5,000 sq ft of support area.
- Orientation: North-south.
- Surface and Drainage: The ice surface must be level. The subsurface can be sand-clay or bituminous material. Drainage provisions are required on the surface beneath the ice and around the rink.
- Material Requirements:
    - Boards: The rink must be surrounded by a wooden wall or fence ("boards") that is 40 in to 48 in high (ideal 42 in) above the ice.
    - Protective Screening: Heavy-gauge wire or safety glass is recommended above the boards for spectator protection.
- Special Considerations: Unless in a northern climate, provisions for artificial ice will be required. Access doors must swing away from the ice surface.

Visual Elements Analysis

This section is composed almost entirely of visual layouts accompanied by technical specifications. The analysis below synthesizes the key visual information not already captured in the technical specifications.

- General Court Layouts (All Sports): The diagrams provide unambiguous layouts for all court lines, player positions, and key features (goals, nets, service boxes, etc.). All dimensions are clearly marked, either in imperial or metric units (with conversions). They serve as the definitive guide for striping a court.
- Badminton (Fig. 1): The isometric view clearly shows the net, posts, and the 3D relationship of the court markings. The court layout specifies dimensions for the short service line (6'-6" from net), the long service line for doubles, and the side alleys for doubles play.
- Basketball (AAU, Fig. 2): The layout details the free throw lane (3.60m/12'-0" wide), the free throw line (5.80m/19'-0" from the end line), and the center circle. The free throw lane detail shows the hash marks for player positioning.
- Basketball (NCAA, Fig. 3): This figure uniquely shows two backboard types: the fan-shaped and the rectangular, with complete dimensions for each. The court layout differentiates between High School (84' court) and Collegiate (94' court) dimensions and includes the three-point line (labeled as a 19'-9" radius in later documents, though not explicitly dimensioned here).
- Handball Courts (Figs. 8, 9, 10): The elevations and plans clearly distinguish between one-, three-, and four-wall configurations. They show the 16'-0" wall height for one-wall, the 20'-0" minimum overhead clearance for three/four-wall, and the location of access doors and service lines.
- Horseshoes (Fig. 12): The detailed sections (A-A and B-B) and detail drawing are crucial. They specify the construction of the pitching platform (2"x6" wood members), the pitcher's box (filled with clay), and the anchor plate for the peg, showing how it's embedded in a 20"x20"x10" solid oak block. This level of detail is for fabrication, not just layout.
- Ice Hockey (Fig. 13): The rink layout provides dimensions for all key zones and circles: the neutral zone, face-off spots (2'-0" dia.), goal creases (4'-0" radius), and corner radius (28'-0"). The isometric of the goal shows its dimensions (6'-0" wide x 4'-0" high) and construction.

BOQ Implications

- Material Quantity Calculation:
    - Paved Areas: Calculated in sq ft or sq m. Differentiated by type (concrete vs. bituminous).
    - Markings: Calculated by linear foot, with paint quantities dependent on line width (typically 1½" to 2").

    - Fencing: Calculated by linear foot and height (e.g., 10-ft high chain link).
    - Turf/Sand-Clay: Calculated by sq ft or cubic yards for fill.
    - Goals/Nets/Posts: Quantified by unit.
- Cost Estimation Factors:
    - Surfacing: The choice between concrete, bituminous, synthetic, or turf is a primary cost driver. Turf and synthetic surfaces have high initial costs.
    - Fencing and Lighting: Significant costs for many courts, especially if night play is desired (though lighting is not detailed in this section).
    - Specialized Equipment: Cost of official goals, backboards (especially transparent, padded ones), nets, and specialized hardware (e.g., Croquet arches, Horseshoe pegs) must be included.
    - Subsurface Work: Extensive costs for underdrainage (for turf/sand-clay courts) and proper subgrade preparation and drainage for all surfaces.

Critical Notes and Warnings

- Marking Accuracy: All measurements for court markings are specified as being to the outside of lines, except for center lines which are equally divided. This is a critical note for accurate layout.
- Safety Padding: Padding is explicitly required for NCAA basketball backboards and recommended for posts in AAU and Biddy basketball.
- Surface Slopes: Consistent minimum drainage slopes (1 in. in 10 ft for most hard surfaces) are specified to prevent water pooling and ensure usability and safety.
- Material Selection: The choice of materials is critical for longevity and safety, from weather-resistant backboards to non-corrosive hardware and non-toxic marking paints.

Chapter 10: Recreation and Entertainment (Part 3 of 15: Pages 1076-1087)

Overview

This section continues to provide detailed architectural and construction standards for a variety of sports facilities. The focus is on sports requiring specialized courts and large playing fields. It covers lawn bowling, roque, shuffleboard, various forms of tennis (deck, platform, paddle, and standard), and the foundational layouts for official and league-specific baseball diamonds. The content maintains a high level of technical detail, offering precise dimensions for playing areas, clearances, line markings, and equipment. The specifications for surfaces, drainage, fencing, and orientation remain critical components of each sport's section.

Key Standards and Codes Referenced

- *Outdoor Sports Facilities, Departments of the Army, Navy, and Air Force, Washington, D.C., 1975*: This manual continues to be the primary source for the data presented in this section.
- Fig. 51, 52, 53: Net and Post Details (Referenced for Deck Tennis, Paddle Tennis, Tennis, Volleyball)
- Fig. 55: Fence Details (Referenced for Deck Tennis, Paddle Tennis, Tennis)
- Fig. 57: Grading and Drainage Details (Referenced for Baseball)
- Fig. 58, 59, 60, 61: Surfacing Details (Referenced for Lawn Bowling, Roque, Deck Tennis, Paddle Tennis, Tennis, Baseball)
- Fig. 62: Backstop Details (Referenced for Baseball)

Technical Specifications

Lawn Bowling (p. 1076)

- Recommended Area: A square green with six rinks requires 12,996 sq ft minimum to 17,424 sq ft maximum.
- Court Dimensions:
  - Square Green: 110 ft minimum to 125 ft maximum on each side.
  - Rink Width: 14'-0" minimum to 19'-0" maximum.
  - Rink Length: 110'-0" minimum to 125'-0" maximum.
  - Ditch: A ditch is required on all sides with a width of 8 in minimum to 15 in maximum, and a depth of 2 in minimum to 8 in maximum below the green surface.
- Orientation: Optional.
- Surface and Drainage:
  - Material: Closely cropped bent grass or sand-clay.
  - Drainage: The entire green should be level with adequate underdrainage.
- Markings: Side boundaries of rinks are marked with a 2-in-wide green linen tape attached with pins.

Roque (p. 1077)

- Recommended Area: Ground space is 1,800 sq ft minimum, plus the curb.
- Court Dimensions: Playing court is 30'-0" wide by 60'-0" long.
- Orientation: Preferred orientation is for the long axis to be north-south.
- Surface and Drainage:
  - Material: The playing surface is a hard, smooth, and level sand-clay mixture.

    - Drainage: Achieved through a perimeter drainage system and/or underdrains.
- Material Requirements:
    - Curb: A concrete curb is required on all sides.
    - Arches: 5/8-in dia. steel rod, 3-3/8 in wide, and 8 in above the surface, set in concrete anchors.
    - Stakes: ¼-in dia. steel, extending 2 in above the surface.
- Special Considerations: A concrete curb is to be provided on all sides.

Shuffleboard (p. 1078)

- Recommended Area: Ground space is 312 sq ft minimum.
- Court Dimensions: Playing court is 6'-0" x 52'-0".
- Clearance: A recommended minimum of 2'-0" on each side, or 4'-0" between courts in battery.
- Orientation: Preferred orientation for the long axis is to be north-south.
- Surface and Drainage:
    - Material: Concrete with a burnished finish.
    - Drainage: The court surface is level, with drainage away from the playing surface on all sides.
- Markings: Lines are ¾ in minimum to 1½ in maximum wide, marked with black shoe dye or black acrylic paint. All dimensions are to the centers of lines.
- Special Considerations: A depressed alley (24 in wide, min. 4 in deep at midcourt) should be constructed between and outside of courts. Secure covered storage for playing equipment should be provided nearby.

Deck Tennis (p. 1079)

- Recommended Area: Ground space is 1300 sq ft including clear space.
- Court Dimensions:
    - Singles Court: 12'-0" by 40'-0".
    - Doubles Court: 18'-0" by 40'-0".
- Clearance: Additional paved area of at least 4'-0" on sides and 5'-0" on ends is recommended.
- Orientation: North-south preferred.
- Surface and Drainage: Concrete or bituminous material with a minimum slope of 1 in. in 10 ft.
- Fencing: A 10-ft-high chain link fence is recommended on all sides of the court.
- Markings: All markings to be 1½ in wide.

Platform Tennis (p. 1080)

- Recommended Area: Ground space is 1,800 sq ft to the playable perimeter fence.
- Court Dimensions: Playing court is 20'-0" x 44'-0".
- Clearance: An 8'-0" space is required on each end and a 5'-0" space on each side within the fenced area.
- Orientation: North-south preferred.
- Surface and Drainage:
  - Structure: A raised level platform, typically of treated wood or aluminum, set on concrete piers.
  - Drainage: Provided by ¼-in spaces between 6-in deck planks or channels.
- Special Considerations:
  - Fencing: A 12-ft-high, 16-gauge, hexagonal, 1-in flat wire mesh fabric is mandatory on all sides.
  - Lighting: Lights are essential as the game is played at night throughout the year.
  - Climate Control: Hinged "snow gates" facilitate snow removal. Heating units with fans under the platform are used in cold climates.
  - Net Height: 3'-1" at posts, 2'-10" at center.

Paddle Tennis (p. 1081)

- Recommended Area: Ground space is 3,200 sq ft minimum to the edge of pavement.
- Court Dimensions: Playing court is 20'-0" x 50'-0".
- Clearance: A 15-ft minimum space is required on each end and a 10-ft minimum space on each side (or between courts in battery).
- Orientation: North-south preferred.
- Surface and Drainage: Concrete or bituminous material with a minimum slope of 1 in. in 10 ft.
- Fencing: A 10-ft-high chain link fence is recommended on all sides.
- Markings: All markings to be 1½ in wide.

Tennis (p. 1082)

- Recommended Area: Ground space is 7,200 sq ft minimum.
- Court Dimensions: Playing court is 36'-0" x 78'-0".

- Clearance: At least 12 ft clearance on both sides (or between courts) and 21 ft clearance on each end. Minimum distance between parallel courts is 12'-0".
- Orientation: North-south preferred.
- Surface and Drainage:
    - Material: Concrete, bituminous material with protective color coating, or sand-clay.
    - Drainage: For pavement, a slope of 1 in. in 10 ft. Sand-clay surfaces are level with underdrainage.
- Fencing: A 10-ft-high, 11-gauge, 1¾-in mesh chain link fence is recommended.
- Markings: All markings to be 2 in wide.

Official Baseball (Babe Ruth, Senior League) (p. 1085)

- Recommended Area: 3.0 to 3.85 acres minimum.
- Field Dimensions:
    - Baselines: 90'-0".
    - Pitching Distance: 60'-6".
    - Pitcher's Plate Elevation: 10 in above home plate level.
    - Foul Lines: 320 ft minimum, 350 ft preferred.
    - Center Field Distance: 400 ft+. (Senior League recommends 300 ft+ to outfield fence).
- Orientation: Optimum orientation is east-northeast (line from home plate through pitcher's mound to second base).
- Surface and Drainage: Turf surface. Infield may be skinned. Graded so baselines and home plate are level.
- Backstop: Required at a minimum distance of 40 ft (preferably 60 ft) behind home plate.
- Markings: Foul lines and boxes are 2 to 3 in wide, marked with chalk or other white material (caustic lime must not be used).

Baseball - Bronco League (9-12 yr) (p. 1086)

- Recommended Area: 1.0 acre minimum.
- Field Dimensions:
    - Baselines: 70'-0".
    - Pitching Distance: 48'-0".
    - Pitcher's Plate Elevation: 6 in above home plate level.
    - Foul Lines: 175 ft.
    - Center Field Distance: 225 ft.

- Orientation: East-northeast.
- Surface and Drainage: Turf surface. Infield may be skinned. Graded so baselines and home plate are level.
- Backstop: Required at a recommended distance of 20 ft behind home plate.
- Markings: 2 in wide, marked with white chalk (caustic lime must not be used).

Baseball - Pony League (13-14 yr) (p. 1087)

- Recommended Area: 2.0 acres minimum.
- Field Dimensions:
  - Baselines: 80'-0".
  - Pitching Distance: 54'-0".
  - Pitcher's Plate Elevation: 8 in above home plate level.
  - Foul Lines: 250 ft.
  - Center Field Distance: 300 ft.
- Orientation: East-northeast.
- Surface and Drainage: Turf surface. Infield may be skinned. Graded so baselines and home plate are level.
- Backstop: Required at a recommended distance of 40 ft behind home plate.
- Markings: 2 in wide, marked with white chalk (caustic lime must not be used).

Visual Elements Analysis

- Lawn Bowling (Fig. 14): The diagram provides a comprehensive plan and sectional views. The ELEVATION - RINK NUMBER PANEL shows a numbered marker for identifying rinks. The sections (SECTION A-A and ALTERNATE SECTION A-A) detail the construction of the ditch and bank, specifying a SAND CUSHION and PRESSURE TREATED WOOD RETAINING WALL. The GREEN LAYOUT shows six rinks side-by-side.
- Roque (Fig. 15): The COURT LAYOUT illustrates the octagonal shape of the playing area, the placement of the 10 arches, and the two stakes. The CURB SECTION A-A is a critical construction detail, showing a 3" x 3" x ¼" ANGLE at the top edge of the concrete curb, a 5" x 2½" MIN. CHANNEL, and NO. 4 HORIZONTAL RODS, 6" O.C. for reinforcement. It also specifies a drainage connection to a storm sewer.
- Platform Tennis (Fig. 18): The isometric view is highly informative, showing the complete raised structure with its perimeter tension fencing, under-structure, piers, and lighting. It visually explains concepts like "snow gates" (hinged panels at the base of the fence). The court layout confirms all dimensions for play within the fenced area.

- Official Baseball and League Diamonds (Figs. 23, 24, 25): These diagrams are essential for accurate field layout.
    - LAYOUT AT HOME PLATE: Provides precise dimensions for the batter's boxes (4'-0" x 6'-0" for official, slightly different for leagues), catcher's box, and the shape of home plate.
    - LAYOUT AT PITCHER'S PLATE: Shows the 9'-0" radius circle, the 18" x 24" plate, and the critical slope from the pitcher's plate toward home plate (1" to 1' slope).
    - DIAMOND LAYOUT / PLAYING FIELD LAYOUT: These large-scale plans show the entire infield and outfield layout, including baseline distances, foul line angles, coach's box dimensions, and recommended outfield fence distances for each league. They visually represent the scaling of the field for different age groups.

BOQ Implications

- Quantity Calculation Methods:
    - Area-Based Sports (Bowling, Roque, Shuffleboard): Materials like turf, sand-clay, or concrete are calculated by the square foot. Curbs are calculated by the linear foot.
    - Court Sports (Tennis variants): Pavement (concrete/bituminous) and fencing are the primary quantities, calculated by sq ft and linear ft, respectively.
    - Baseball Fields: Requires large quantities of turf (sod or seed), infield mix (sand/clay/silt), and foul line marking material (chalk). Fencing for the backstop and outfield is a major component measured in linear feet by height.
- Material Waste Factors:
    - For sand-clay or turf surfaces, extra material should be accounted for initial settling and future repairs.
    - Concrete and asphalt paving will have standard waste factors associated with batching and placement.
- Labor Considerations:
    - Specialized Labor: The construction of a platform tennis court is a specialty trade. Creating quality turf for lawn bowling greens or sand-clay surfaces for roque requires horticultural or soil expertise.
    - Precision Work: The burnished finish on a shuffleboard court and the levelness of baseball baselines require skilled concrete and grading crews.

Critical Notes and Warnings

- Material Specifications: The documents repeatedly specify materials that resist weathering, wear, and vandalism. For baseball markings, the warning "Caustic lime must not be used" is a critical safety and liability note.
- Drainage: Adequate drainage is paramount for all outdoor surfaces to ensure playability and longevity. The specified slopes and underdrainage systems are mandatory for a successful installation.
- Fencing: Fencing is not just for containing the game but is a critical safety feature, especially for tennis courts and baseball backstops. The gauge and mesh size are specified for durability and to prevent balls from passing through.
- Orientation: The consistent recommendation for a north-south axis for most court games and an east-northeast axis for baseball is a fundamental design principle to mitigate sun glare for players.

Chapter 10: Recreation and Entertainment (Part 4 of 15: Pages 1088-1098)

Overview

This section focuses on the layout and dimensional standards for large-scale outdoor playing fields. It provides specifications for the remaining age-specific baseball leagues (Colt and Little League) and transitions to various football, hockey, lacrosse, and soccer disciplines. A detailed section on golf driving ranges is also included. For each sport, the analysis specifies the required ground space, field dimensions, orientation to manage sun interference, surface materials, drainage principles, and critical equipment like goals and safety features. The information is highly prescriptive, providing the necessary data for site planning and accurate field layout for competitive and recreational play.

Key Standards and Codes Referenced

- *Outdoor Sports Facilities, Departments of the Army, Navy, and Air Force, Washington, D.C., 1975*: Continues to be the primary source for the technical specifications and diagrams in this section.
- Fig. 57: Grading and Drainage Details (Referenced for Baseball, Field Hockey, Flickerball, Football, Lacrosse, Soccer)
- Fig. 58: Surfacing Details (Referenced for all sports covered in this section)
- Fig. 62: Backstop Details (Referenced for Colt and Little League Baseball)

Technical Specifications

Baseball - Colt League (15-16 yr) (p. 1088)

- Recommended Area: 3.0 acres minimum.
- Field Dimensions:
  - Baselines: 90'-0".
  - Pitching Distance: 60'-6".
  - Pitcher's Plate Elevation: 10 in above the level of home plate.
  - Foul Lines: 300 ft.
  - Center Field Distance: 350 ft.
- Orientation: Optimum orientation is for the line from home plate through second base to run east-northeast.
- Surface and Drainage: Surface is to be turf. The infield may be skinned and shall be graded so that baselines and home plate are level.
- Backstop: Required at a recommended distance of 60 ft behind home plate.
- Markings: Foul lines, boxes, and restraining lines shall be 2 in wide and marked with white chalk or other white material. Caustic lime must not be used.

Baseball - Little League (9-12 yr) (p. 1089)

- Recommended Area: 1.21 percent longitudinal crown.
- Material Requirements:
  - Goal Posts: Provided at each end of the field. Can be dual posts or a single cantilevered post.
  - Pylons: Required (8 total), constructed of soft, flexible material, red or orange in color.
  - Markings: 4 in wide, white, nontoxic material. Measurements are from the inside edge of lines.

Touch and Flag Football (p. 1093)

- Recommended Area: 41,200 sq ft (0.94 acre) minimum.
- Field Dimensions:
  - Playing Field: 120'-0" wide x 300'-0" long (100 yds). This includes two 10-yard end zones.
  - Alternate Field: For 9 or 11 players, a 360'-0" (120-yd) long field is recommended.
- Clearance: A 6'-0" minimum unobstructed space on all sides is recommended.
- Orientation: Northwest-southeast for fall season, or north-south.
- Surface and Drainage: Turf surface with a preferred 1 percent longitudinal crown.
- Material Requirements: Goal posts and pylons are required as per NCAA rules.

Golf Driving Range (p. 1094)

- Recommended Area: 13.5 acres for a minimum of 25 tees.
- Range Dimensions:
  - Length: 900 ft (300 yd) minimum.
  - Width: 690 ft (230 yd) minimum, including buffer areas.
  - Tee Width: Add 12 ft width for each additional tee.
- Orientation: Long axis should run southwest to northeast, with the golfer driving toward the northeast.
- Surface and Drainage:
  - Material: Turf. Center area is closely mowed for ball collection; side buffer areas are rough cut.
  - Drainage: Away from the raised tee area and preferably across the axis of play.
- Tee Construction: The tee area is raised with a maximum slope of 3:1. The acres** minimum.
- Field Dimensions:
  - Baselines: 60'-0".
  - Pitching Distance: 46'-0".
  - Pitcher's Plate Elevation: 6 in above the level of home plate.
  - Foul Lines: 200 ft.
  - Center Field Distance: 200 to 250 ft optional.
- Orientation: Optimum orientation is east-northeast.
- Surface and Drainage: Turf surface. Infield may be skinned and graded so baselines and home plate are level.
- Backstop: Required at a recommended minimum distance of 25 ft behind home plate.
- Fencing: A 4'-0" high outfield fence is recommended.

Field Hockey (p. 1090)

- Recommended Area: Ground space is 64,000 sq ft (1.5 acres) minimum.
- Field Dimensions: Playing field is 180'-0" wide by 300'-0" long.
- Clearance: A 10'-0" minimum unobstructed space on all sides is recommended.
- Orientation: Preferred orientation is northwest-southeast for the fall playing season, or north-south for longer periods.
- Surface and Drainage:
  - Material: Turf.

    - Drainage: Preferred grading is a longitudinal crown with a 1 percent slope from the center to each side with adequate underdrainage.
- Goals: To be provided at each end of the playing field.
- Markings: All lines are to be 3 in wide, white, and made from a non-toxic material. All measurements are from the inside edge of lines.

Flickerball (p. 1091)

- Recommended Area: Ground space is 17,600 sq ft (0.4 acre) minimum.
- Field Dimensions: Playing field is 90'-0" wide by 160'-0" long. Goals are located 15'-0" beyond each end line.
- Clearance: A 6'-0" minimum unobstructed space on all sides is recommended.
- Orientation: Northwest-southeast for fall season, or north-south for longer periods.
- Surface and Drainage: Turf, with a preferred longitudinal crown (1 percent slope).
- Markings: 3 in wide, white, and non-toxic.

Football (NCAA) / Pop Warner Junior League (p. 1092)

- Recommended Area: Ground space is 64,000 sq ft (1.5 acres) minimum.
- Field Dimensions: Playing field is 160'-0" wide by 360'-0" long (120 yds).
- Clearance: 6'-0" minimum unobstructed space on all sides is required.
- Orientation: Preferred orientation is northwest-southeast.
- Surface and Drainage: Turf, with a preferred longitudinal crown (1 percent slope).
- Goals and Pylons: Goal posts are required at each end of the field. Pylons are to be provided as required by rules.
- Markings: All field dimension lines must be 4 in wide, white, and non-toxic. If cross-hatching in the end zone is white, it shall be no closer than 2 ft to the boundary lines.

Touch and Flag Football (p. 1093)

- Recommended Area: Ground space is 41,200 sq ft (0.94 acre) minimum.
- Field Dimensions:
    - Standard: **120'-0" wide by 300'-0" long top of the tee has a 1.6' minimum slope. Tees are marked with suitable material.

Lacrosse - Men's (p. 1095)

- Recommended Area: 62,650 sq ft (1.4 acres) to 70,000 sq ft (1.6 acres).
- Field Dimensions: 159'-0" to 180'-0" wide x 330'-0" (110 yds) long.
- Clearance: 10'-0" minimum unobstructed space with a barrier fence, or 20'-0" without a fence.
- Orientation: Northwest-southeast for fall season, or north-south.
- Surface and Drainage: Turf surface with a preferred 1 percent longitudinal crown.
- Material Requirements:
    - Goal: Provided 45'-0" *in front of* each end line. Net must be cord with openings not more than 1½ in. Posts are 1½-in nominal pipe painted orange.
    - Markings: Lines are 2 in wide (except center line is 4 in wide), white, and nontoxic.

Soccer - Men's and Boys' (p. 1097)

- Recommended Area: 75,250 sq ft (1.7 acres) to 93,100 sq ft (2.1 acres).
- Field Dimensions: 195'-0" to 225'-0" (65-75 yds) wide x 330'-0" to 360'-0" (110-120 yds) long.
- Clearance: A 10'-0" minimum unobstructed space on all sides is recommended.
- Orientation: Northwest-southeast for fall season, or north-south.
- Surface and Drainage: Turf surface with a preferred 1 percent longitudinal crown.
- Material Requirements:
    - Goal Posts: Must be pressure-treated with paintable, oil-borne preservative and painted with three coats of white lead and oil. Posts and crossbar must present a flat surface (4 in to 5 in wide) to the field. Nets are attached to the posts, crossbar, and ground behind the goal.
    - Markings: 2 in wide, white, nontoxic material.

Visual Elements Analysis

- Baseball Layouts (Figs. 26, 27): Continue to show scaled layouts for Colt and Little League. They clearly depict the reduced baseline distances (90' vs. 60'), pitching distances, and outfield fence distances compared to official baseball, making them suitable for younger players. The diagrams consistently include the on-deck circle, coach's box, and 3-ft restraining line.
- Field Hockey (Fig. 28): The FIELD LAYOUT provides all necessary markings, including the 25-yard line, center line, and the critical STRIKING CIRCLE (a semi-circle with a 16 yd radius from the goal). The GOAL DETAIL is an isometric drawing (100 yds)**.

    - For 9 or 11 players: A 360'-0" (120-yd) long field with five 60'-0" (20-yd) zones and two 30'-0" (10-yd) end zones is recommended.
- Clearance: 6'-0" minimum unobstructed space on all sides is recommended.
- Markings: 4 in wide, white, and non-toxic.

Golf Driving Range (p. 1094)

- Recommended Area: 13.5 acres for a minimum of 25 tees.
- Range Dimensions:
    - Minimum Length: 900 ft (300 yd).
    - Minimum Width: 690 ft (230 yd) including side buffer areas.
    - Tee Spacing: Add 12 ft width per additional tee.
- Orientation: Preferred orientation is for the long axis to run southwest to northeast, with the golfer driving toward the northeast.
- Surface and Drainage: Turf surface. Center area is closely mowed for ball collection. Side buffer areas are rough cut and may rise to contain stray drives. Drainage should be away from the raised tee area.
- Tee Construction: The teeing area is raised with a maximum side slope of 3:1. The section view shows a 12'-0" wide tee surface, a 1'-6" minimum rear slope, and a 3" x 6" curb at the front edge.

****Lacrosse, Men's (showing a 12'-0" wide x 7'-0" high goal with side and top boards.**

- Football Layouts (Figs. 30, 31): These diagrams meticulously detail the standard American football field markings.
    - Playing Field: Clearly marks the 5-yard line increments, hash marks (inbound lines), 3-yard line (for Pop Warner), and end zones.
    - Goal Posts Detail: Provides dimensions for the goal posts: 10'-0" high to the crossbar, uprightp. 1095)**
- Recommended Area: 62,650 sq ft (1.4 acres) to 70,000 sq ft (1.6 acres).
- Field Dimensions: Playing field is 159'-0" to 180'-0" wide bys extending 20'-0" above that, and a width of 23'-4". 330'-0" long. Goals are located 45'-0" in from each end line.
- Clearance: 10'-0" min with a barrier fence, or 20'-- Pylon Detail: Shows an 18" high x 4"x4" soft, flexible pylon0" min without a fence.
- Orientation: Northwest-southeast.
- Surface: Turf at the goal line corners.

- Golf Driving Range (Fig. 32): The visual analysis with a 1 percent longitudinal crown.
- Markings: All lines are 2 in wide, except is crucial here.
    - RANGE LAYOUT: Shows a fan-shaped playing area with distances marked at the center/offside line which is 4 in wide.
- Goal Netting: Cord netting with openings not more 100, 200, and 300 yards. The tee line is curved. The layout than 1½ in.

Lacrosse, Women's (p. 1096)

- Recommended Area: **54,000 sq ft (1.2 acres) illustrates the central closely-mowed area flanked by rough-cut buffer zones.
    - SECTION OF TEES: A to 61,500 sq ft (1.4 acres)** (optional).
- Field Dimensions:
    - Width: 150'-0" minimum.
    - Length: ** detailed cross-section showing the raised tee construction with a 3:1 maximum slope on the front embankment, a 1360'-0" to 420'-0" optional.
    - Critical Note: There are2'-0"** deep tee surface, and a 3'x6" curb at the rear. no definite boundaries or shape for the field of play. Officials decide on boundaries before a match.
- Orientation: Northwest-southeast.
- Surface: Turf with a 1 percent longitudinal crown.
- ** - PLAN OF TEES: Shows the linear arrangement of individual tee stalls, each marked and separated.
- Goal Posts: Shall be of wood, 2 in x 2 in, and painted white. Pipe goals are consideredLacrosse and Soccer Layouts (Figs. 33, 35)**: These layouts detail the placement of goals relative legal but wood is preferred.

Soccer, Men's and Boys' (p. 1097)

- Recommended Area: 75,250 sq ft (1.7 acres to the end lines, the goal area, goal crease (lacrosse), and penalty area (soccer). The flag and) to 93,100 sq ft (2.1 acres).
- Field Dimensions: 195'-0" to 225'-0" wide by 330'- goal details provide key construction information, such as the use of cloth flags on flexible shafts and specifications for pressure-treating and0" to 360'-0" long.
- Clearance: **10'-0 painting wooden goal posts.

BOQ Implications

- Quantity Calculation:
  - Turf:"** minimum unobstructed space on all sides.
- Orientation: Northwest-southeast.
- Surface: Turf with a 1 percent longitudinal crown.
- Goal Posts: Must be pressure-treated wood The primary material, calculated in acres or square feet. This is a major cost component for all fields.
  - , painted with three coats of white lead and oil. They shall present a flat surface to the field, 4 inLine Marking**: Extensive linear footage of markings required, especially for football fields. Calculated by linear foot.
  - Goal to 5 in wide.

Soccer, Women's and Girls' (p. 1098 Posts: Quantified by the set (pair). Fabrication and installation are key costs, especially for materials requiring specific treatments (e.)**

- Recommended Area: 36,400 sq ft (0.8 acre) to 64,000 sq ft (1.4 acres).
- Field Dimensions: **g., pressure-treated, painted wood for soccer).
  - Earthwork: Significant quantities for grading large120'-0" to 180'-0" wide** by 240'-0" to 300'-0" long.
- Clearance: 10'-0" minimum unobstructed space on all sides.
- Goal Posts: Same specifications as for Men's and Boys' soccer.

fields to achieve the specified crown and for constructing raised tees for a driving range. - Specialty Items: P### Visual Elements Analysis

- Baseball Fields (Figs. 26, 27): The diagrams clearlyylons (football), corner flags (field hockey, soccer), backstops (baseball), and range equipment (tee markers, ball illustrate the scaled-down dimensions for youth leagues. The "Optional Layout at Home Plate" provides standardized dimensions for batter's boxes and catcher's box. Key elements like the optional dugout, the next batter's circle (5' dia.), and the coach's box are dimensioned and located.
- Field Hockey (Fig. 28): The collectors) are all distinct line items.
- Cost Estimation Factors:
  - Field Size: The sheer scale of these fields makes material quantities (turf, paint) and labor (grading, layout) the dominant costs.
  - Drainage Systems: Installing adequate underdrainage for crowned turf fields is a significant, though "GOAL DETAIL" shows an isometric view of

    - the goal, which has 9' boards on the sides and back often hidden, expense.
    - Material Durability: Choosing nontoxic but durable paint, weather-resistant goal and is 12'-0" wide. The "FIELD LAYOUT" clearly marks the 25-yard line, materials, and soft-but-sturdy pylons impacts both initial cost and long-term maintenance/replacement budgets.

center line, and the 16-yard radius striking circle.

- **Football Fields (Figs. ### Critical Notes and Warnings
- Safety and Material Toxicity: The repeated specification of nontoxic material for line30, 31)**: The diagrams for NCAA and Touch/Flag football are crucial for accurate line marking. markings is a critical safety requirement. Similarly, football pylons must be made of soft, flexible material. The warning- Goal Posts: The drawing shows the standard H-style goal posts with dimensions (23'-4" against using caustic lime for baseball lines is reiterated.
- Field Orientation: The orientation of fields apart for NCAA, 10'-0" high crossbar). It also describes an optional single-post cantilevered goal. (east-northeast for baseball, northwest-southeast for fall sports) is a crucial design principle to minimize sun interference
    - Pylon Detail: Shows an 18" high, 4"x4" p for players during typical game times.
- Grading and Drainage: The 1 percent longitudinal crown is theylon made of soft, flexible material.
    - Playing Field Layout: Details the 5-yard line standard and preferred method for draining large turf fields. This is a fundamental requirement for maintaining a playable surface and preventing water damage markings, inbound lines (hash marks), and the team area.
- **Golf Driving Range (Fig. 3 to the turf.
- Measurement Standards: All field dimension measurements are to be made from the inside edge2)**: The "RANGE LAYOUT" shows a symmetrical fan-shaped area, **900 ft (300 y of the boundary lines. This is a critical instruction for accurate layout.

Chapter 10: Recreation and Entertainment (Part 5 of 15: Pages 1099-1107)

Overview

This section focuses on the layout and dimensional standards for large-scale outdoor playing fields. It provides specifications for the remaining age-specific baseball leagues (Colt and Little League) and transitions to various football, hockey, lacrosse, and soccer disciplines. A detailed section on golf driving ranges is also included. For each sport, the analysis specifies the required ground space, field dimensions, orientation to manage sun interference, surface materials, drainage principles, and critical equipment like goals and safety features. The information is highly prescriptive, providing the necessary data for site planning and accurate field layout for competitive and recreational play.

Key Standards and Codes Referenced

- *Outdoor Sports Facilities, Departments of the Army, Navy, and Air Force, Washington, D.C., 1975*: Continues to be the primary source for the technical specifications and diagrams in this section.
- Fig. 57: Grading and Drainage Details (Referenced for Baseball, Field Hockey, Flickerball, Football, Lacrosse, Soccer)
- Fig. 58: Surfacing Details (Referenced for all sports covered in this section)
- Fig. 62: Backstop Details (Referenced for Colt and Little League Baseball)

Technical Specifications

Baseball - Colt League (15-16 yr) (p. 1088)

- Recommended Area: 3.0 acres minimum.
- Field Dimensions:
    - Baselines: 90'-0".
    - Pitching Distance: 60'-6".
    - Pitcher's Plate Elevation: 10 in above the level of home plate.
    - Foul Lines: 300 ft.
    - Center Field Distance: 350 ft.
- Orientation: Optimum orientation is for the line from home plate through second base to run east-northeast.
- Surface and Drainage: Surface is to be turf. The infield may be skinned and shall be graded so that baselines and home plate are level.
- Backstop: Required at a recommended distance of 60 ft behind home plate.
- Markings: Foul lines, boxes, and restraining lines shall be 2 in wide and marked with white chalk or other white material. Caustic lime must not be used.

Baseball - Little League (9-12 yr) (p. 1089)

- Recommended Area: 1.2 acres minimum.
- Field Dimensions:
  - Baselines: 60'-0".
  - Pitching Distance: 46'-0".
  - Pitcher's Plate Elevation: 6 in above the level of home plate.
  - Foul Lines: 200 ft.
  - Center Field Distance: 200 to 250 ft optional.
- Orientation: Optimum orientation is east-northeast.
- Surface and Drainage: Turf surface. Infield may be skinned and graded so baselines and home plate are level.
- Backstop: Required at a recommended minimum distance of 25 ft behind home plate.
- Fencing: A 4'-0" high outfield fence is recommended.

Field Hockey (p. 1090)

- Recommended Area: Ground space is 64,000 sq ft (1.5 acres) minimum.
- Field Dimensions: Playing field is 180'-0" wide by 300'-0" long.
- Clearance: A 10'-0" minimum unobstructed space on all sides is recommended.
- Orientation: Preferred orientation is northwest-southeast for the fall playing season, or north-south for longer periods.
- Surface and Drainage:
  - Material: Turf.
  - Drainage: Preferred grading is a longitudinal crown with a 1 percent slope from the center to each side with adequate underdrainage.
- Goals: To be provided at each end of the playing field.
- Markings: All lines are to be 3 in wide, white, and made from a non-toxic material. All measurements are from the inside edge of lines.

Flickerball (p. 1091)

- Recommended Area: Ground space is 17,600 sq ft (0.4 acre) minimum.
- Field Dimensions: Playing field is 90'-0" wide by 160'-0" long. Goals are located 15'-0" beyond each end line.
- Clearance: A 6'-0" minimum unobstructed space on all sides is recommended.
- Orientation: Northwest-southeast for fall season, or north-south for longer periods.
- Surface: Turf, with a preferred longitudinal crown (1 percent slope).
- Markings: 3 in wide, white, and non-toxic.

Football (NCAA) / Pop Warner Junior League (p. 1092)

- Recommended Area: Ground space is 64,000 sq ft (1.5 acres) minimum.
- Field Dimensions: Playing field is 160'-0" wide by 360'-0" long (120 yds).
- Clearance: 6'-0" minimum unobstructed space on all sides is required.
- Orientation: Preferred orientation is northwest-southeast.
- Surface and Drainage: Turf, with a preferred longitudinal crown (1 percent slope).
- Goals and Pylons: Goal posts are required at each end of the field. Pylons are to be provided as required by rules.
- Markings: All field dimension lines must be 4 in wide, white, and non-toxic. If cross-hatching in the end zone is white, it shall be no closer than 2 ft to the boundary lines.

Touch and Flag Football (p. 1093)

- Recommended Area: Ground space is 41,200 sq ft (0.94 acre) minimum.
- Field Dimensions:
    - Standard: 120'-0" wide by 300'-0" long (100 yds).
    - For 9 or 11 players: A 360'-0" (120-yd) long field with five 60'-0" (20-yd) zones and two 30'-0" (10-yd) end zones is recommended.
- Clearance: 6'-0" minimum unobstructed space on all sides is recommended.
- Markings: 4 in wide, white, and non-toxic.

Golf Driving Range (p. 1094)

- Recommended Area: 13.5 acres for a minimum of 25 tees.
- Range Dimensions:
    - Minimum Length: 900 ft (300 yd).
    - Minimum Width: 690 ft (230 yd) including side buffer areas.
    - Tee Spacing: Add 12 ft width per additional tee.
- Orientation: Preferred orientation is for the long axis to run southwest to northeast, with the golfer driving toward the northeast.
- Surface and Drainage: Turf surface. Center area is closely mowed for ball collection. Side buffer areas are rough cut and may rise to contain stray drives. Drainage should be away from the raised tee area.
- Tee Construction: The teeing area is raised with a maximum side slope of 3:1. The section view shows a 12'-0" deep tee surface, and a 3'x6" curb at the rear.

Lacrosse, Men's (p. 1095)

- Recommended Area: 62,650 sq ft (1.4 acres) to 70,000 sq ft (1.6 acres).
- Field Dimensions: Playing field is 159'-0" to 180'-0" wide by 330'-0" long. Goals are located 45'-0" in from each end line.
- Clearance: 10'-0" min with a barrier fence, or 20'-0" min without a fence.
- Orientation: Northwest-southeast.
- Surface: Turf with a 1 percent longitudinal crown.
- Markings: All lines are 2 in wide, except the center/offside line which is 4 in wide.
- Goal Netting: Cord netting with openings not more than 1½ in.

Lacrosse, Women's (p. 1096)

- Recommended Area: 54,000 sq ft (1.2 acres) to 61,500 sq ft (1.4 acres) (optional).
- Field Dimensions:
    - Width: 150'-0" minimum.
    - Length: 360'-0" to 420'-0" optional.
    - Critical Note: There are no definite boundaries or shape for the field of play. Officials decide on boundaries before a match.
- Orientation: Northwest-southeast.
- Surface: Turf with a 1 percent longitudinal crown.
- Goal Posts: Shall be of wood, 2 in x 2 in, and painted white. Pipe goals are considered legal but wood is preferred.

Soccer, Men's and Boys' (p. 1097)

- Recommended Area: 75,250 sq ft (1.7 acres) to 93,100 sq ft (2.1 acres).
- Field Dimensions: 195'-0" to 225'-0" wide by 330'-0" to 360'-0" long.
- Clearance: 10'-0" minimum unobstructed space on all sides.
- Orientation: Northwest-southeast.
- Surface: Turf with a 1 percent longitudinal crown.
- Goal Posts: Must be pressure-treated wood, painted with three coats of white lead and oil. They shall present a flat surface to the field, 4 in to 5 in wide.

Soccer, Women's and Girls' (p. 1098)

- Recommended Area: 36,400 sq ft (0.8 acre) to 64,000 sq ft (1.4 acres).
- Field Dimensions: 120'-0" to 180'-0" wide by 240'-0" to 300'-0" long.
- Clearance: 10'-0" minimum unobstructed space on all sides.
- Goal Posts: Same specifications as for Men's and Boys' soccer.

Visual Elements Analysis

- Baseball Fields (Figs. 26, 27): The diagrams clearly illustrate the scaled-down dimensions for youth leagues. The "Optional Layout at Home Plate" provides standardized dimensions for batter's boxes and catcher's box. Key elements like the optional dugout, the next batter's circle (5' dia.), and the coach's box are dimensioned and located.
- Field Hockey (Fig. 28): The "GOAL DETAIL" shows an isometric view of the goal, which has 9' boards on the sides and back and is 12'-0" wide. The "FIELD LAYOUT" clearly marks the 25-yard line, center line, and the 16-yard radius striking circle.
- Football Fields (Figs. 30, 31): The diagrams for NCAA and Touch/Flag football are crucial for accurate line marking.
    - Goal Posts: The drawing shows the standard H-style goal posts with dimensions (23'-4" apart for NCAA, 10'-0" high crossbar). It also describes an optional single-post cantilevered goal.
    - Pylon Detail: Shows an 18" high, 4"x4" pylon made of soft, flexible material.
    - Playing Field Layout: Details the 5-yard line markings, inbound lines (hash marks), and the team area.
- Golf Driving Range (Fig. 32): The visual analysis is crucial here.
    - RANGE LAYOUT: Shows a fan-shaped playing area with distances marked at 100, 200, and 300 yards. The tee line is curved. The layout illustrates the central closely-mowed area flanked by rough-cut buffer zones.
    - SECTION OF TEES: A detailed cross-section showing the raised tee construction with a 3:1 maximum slope on the front embankment, a 12'-0" deep tee surface, and a 3'x6" curb at the rear.
    - PLAN OF TEES: Shows the linear arrangement of individual tee stalls, each marked and separated.
- Lacrosse and Soccer Layouts (Figs. 33, 35): These layouts detail the placement of goals relative to the end lines, the goal area, goal crease (lacrosse), and penalty area (soccer). The flag and goal details provide key construction information, such as the use of cloth flags on flexible shafts and specifications for pressure-treating and painting wooden goal posts.

BOQ Implications

- Quantity Calculation:
  - Turf: The primary material, calculated in acres or square feet. This is a major cost component for all fields.
  - Line Marking: Extensive linear footage of markings required, especially for football fields. Calculated by linear foot.
  - Goal Posts: Quantified by the set (pair). Fabrication and installation are key costs, especially for materials requiring specific treatments (e.g., pressure-treated, painted wood for soccer).
  - Earthwork: Significant quantities for grading large fields to achieve the specified crown and for constructing raised tees for a driving range.
  - Specialty Items: Pylons (football), corner flags (field hockey, soccer), backstops (baseball), and range equipment (tee markers, ball collectors) are all distinct line items.
- Cost Estimation Factors:
  - Field Size: The sheer scale of these fields makes material quantities (turf, paint) and labor (grading, layout) the dominant costs.
  - Drainage Systems: Installing adequate underdrainage for crowned turf fields is a significant, though often hidden, expense.
  - Material Durability: Choosing nontoxic but durable paint, weather-resistant goal materials, and soft-but-sturdy pylons impacts both initial cost and long-term maintenance/replacement budgets.

Critical Notes and Warnings

- Safety and Material Toxicity: The repeated specification of nontoxic material for line markings is a critical safety requirement. Similarly, football pylons must be made of soft, flexible material. The warning against using caustic lime for baseball lines is reiterated.
- Field Orientation: The orientation of fields (east-northeast for baseball, northwest-southeast for fall sports) is a crucial design principle to minimize sun interference for players during typical game times.
- Grading and Drainage: The 1 percent longitudinal crown is the standard and preferred method for draining large turf fields. This is a fundamental requirement for maintaining a playable surface and preventing water damage to the turf.
- Measurement Standards: All field dimension measurements are to be made from the inside edge of the boundary lines. This is a critical instruction for accurate layout

Chapter 10: Recreation and Entertainment (Part 5 of 15: Pages 1099-1107)

Overview

This section covers a diverse range of athletic facilities, transitioning from field sports to track and field events. It begins with standards for different variations of softball (12-inch and 16-inch) and other field games like speedball and team handball. The second half of the section is dedicated to the technical requirements for throwing events (shot put, hammer, discus, javelin) and the construction of a standard ¼-mile running track. The specifications are highly detailed, focusing on precise dimensions for playing surfaces, markings, safety equipment such as throwing cages, and the layered construction of specialized surfaces like running tracks. The source remains the *Outdoor Sports Facilities* manual, ensuring consistent, high-quality standards.

Key Standards and Codes Referenced

- *Outdoor Sports Facilities, Departments of the Army, Navy, and Air Force, Washington, D.C., 1975*: The authoritative source for all technical data and drawings in this section.
- Fig. 57: Grading and Drainage Details (Referenced for Softball, Speedball, Team Handball).
- Fig. 58: Surfacing Details (Referenced for Softball, Speedball, Team Handball).
- Fig. 59: Backstop Details (Referenced for 12-inch Softball).
- Fig. 63: Backstop Details (Referenced for 16-inch Softball).

Technical Specifications

Softball, 12-Inch (Fast and Slow Pitch) (p. 1099)

- Recommended Area: 62,500 sq ft (1.5 acres) to 90,000 sq ft (2.0 acres).
- Field Dimensions:
  - Baselines: 60'-0" for men and women; 45'-0" for juniors.
  - Pitching Distances: 46'-0" for men; 40'-0" for women; 35'-0" for juniors.
  - Playing Field Radius (from home plate):
    - Fast Pitch: 225-ft radius for men and women.
    - Slow Pitch: 275-ft radius for men; 250-ft radius for women.
- Orientation: Optimum orientation is east-northeast (pitcher throws across the sun).

- Surface and Drainage: Surface to be turf; infield may be skinned. The infield shall be graded so that baselines and home plate are level.
- Backstop: To be located at a minimum distance of 25 ft behind home plate.
- Markings: Foul lines and boxes are 2 to 3-in chalk lines.

Softball, 16-Inch (Slow Pitch) (p. 1100)

- Recommended Area: 50,625 sq ft (1.2 acres) to 75,625 sq ft (1.7 acres).
- Field Dimensions:
  - Baselines: 55'-0" for men; 50'-0" for women.
  - Pitching Distance: 38'-0" for men and women.
  - Playing Field Radius (from home plate): 250 ft for men; 200 ft for women.
- Orientation: Optimum orientation is east-northeast.
- Surface and Drainage: Turf surface; infield may be skinned. Graded so baselines and home plate are level.
- Backstop: To be located at a minimum distance of 25 ft behind home plate.
- Markings: 2 to 3-in chalk lines.

Speedball (p. 1101)

- Recommended Area: 36,400 sq ft (0.85 acre) for high school to 76,000 sq ft (1.7 acres).
- Field Dimensions:
  - Standard: 180'-0" wide x 300'-0" long.
  - High School: May be 120 ft wide by 240 ft long.
- Clearance: An additional 30 x 180-ft out-of-bounds touchdown area is recommended on each end, plus 10'-0" unobstructed space on all sides.
- Orientation: Northwest-southeast for fall season, or north-south for longer periods.
- Surface and Drainage: Turf, with a preferred longitudinal crown (1 percent slope).
- Goals: Goal posts are to be provided at each end of the playing field.
- Markings: All markings to be 2 in wide, white, and nontoxic.

Team Handball (p. 1102)

- Recommended Area: 11,230 sq ft (0.25 acre) (1,066 m²).
- Field Dimensions:
  - Width: 65'-8" (20 m).

    - Length: 131'-4" (40 m).
- Clearance: A 6'-0" minimum unobstructed space on all sides is recommended.
- Orientation: Northwest-southeast for fall season, or north-south.
- Surface and Drainage: Turf, with a preferred longitudinal crown (1 percent slope).
- Goals:
    - Material: Metal or wood, painted on all sides in two contrasting colors.
    - Installation: Must be firmly fixed to the ground with hooked stakes.
- Markings: 2 in (5 cm) wide, white, and nontoxic. The goal line between the posts is the same width as the posts.

¼-Mile Running Track (p. 1103)

- Recommended Area: Approximately 4.3 acres.
- Track Dimensions:
    - Inside Radius (to face of curb): 106'-0".
    - Track Width: 32'-0" (for eight 4-ft wide lanes).
    - Overall Dimensions: 276'-0" wide x 600.02 ft long.
- Orientation: Long axis should fall in a sector from north-south to northwest-southeast, with the finish line at the northerly end.
- Surface and Drainage:
    - Surface: Preferably bituminous material with a hot plant cushion course mix and optional protective colorcoating.
    - Slopes (Maximum): 2% (1:50) inward on curves; 1% (1:100) inward on straightaways; 0.1% (1:1000) in the running direction.
- Construction: Concrete curb edges are to be rounded.
- Measurement Lines:
    - Lane 1: Measured on a line 12 in outward from the inner edge of the track.
    - Lanes 2-8: Measured on a line 8 in outward from the inner line of the lane.

Shot Put (p. 1104)

- Recommended Area: 2100 sq ft minimum.
- Throwing Area Dimensions:
    - Circle: 7'-0" (2.134m) in diameter.
    - Sector: 45° angle with a 70 ft (21.33m) minimum radius.
- Orientation: Preferred for throwing direction to be toward the northeast quadrant.
- Surface and Drainage:
    - Inner Circle: Concrete or similar material, surfaced ¾ in (2cm) lower than the outside level.

    - Throwing Sector: Turf, at the same level as the top of the metal ring.
- Material Requirements:
    - Circle Ring: Band iron or steel angle, 3 in x 2 in x ¼ in, sunk flush with the ground.
    - Stop Board: Made of wood, painted white. Must be firmly fixed so its inner edge coincides with the inner edge of the circle.

Javelin Throw (p. 1107)

- Recommended Area: 24,000 sq ft minimum.
- Throwing Area Dimensions:
    - Runway Length: 120'-0" (36.5m) minimum.
    - Runway Width: 13'-1½" (4.0m).
    - Throwing Sector: 30° angle with a 300'-3" (91.5m) minimum radius.
- Orientation: Northeast quadrant.
- Surface and Drainage:
    - Runway: Turf or specialized bituminous surfacing. Max slope of 1% laterally and 0.1% in running direction.
    - Throwing Sector: Turf, at the same level as the runway.
- Material Requirements: Foul board provided at the end of the runway. Sector flags required.
- Markings: Sector lines are 2 in (5cm) wide, white.

Visual Elements Analysis

- Softball Diamonds (Figs. 37, 38): Both figures provide a detailed "DIAMOND LAYOUT" and "LAYOUT AT HOME PLATE". They specify the radii for the skinned area and the grass line. Critical dimensions like the 84'-10¼" diagonal for a 60' baseline diamond and the 15' coach's box are shown. The difference in baseline lengths (60' vs. 55') and pitching distances for different softball types and player categories is clearly illustrated.
- Team Handball (Fig. 40): The "PLAYING FIELD LAYOUT" is unique in its markings, showing a dashed "FREE THROW LINE" at a 29'-6" (9M) radius and a solid "GOAL AREA LINE" at a 19'-8" (6M) radius. The "GOAL POSTS AND CROSSBAR" detail is very specific, showing 3" (8cm) SQUARE POSTS, a fabric net, and a rear pipe support, all with precise dimensions.
- ¼-Mile Running Track (Fig. 41): This is a highly detailed drawing.
    - Plan-Layout (a): Shows the standard oval track with an overall length of 600.02' and width of 276.0'. It locates the start and finish lines for numerous events (100 YD DASH, 440 YARD DASH, 120 YARD

HURDLES, etc.) and shows the placement of an optional football field inside.
    - Typical Section (b): This is a critical construction detail. It shows the layered buildup of the track surface from the bottom up: 6" MINIMUM COMPACTED AGGREGATE BASE, a PRIME COAT, a 1½" BIT. CONC. BINDER COURSE, a 1" BITUMINOUS CONC. SURFACE, and finally a 1" TO 1½" RESILIENT TRACK SURFACE. The inside curb is concrete and rounded.
- Shot Put (Fig. 42): The layout shows the 7'-0" diameter circle within the 45° throwing sector. The DETAIL - SHOT PUT STOP BOARD provides construction dimensions for the curved wooden stop board. The CONCRETE DETAILS - SHOT PUT CIRCLE section is crucial, showing the 3"x2"x¼" metal angle sunk flush with the ground and the concrete throwing surface ¾" below the surrounding grade.
- Javelin Throw (Fig. 45): The layout clearly shows the 120'-0" long runway leading to a curved foul line (throwing arc) with a radius of 26'-3" (8M). The DETAIL - JAVELIN THROW FOUL BOARD shows the construction of this curved board, which is to be painted white.

BOQ Implications

- Quantity Calculation:
    - Turf/Infield Mix: Primary materials for softball, speedball, and team handball, measured in sq ft or acres.
    - Track Surfacing: A highly specialized, multi-layered system. Each layer (aggregate, binder, surface, resilient topcoat) is a separate line item calculated by area (sq ft or sq yd) and thickness. This is a very high-cost item.
    - Concrete: Required for throwing circles, curbs, and footings, measured in cubic yards.
    - Specialty Equipment: Backstops (softball), goals (speedball/handball), throwing circles, stop boards, foul boards, and safety cages (for hammer/discus) are priced per unit.
- Material Waste Factors:
    - Standard waste factors apply for concrete and asphalt. For the multi-layered track surface, precise quantities are critical to meet performance standards, minimizing waste.
- Labor Considerations:
    - Precision Layout: All fields, and especially the running track, require expert surveying and layout to ensure distances and lines are accurate for competition.

    - Specialized Installation: The installation of a resilient track surface is a specialty trade. The construction of throwing cages requires skilled metal fabricators and riggers.

Critical Notes and Warnings

- Surface and Grading: Level playing surfaces for baselines (softball) and tight slope controls for running tracks (0.1% max in running direction) are critical for both performance and safety.
- Safety Equipment: The text implicitly requires a throwing cage for hammer (Fig. 43, p. 1105) and discus (Fig. 44, p. 1106) by stating "All discus and hammer throws must be made from an enclosure or cage to insure the safety of spectators." This is a mandatory safety requirement. Sector flags are also noted as required for competition.
- Track Measurement: The rules for measuring track lanes (12" out for lane 1, 8" out for others) are a critical specification for any track intended for sanctioned competition.
- Material Integrity: The use of pressure-treated, properly painted wood for goal posts (soccer, handball) and the correct steel angle and concrete finish for throwing circles ensures longevity and safety.
-

Chapter 10: Recreation and Entertainment (Part 6 of 15: Pages 1108-1117)

Overview

This section transitions from field sports to the highly technical requirements of track and field events, shooting ranges, and general construction details for ancillary structures like fences and backstops. It provides precise specifications for the runways and landing pits for long jump, triple jump, pole vault, and high jump. The section also covers the layout and safety requirements for archery and automatic trap shooting ranges. A significant portion is dedicated to standardized construction details for fixed nets, posts, fence enclosures, drainage systems, and various playing surfaces (turf, concrete, sand-clay, bituminous). These details serve as a foundational reference for many of the sports discussed throughout the chapter.

Key Standards and Codes Referenced

- *Outdoor Sports Facilities, Departments of the Army, Navy, and Air Force, Washington, D.C., 1975*: The single source for all technical data and drawings in this section.
- National Rifle Association (NRA): Cited as a source for detailed information on trap-house construction and trap machines.

Technical Specifications

Long Jump and Triple Jump (p. 1108)

- Recommended Area: 1500 sq ft minimum.
- Runway Dimensions:
  - Length: 130'-0" (39.62m) minimum.
  - Width: 4'-0" (1.22m) minimum.
- Landing Pit Dimensions:
  - Width: 9'-0" (2.75m) minimum.
  - Length: 32'-10" (10m) minimum.
- Orientation: Preferred for the running direction to be toward the north or northeast.
- Surface and Drainage:
  - Runway: Preferably bituminous material with a hot plant cushion course mix and optional protective colorcoating. Maximum slope is 1% (1:100) laterally and 0.1% (1:1000) in the running direction.
  - Landing Pit: Sand, at the same elevation as the takeoff board.
- Material Requirements:
  - Takeoff Board: To be of wood and fixed immovably in the runway.
  - Landing Pit Construction: Requires 2"x6" retaining boards, 2"x4" stakes, a 1" layer of washed sand, and an 8" (20cm) filter course.

Pole Vault (p. 1109)

- Recommended Area: 1500 sq ft minimum.
- Runway Dimensions:
  - Length: 125'-0" (38.10m) minimum.
  - Width: 4'-0" (1.22m) minimum.
- Vault Pit Dimensions:
  - Width: 16'-0" (5m) minimum.
  - Length/Depth: 12'-0" (3.66m) minimum to 16'-0" (5m) preferred.
  - Height of Landing Material: 18 in (0.46m) minimum to 36 in (0.92m) preferred.

- Orientation: Preferred for the running direction to be toward the north to east-northeast.
- Surface and Drainage: Runway is preferably bituminous material with a hot plant cushion course mix. Slopes are 1% laterally and 0.1% in the running direction.
- Material Requirements:
    - Pole Vault Box: Must be immovably fixed in the ground.
    - Jumping Pit: To be filled with a resilient, sponge-like rubber or other synthetic material.
    - Crossbar: Wood or metal, triangular or circular section. Length is 12'-8" (3.8m) minimum to 14'-10" (4.52m) maximum.

High Jump (p. 1110)

- Recommended Area: 4,000 sq ft minimum.
- Runway/Takeoff Area: A semicircle with a 50 ft (15.24m) radius. No point within the takeoff area may be higher than the point of measurement.
- Jumping Pit Dimensions:
    - Width: 16 ft (5m).
    - Depth (Length): 8 ft (2.5m) minimum.
    - Height of Material: 12 in (0.30m) minimum.
- Orientation: Preferred for the direction of jumping to be toward the north to east-northeast.
- Surface and Drainage: Runway is preferably constructed of bituminous material with an optional synthetic surface. The surface must be level and unvarying within its 180° arc.
- Material Requirements: Jumping pit is to be filled with a resilient, sponge-like rubber or other synthetic material.

Archery Target Range (p. 1111)

- Recommended Area: 28,600 sq ft (0.65 acre) minimum.
- Range Dimensions:
    - Length: 300'-0" (100 yds).
    - Width between targets: 10'-0" minimum, 15'-0" desirable.
- Clearance: Roped clear space of 30'-0" minimum on each side and 90'-0" minimum behind targets (45'-0" with bunker).
- Orientation: Range should be located so the archer is facing north ± 45°.
- Surface and Drainage: Surface to be turf and free from obstructions. Drainage is preferably from side to side.

- Material Requirements: Target may be mounted on a round butt of spirally sewn straw or rush, supported by a portable softwood stand.
- Special Considerations: Background behind targets should be dense trees, hills, or protective shields. Conspicuous signs should be provided to warn people of the range.

International Shooting Union Automatic Trap (p. 1112)

- Recommended Area: 15 acres for a single field.
- Facility Dimensions: Walks and structure occupy an area approx. 60 ft deep by 45 ft wide.
- Safety Zone: A 300-yd-radius shotfall danger zone is required.
- Orientation: Centerline through station #3 should run northeast-southwest, with the shooter facing northeast.
- Surface and Drainage: Shooting stations are to be Portland cement concrete (PCC). The shooting area and a minimum cleared area of 75- to 82-yd-radius are to be turf.
- Special Considerations: The trap-house roof must be on the same level as the shooting stations. Safety provisions for fencing, posting of warning signs, and clearing brush are required. Contact the National Rifle Association for construction details.

Typical Playing Surfaces (p. 1116)

- Concrete (Fig. 59):
  - Compressive Strength: 2,500 psi minimum.
  - Reinforcing: 6x6-in #6 gauge welded wire fabric.
  - Thickness: 4 in minimum.
  - Filter Course: 6-in deep sand filter required.
- Bituminous Material (Fig. 61):
  - Base: 4-in minimum stabilized aggregate base course over a minimum 6-in filter course.
  - Surface: 2½ in minimum in two lifts (1½-in leveling course, 1-in surface course).
- Sand-Clay (Fig. 60):
  - Base: 3 in minimum of 1½-in crushed stone.
  - Surface: 4 in minimum in two lifts (3-in clay, 1-in sand/clay-silt mix).
- Natural Turf (Fig. 58):
  - Topsoil: 6 in minimum, or 8 in of prepared soil mix.

    - Filter Course: 4 to 6 in, used only when subsoil conditions require.

Visual Elements Analysis

- Jump Pits and Runways (Figs. 46, 47, 48): The section views are critical. They detail the multi-layered construction of landing areas (sand/filter course for long jump; foam/shavings for high jump) and the precise, immovable installation of takeoff boards and vault boxes, which are essential for athlete safety and performance. The isometric views clearly show the relationship between the runway, equipment, and landing area.
- Archery Range (Fig. 49): The "RANGE LAYOUT" shows a multi-distance setup with lanes for 30, 40, 50, 60, 80, and 100-yard targets. The "TARGET DETAILS" drawing specifies a standard 48" diameter target face with correctly colored rings.
- Automatic Trap (Fig. 50): The "TRAP FIELD LAYOUT" shows the semicircular arrangement of the five shooting stations relative to the trap house. The "SHOTFALL DANGER ZONE" diagram is a critical safety plan, illustrating the 300-yard radius danger area and the 90° maximum allowed trap angle.
- Fixed Nets and Posts (Figs. 51, 52, 53): These are pure construction details. They specify post diameters (2.875" to 3.5" O.D.), material (galvanized steel), footing dimensions (4'-0" deep), concrete strength (2500#), and hardware (eyebolts, cleats, winches) for Badminton, Tennis, and Volleyball nets. The Volleyball post detail shows multiple attachment points to adjust net height for men's and women's play.
- Fence Enclosures (Figs. 54, 55, 56): These drawings provide standard details for sports fencing. Fig. 55 specifies typical pipe sizes for top rails and posts. Fig. 56 is a crucial construction section, detailing the concrete footing requirements (9" dia., 2'-4" min. depth, 2000psi concrete) for posts set in both earth and paved areas.
- Grading and Drainage (Fig. 57): This diagram presents the fundamental principles for managing water on sports surfaces. It shows options for surface pitching (side-to-side, end-to-end, corner-to-corner) for courts at a slope of 1" in 10'-0". For fields, it details the preferred longitudinal crown (1% slope) and shows how subsoil drains are installed.
- Baseball/Softball Backstops (Figs. 62, 63, 64): These diagrams provide plan and elevation views for standard backstops. They specify heights, widths, and the use of angled wing panels to contain foul balls. Mesh gauge is specified for different impact zones (#9 gauge x 2" mesh for primary areas). Fig. 64 provides typical framing diagrams, guiding the structural steel layout.

BOQ Implications

- Material Quantities:
  - Concrete: Required for post footings, fence footings, throwing circles, and shooting stations. Calculated in cubic yards.
  - Steel: Significant quantities for fence posts, rails, backstop frames, and throwing circle rings. Measured by weight or linear foot depending on the item.
  - Landing Pit Fill: Sand, foam blocks, or other synthetic material calculated by cubic feet or yards.
  - Specialized Surfaces: Resilient track surfaces are a major cost item, calculated by the square yard.
- Labor Considerations:
  - Precision Installation: Setting takeoff boards, vault boxes, and throwing circles requires high precision to ensure they are flush and stable.
  - Specialized Trades: Installation of synthetic track and pit surfaces, tensioning of throwing cage nets, and welding/fabrication of steel structures require specialized labor.
- Safety Equipment: The cost of throwing cages, warning signs, and roped-off safety zones must be included in the budget for any facility involving thrown or shot projectiles.

Critical Notes and Warnings

- Safety is Paramount: For all throwing and shooting events, safety enclosures (cages) and clearly defined danger zones are mandatory. Conspicuous warning signs are required for archery ranges.
- Level Surfaces: Takeoff areas for jumping events must be perfectly level and unvarying to prevent injury and ensure fair competition.
- Immovable Fixtures: Takeoff boards and vault boxes must be "fixed immovably" to provide a safe and consistent surface for athletes.
- Drainage is Key: The detailed drainage plans are not optional; they are critical for maintaining the usability and longevity of all outdoor sports surfaces.
- Construction Accuracy: The provided diagrams are construction guides. Adherence to specified dimensions, materials (e.g., concrete strength, steel gauge), and installation methods is essential for creating a safe and regulation-compliant facility.
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Chapter 10: Recreation and Entertainment (Part 7 of 15: Pages 1118-1128)

Overview

This section shifts focus from outdoor sports facilities to enclosed entertainment venues, specifically providing comprehensive architectural standards for indoor Movie Theaters and Drive-In Theaters. The content is authored by theater consultant Ben Schlanger, Architect, with supplementary plans from the Department of the Navy and accessibility guidelines from the North Carolina State Building Code. The section covers the entire scope of theater design, including site selection, capacity determination, optimal viewing geometry, auditorium floor slope design, seating layouts (including "continental" and handicapped seating), general lighting, and the technical requirements for projection rooms. The drive-in theater portion details plot layout, ramp design, screen construction, and support facilities.

Key Standards and Codes Referenced

- Ben Schlanger, Architect, Theater Consultant: Authored the primary text on movie theater design principles (p. 1118).
- *Time-Saver Standards: A Handbook of Architectural Design, 2d ed., McGraw-Hill Book Co., New York, 1950*: Source for the detailed theater auditorium floor slope diagrams (p. 1120).
- *An Illustrated Handbook of the Handicapped, Section of the North Carolina State Building Code, 1977*, by Ronald Mace, AIA and Betsy Laslett: Source for all handicapped seating diagrams and specifications (p. 1123).
- *Definitive Designs for Naval Shore Facilities, Department of the Navy, Washington, D.C., 1972*: Source for the 500-seat movie theater plans (p. 1125-1126).
- *Commercial Buildings, F. W. Dodge Corp., New York, 1954*: Source for drive-in theater data (p. 1127).

Technical Specifications

Indoor Movie Theaters

- Sizing and Capacity:
  - General Theaters: 600 to 1,500 seats.
  - "Art" Theaters: 400 to 900 seats.
- Viewing Geometry and Seating:
  - Minimum Viewing Distance: The first row of seats should be no closer than 1.0 times the screen width (1W).
  - Maximum Viewing Distance: Should be no greater than 2.0 times the widest screen width (2W). A screen 11 ft high by 15 ft wide is considered good for a 22-row theater.

    - Viewing Angle: The vertical angle from a front-row viewer's eye to the top of the projected picture should not exceed 33 degrees.
    - Seating Pattern Width: Should vary from 1.0W at the first row to 1.3W at the furthest row.
    - Row Spacing (Back-to-Back): 34 in. minimum. For "continental seating," 40 to 42 in. is used to eliminate intermediate aisles.
    - Seat Width: 20 in. minimum for rows farthest from the screen. Wider chairs (up to 26 in.) are used in front rows to improve sightlines for two-row vision.
- Projection and Screen:
    - Projection Angle: Should not exceed 10 degrees from horizontal to minimize picture distortion. 0 degrees is ideal but usually impossible.
    - Screen Curvature: Should have a radius equal to approximately 1.5 times the projection distance.
    - Screen Masking: Can be a matte black surround or a luminous light box. For multiple film formats (e.g., Cinemascope and 70mm), a compromise in frame size and aspect ratio (e.g., 1 to 2.22) is required.
- Projection Room:
    - Size: 48 sq ft for the first projector; 24 sq ft for each additional projector.
    - Film Storage: Up to 12,000 ft of film can be stored in metal containers. Film safes are required for greater amounts, with 24,000 ft being the usual maximum.
- Toilet Facilities (Recommended Minimums):
    - Up to 400 seats: Men (1 basin, 1 toilet, 1 urinal), Women (1 basin, 2 toilets).
    - 400-600 seats: Men (2 basins, 2 toilets, 2 urinals), Women (2 basins, 3 toilets).
    - 600-1,000 seats: Men (2 basins, 2 toilets, 3 urinals), Women (2 basins, 4 toilets).

Handicapped Seating (Accessibility)

- Wheelchair Space:
    - A wheelchair projects approximately 16 inches into a cross aisle when parked adjacent to fixed seating. Cross aisle width must allow for this extra space.
    - Steeply sloping floors are unsuitable for wheelchairs due to an offset center of gravity, causing discomfort.
    - Preferred Location: Level floor areas, such as at cross aisles, the front or rear of the theater, or in side boxes.

- Ambulant Handicapped (Leg Braces/Crutches):
    - Seats for persons with leg braces require an extra 18 to 24 inches of legroom in front of the seat.
    - A minimum seat width of 24 inches is needed to accommodate leg braces beside the person. Staggered seating can provide this extra space.

Drive-In Theaters

- Capacity and Ramp Dimensions:
    - 500 cars: 10 ramps, screen-to-rear-of-ramps depth of 510 ft.
    - 670 cars: 12 ramps, depth of 586 ft.
    - 1,000 cars: 15 ramps, depth of 700 ft.
    - Ramp spacing is typically 38 ft on center.
- Screen:
    - Orientation: Desirable to face screen east or north to block evening sun and permit earlier show times.
    - Construction: Asbestos sheets, aluminum, or steel decking. Structure must withstand at least 25 lb per sq ft wind pressure and be fire-resistant.
    - Typical Size: 48 ft x 37 ft for 650 cars; 56 ft x 42 ft for 950 cars.
- Site Layout:
    - Waiting Space: Provide waiting space for 30% to 40% of car capacity.
    - Projection Booth: Often placed about 280 ft from the screen.
    - Speaker Units: Typically placed on posts spaced 16 to 18 ft on center.

Visual Elements Analysis

- Figs. 1 & 2: Viewing Geometry (p. 1118): These diagrams establish the core principles of theater layout. Fig. 1 shows the 33° maximum vertical viewing angle from the first row. Fig. 2 shows the maximum viewing distance as 2W (twice the screen width) and the maximum seating width as 1.3W. This defines the ideal trapezoidal seating area.
- Figs. 6, 7, 8: Auditorium Floor Slopes (p. 1120): These are highly technical cross-sections illustrating how to calculate floor slopes to ensure sightlines. They show a datum line and plot out row-by-row riser heights in inches (e.g., 5.93", 5.78", etc.) for single-slope, double-slope, and stadium seating configurations. They visually demonstrate the concept of staggered seating reducing the required slope.
- Fig. 9: Example of "continental seating" (p. 1121): This plan view of a theater in Turku, Finland, illustrates a layout with wide row spacing (40 in.) and exit doors along the side walls, eliminating the need for center aisles.

- Fig. 11: Plan of projection room (p. 1122): A detailed plan and elevation of a projection room showing the precise layout of two projectors, a spot light, rectifiers, rewind table, film safe, and an observation port. The keyed legend identifies all electrical and mechanical components, including dimmers, amplifiers, switches, and fuse boxes.
- Figs. 12-17: Handicapped Seating (p. 1123-1124): These diagrams are crucial for accessibility compliance.
    - Fig. 12 shows a wheelchair at an aisle, highlighting how the chair's height can interrupt sightlines.
    - Fig. 13 clearly illustrates the 16" projection of a wheelchair into a cross aisle.
    - Fig. 15 provides specific dimensions for leg brace clearance (18-24 in front clearance, 24 in seat width).
    - Fig. 17 visually explains why sloping floors are bad for wheelchairs (discomfort from gravity) and recommends level areas.
- Fig. 18 & 19: 500-Seat Movie Theater (p. 1125-1126): Fig. 18 provides a complete architectural floor plan, labeling all spaces from the porch and lobby to the auditorium, stage, and mechanical rooms. Fig. 19 is a technical elevation of the projection room wall, showing the splay on projection ports and including the critical calculation schedule.
- Figs. 1 & 2: Drive-In Theaters (p. 1127): Fig. 1 shows a typical site layout, including the fan-shaped ramp area, screen, projection/snack bar building, and the circulation path for cars. Fig. 2 provides a "Typical profile," a cross-section showing how each ramp is elevated relative to the one in front to create clear sightlines from car to screen.

Calculations and Formulas

Schedule for Determination of Projection Port Height (Fig. 19, p. 1126)

This schedule provides a direct method for calculating a critical dimension in the projection room.

- Purpose: To determine the required vertical height of the projection port opening based on the angle of projection and the thickness of the projection room wall.
- Formula: This is a lookup table, not an algebraic formula.
- Variables:
    - Projection Angle: The angle measured between a horizontal line from the projector and the line to the center of the screen image height.
    - Wall Thickness: The depth of the wall the light must pass through.
    - Projection Port Height: The required vertical opening.

- Example Data from Table:
  - For a 2° projection angle and a wall up to 8" thick, the port height is 3'-10 ½".
  - For a 2° projection angle and a wall 8" to 16" thick, the port height is 3'-11".
  - For a 6° projection angle and a wall up to 8" thick, the port height is 3'-7 ½".

BOQ Implications

- Cost Estimation Factors:
  - Specialized Equipment: High-cost items include projection systems (projectors, lenses, sound heads), sound systems (speakers, amplifiers), and automated screen masking.
  - Seating: Upholstered, self-rising theater seats are a major cost per unit.
  - Acoustics: Materials for acoustic treatment of walls and ceilings are a significant cost factor.
  - Earthwork (Drive-ins): Extensive grading is required to create the ramps, representing a major construction cost.
  - Structure (Drive-ins): The large, wind-resistant screen tower is a significant structural engineering and construction cost.
- Quantity Calculation Methods:
  - Seating: Calculated by seat count.
  - Acoustic Treatment: Calculated by square footage of surface area covered.
  - Projection/Sound Equipment: Quantified by the unit/system.
  - Earthwork: Calculated in cubic yards of cut and fill.
  - Paving (Drive-ins): Calculated by square yards.

Critical Notes and Warnings

- Sightline Design is Fundamental: The text emphasizes that theater design is dictated by visual standards. The choice between one-row and two-row vision determines the floor slope, which in turn affects the entire building volume and construction cost.
- Accessibility is Code: The detailed handicapped seating requirements are not optional suggestions but are based on building codes (specifically the 1977 NC code in this reference). Aisles must be sized to accommodate wheelchair projections.

- Projection Geometry is Critical: An excessive projection angle (>10°) or improper screen curvature will cause visible distortion of the image, degrading the viewing experience.
- Drive-In Orientation: Facing the screen away from the setting sun (east or north) is a critical planning decision that directly impacts the theater's operating hours and revenue potential.

Chapter 10: Recreation and Entertainment (Part 8 of 15: Pages 1129-1137)

Overview

This section provides an in-depth analysis of the architectural and planning requirements for two major recreational facilities: Bowling Alleys and Golf Courses/Clubhouses. The bowling alley segment covers everything from site selection and parking lot design to the specific interior dimensions required for lanes, seating, and support facilities like billiard rooms, snack bars, and control counters. The golf course segment begins the discussion on the principles of course design, focusing on site selection, land area requirements, accessibility, soil conditions, and the fundamental rules for mapping a course, including par definitions and hole-length variations. The content is sourced from Brunswick Corporation's "Planning Bowling Centers" and the National Golf Foundation's "Planning and Building the Golf Course."

Key Standards and Codes Referenced

- *Planning Bowling Centers, Brunswick Corp., Chicago, Ill, 1968*: The source for the extensive data on bowling alley design, layout, and operational requirements (p. 1129).
- *Planning the Golf Clubhouse, National Golf Foundation, Inc., Chicago, 1967*: The source for clubhouse design principles (p. 1137).
- *Planning and Building the Golf Course, National Golf Foundation, Inc., Chicago*: The source for golf course layout and selection criteria (p. 1135).
- United States Golf Association (U.S.G.A.): Cited for regulations establishing par figures for men and women based on hole length (p. 1137).

Technical Specifications

Bowling Alleys

- Site Planning & Parking:
  - Parking Requirement: Seven cars per lane is the general national minimum requirement.
  - Parking Layout: Parking should be well-illuminated, paved, and drained. Blacktop is preferred over crushed stone. Wheel bumpers should be used for head-to-head parking.
  - Parking Stall Dimensions:
    - 90° Back-in: Stall width 8'-6", aisle width 22'-0", total unit depth 58'-0". Area per car 247 sq ft.
    - 60° Back-in: Stall width 8'-6", aisle width 18'-4", total unit depth 56'-0". Area per car 270 sq ft.
    - 45° Forward: Stall width 8'-6", aisle width 12'-8", total unit depth 47'-0". Area per car 282 sq ft.
- Building Dimensions:
  - Lane Installation Length: The overall length for bowling equipment installation is 83 ft-2 in. (includes pit, bed, and approach).
  - Service Aisle/Passage: A 5-ft (minimum 3-ft) clear service passage is required behind the lanes.
  - Bowler Seating Area: Requires 12 ft for settee arrangements with cluster subway returns or 9 ft minimum for standard in-line returns.
  - Column Spacing: For clear span avoidance, a minimum lateral spacing of 22 ft-6½ in. (a four-lane bay plus 1 in. clearance) is desirable to reduce noise transmission.
  - Concourse: Must be wide enough for a peak load of at least 10 people per lane.
- Pinsetter Entrance Requirements:
  - Front Entrance: Minimum clear opening of 6'-0" wide x 6'-8" high.
  - Rear/Side Entrance: Minimum clear opening of 6'-0" wide x 6'-8" high.
- Billiard Rooms (Companion Facility):
  - Cue Clearance: A minimum of 57 in. is needed between the table rail and any obstruction over 30 in. high.
  - Lighting: Requires 50 to 75 footcandles of even intensity on the playing surface (30 in. above floor). Flush ceiling-mounted fixtures or a luminous ceiling are recommended.
  - Flooring: Vinyl tile or vinyl asbestos is recommended over carpet, which wears out three times as fast.

Golf Courses

- Site Selection & Area:

    - 9-Hole Course: 50 acres is the minimum, but this involves risk from parallel holes. 80 acres is about right. Gently rolling land requires approx. 60 acres.
    - 18-Hole Course: 110 acres is the minimum (cramped). 160 acres is about right. Gently rolling land requires approx. 120 acres. Hilly/rugged land requires 140-180 acres.
- Course Mapping & Hole Lengths:
    - Ideal 9-Hole Course: Should measure over 3,000 yds, preferably around 3,200 yds, with a par of 35, 36, or 37. Typically includes two par-3s, two par-5s, and five par-4s.
    - Par-3 Holes: One should be short (130 to 160 yds), the other a long iron or wood shot (180 yds or more).
    - Par-5 Holes: One should be short (about 480 yds), the other long (520 to 550 yds).
    - Par-4 Holes: These should be varied, grading up from a minimum of 350 yds to the upper limit of 470 yds.
- Course Planning Principles:
    - Green-to-Tee Distance: Should be no more than 75 yds, with 20 to 30 yds recommended. Tees should be no closer than 20 yds to a green for safety.
    - Layout: The first tee and ninth green should be adjacent to the clubhouse.
    - Orientation: Avoid laying out holes in an east-to-west direction to prevent players from hitting into the sun. Southwest direction is particularly bad.
    - First Hole: Should be a relatively easy par-4 hole (380 to 400 yds) with minimal hazards to speed up play.

Visual Elements Analysis

- Fig. 1: Recommended Parking Dimensions (p. 1129): This diagram visually compares 90°, 60°, and 45° parking layouts. It clearly labels the key dimensions (A-G) that correspond to the data table, making it easy to understand the space efficiency of each configuration.
- Fig. 2 & Table: Bowling Lane Widths (p. 1130): Fig. 2 is a cross-section showing key dimensions of a bowling lane setup, including the 16'-2½" approach, 62'-10⅜" lane, and ball return equipment. The accompanying table is critical, providing the precise, cumulative net width required for installations ranging from 2 lanes (11'-4") to 48 lanes (266'-8¾"). It establishes a standard increment of 11'-1¾" for each additional pair of lanes.
- Fig. 3: Column Spacing Illustration (p. 1131): This simple diagram visually explains the recommended column spacing. It shows a structural column placed between two sets of four lanes, with a dimension of 4 LANES = 22'-5¼" on each side, plus a 1" clearance at the column, totaling 22'-6¼" between column centers.

- Figs. 4, 5, 6, 7: Lane Installation Plans (p. 1132-1134): These architectural plans show the evolution of a bowling facility from a small 4-lane setup to a large 36-lane entertainment center. They illustrate how as lane count increases, so does the scale of "companion accommodations" like snack bars, kitchens, lounges, and dedicated billiard rooms. They serve as excellent examples of functional space planning and circulation.
- Fig. 8: Areas of Public Occupancy (p. 1135): This is a complex functional layout for a large bowling center that includes a billiard room, nursery/playroom, cocktail lounge, and kitchen/snack bar. It serves as a master plan for integrating multiple revenue streams into a single facility.
- Fig. 1 & 2: Golf Course Layouts (p. 1136, 1137): These are exemplary golf course architecture plans.
    - Fig. 1 (p. 1136) shows a sophisticated 18-hole layout on an irregular tract, demonstrating how to use trees and doglegging to create strategic challenges. It includes a "Card of the Course" table showing the par and yardage for each hole.
    - Fig. 2 (p. 1137) illustrates a 9-hole layout with two sets of tees for each hole, effectively creating an 18-hole experience with varied shot requirements on a smaller footprint. This highlights a cost-effective design strategy.

Calculations and Formulas

U.S.G.A. Par Definitions (p. 1137)

This provides the rules for calculating the par of a golf hole based on its length.

- Men:
    - Par-3: Up to 250 yds, inclusive.
    - Par-4: 251 to 470 yds, inclusive.
    - Par-5: 471 yds and over.
- Women:
    - Par-3: Up to 210 yds, inclusive.
    - Par-4: 211 to 400 yds, inclusive.
    - Par-5: 401 to 575 yds, inclusive.
    - Par-6: 576 yds and over.

BOQ Implications

- Bowling Alleys:
    - Major Equipment: Automatic pinsetters, scorers, ball returns, and the lanes themselves are the primary cost drivers.

    - Foundation: The choice between a built-up crib foundation (for noise reduction) and a 2-by-4 stringer foundation significantly impacts cost.
    - Finishes: Specialized lighting over lanes, durable flooring (vinyl asbestos), and acoustic treatments are key line items.
- Golf Courses:
    - Land Acquisition: The single largest cost factor.
    - Earthwork and Drainage: The cost of building a course is heavily dependent on the amount of clearing, grading, and installation of drainage and irrigation systems.
    - Turf Establishment: Costs for topsoil, soil amendments, seed/sod, and the initial grow-in period are substantial.
    - Hazard Construction: Building greens, tees, and sand traps requires specialized materials (sand, peat, specific soil mixes) and labor.

Critical Notes and Warnings

- Bowling Alley Noise: Noise reduction is a critical design factor. The text recommends specific column spacing to reduce noise transmission and notes the acoustic benefits of crib foundations.
- Golf Course "No Man's Land": A critical design principle is to avoid designing par-4 holes between 251 and 350 yards, as they are considered uninteresting ("too short; after the drive nothing remains but an easy chip-shot").
- Site Selection: For both facilities, proper site selection is paramount. Bowling alleys need good visibility, access, and zoning. Golf courses need suitable acreage, good soil, and available water/power.
- Orientation for Sun: For golf courses, avoiding an east-west orientation for holes is a fundamental rule to prevent players from having to play directly into the setting sun.

Chapter 10: Recreation and Entertainment (Part 9 of 15: Pages 1138-1148)

Overview

This section completes the detailed guidance on Golf Clubhouses and then transitions to an extremely technical and safety-critical analysis of indoor and outdoor Rifle and Pistol Ranges. The clubhouse portion outlines the functional areas and circulation patterns for both private and public facilities, emphasizing the differences in operational goals (member service vs. public revenue). The rifle and pistol range segment, sourced from the National Rifle Association (NRA), provides exhaustive standards for site selection, backstop design and materials, interior safety construction (bulletproofing), ventilation, lighting, and acoustics. It includes specific material specifications, construction drawings, and data tables essential for designing safe and functional shooting facilities.

Key Standards and Codes Referenced

- *Planning the Golf Clubhouse, National Golf Foundation, Inc., Chicago, 1967* (p. 1138-1140).
- *Range Facilities Section, National Rifle Association (NRA), 1600 Rhode Island Avenue N.W., Washington, D.C.*: The primary source for all rifle and pistol range information (p. 1141).
- General Services Administration (GSA) Bulletin PBS: 3-1395 (INT): Provides federal construction standards for 45° steel plate backstops (p. 1142).
- ASTM A514, Grade B: The specified type of steel for durable backstops (p. 1142).
- *Handbook of Noise Control," McGraw-Hill Book Co.; Celotex Corp.; Gustin-Bacon Corporation*: Sources for the acoustic absorption coefficient data (p. 1147).

Technical Specifications

Golf Clubhouses (Public and Private)

- Functional Areas:
    - Social: Lounge, cocktail bar, main dining room, private dining rooms, card rooms.
    - Athletic (Golf): Men's and women's locker rooms (showers/toilets), pro shop, club/cart storage, club cleaning, attendant's station.
    - Support: Entrance/vestibule, kitchen, storage, checkroom, offices, caddie house.
- Circulation Principles:
    - Separation: A natural division must be maintained between social and athletic activities. Provide separate entrances for social guests and for golfers coming from the parking area.
    - Golfer Flow: Parking Area → Locker Room → Pro Shop → 1st Tee. And: 18th Green → Clubhouse (Pro Shop/Locker Room/Grill).
- Toilet Facilities (Social Area Standard):
    - A lookup table dictates the number of water closets based on the number of persons served.
    - 75 to 100 persons: 5 water closets.

    - 151 to 175 persons: 8 water closets.
    - Over 175 persons: Add 1 water closet for each 30 additional persons.
- Public Clubhouse Differences:
    - Focus: Essential functions are the starter's booth, golf shop, food concession (snack bar), and public toilets.
    - Optional Facilities: Locker and shower rooms are not always necessary.
    - Efficiency: Design must allow for multi-use of employees (e.g., starter also selling merchandise).

Indoor Rifle and Pistol Ranges

- Site & Building Selection:
    - Space Requirement: A room must be at least 75 ft long for a standard 50-ft range. This allows for the bullet stop, firing line, and a spectator/assembly area.
    - Structural Strength: The floor must support the backstop weight (a ½" steel plate 10'x25' weighs over 2 tons).
    - Firing Point Width: 4 ft for pistol; 5 ft (minimum) to 6 ft (preferred) for rifle.
- Backstop Specifications:
    - 45° Steel Plate with Pit:
        - Plate Thickness (Minimums): ¼ in. for standard velocity .22 caliber; ⅜ in. for .38 wadcutters; ½ in. for .45 caliber hardball.
        - Pit: Should be a minimum of 4 in. deep under the entire backstop. Can be filled with sand or water (water is preferred as it reduces lead dust and simplifies cleaning).
    - "Venetian Blind" Trap: A commercial, space-saving design (approx. 4'-0" deep) of angled louver plates. Requires manufacturer installation.
    - Backstop Steel:
        - Specification: Must be ASTM A514, Grade B heat-treated steel (or equivalent). Brinnell hardness of 321.
        - Warning: Standard SAE 1020 steel is too soft and will be damaged quickly.
        - Welding: Requires low hydrogen welding practice and low heat input to avoid impairing the steel's properties.
- Interior Safety (Bulletproofing):
    - Walls: Cinder block or brick is generally sufficient. Wooden walls must be protected with at least 2 in. of plywood, installed over furring strips to create a bullet trap.

    - Ceilings and Floors: Areas over occupied spaces must be protected. Floors require at least 2 in. of plywood. Ceilings can be covered or protected with vertical baffles that block the line of sight.
    - Service Equipment: Exposed pipes, ducts, and wiring must be protected by two thicknesses of ¾-in plywood backed by 12-gauge steel.
- Ventilation:
    - Performance: Must provide 20 to 40 complete air changes per hour.
    - Airflow: A steady, positive flow of 50 ft per minute away from the firing line toward the backstop.
    - Duct Placement: Exhaust ducts should be located over the target line and, if possible, just in front of the firing line to remove lead dust and combustion gases at their source.
- Acoustics:
    - Absorption: Use of materials with high Noise Reduction Coefficients (NRC) is critical, especially near the firing line. The provided table shows mineral fiber tile and fiberglass are highly effective.
    - Construction: Carpeting on the floor and acoustic baffles on the ceiling help break up sound reflections.
    - Noise Transmission: Seal all air leaks (e.g., weatherstrip doors) to prevent noise from escaping the range. Muffling chambers should be used for ventilation ducts.

Visual Elements Analysis

- Figs. 6 & 7: Clubhouse Circulation Diagrams (p. 1139-1140): These are functional flow diagrams, not architectural plans. They use bubbles and arrows to illustrate the logical connections between different clubhouse areas (social, golf, kitchen, parking) and the course itself. They are essential tools for initial space planning.
- Fig. 1: Indoor Range Plan (p. 1142): A complete plan and section for a 50-ft indoor range. The plan shows a club room separated from the 10-point firing line. The section is highly detailed, showing the 45° steel plate backstop, the sand pit, the trolley wire system for targets, and baffles to protect lights.
- Fig. 3: Revolver Gallery (p. 1144): A real-world example from the Minneapolis police department. It provides general notes specifying 40-50 foot-candles of light on targets and 5-10 foot-candles at the firing line. It also notes the need to protect walls from bullet splatter with ⅛" steel plates.
- Fig. 4: "Venetian Blind" Bullet Trap (p. 1145): This diagram is a crucial construction detail for an alternative backstop. The section view clearly shows how the angled steel louvers deflect bullets down into a retrieval pan. The notes provide critical dimensions for space planning (7'-0" high x 4'-0" deep).

- Fig. 5: U.S. Government Indoor Target Range (p. 1146): This is a fully integrated design. The plan shows a logical layout with storage, a ready area, and the range. The section view is the most valuable part, showing the relationship between the acoustic ceiling, suspended lighting protected by baffles, the target carrier system, and the backstop with sand pit. It is a best-practice example.
- Fig. 1: Outdoor Small-Bore Range (p. 1148): This introduces outdoor range design. The Typical Section is key, illustrating the use of a covered firing line with a translucent wind screen and, most importantly, baffles placed ahead of the firing line. The note specifies baffle construction from two thicknesses of yellow pine. These baffles are a critical safety feature to prevent shots from accidentally clearing the backstop.

Calculations and Formulas

Acoustic Coefficients of Absorption (p. 1147)

This table provides quantitative data for making material selections based on acoustic performance.

- Purpose: To compare the sound absorption efficiency of different construction materials.
- Formula: The values are Noise Reduction Coefficients (NRC), representing the percentage of sound energy absorbed.
- Variables:
    - Material: Type of building material (e.g., concrete block, plywood, mineral fiber tile).
    - Frequency (Hz): The pitch of the sound (low to high).
- Example Data from Table:
    - Plywood (⅜-in.): Absorbs only 17% of sound at 500 Hz (NRC = 0.17). It is a poor acoustic material.
    - Mineral Fiber Tile (⅝-in.): Absorbs 62% of sound at 500 Hz (NRC = 0.62). It is a good acoustic material.
    - Ultraliner Fiberglass (1-in.): Absorbs 69% of sound at 500 Hz and 93% at 2000 Hz. It is an excellent acoustic material.

BOQ Implications

- Golf Clubhouses:
    - Quantities are driven by square footage of different functional areas (lounge, dining, kitchen, lockers).
    - Major costs include commercial kitchen equipment, bar fixtures, and high-quality interior finishes.

- Rifle/Pistol Ranges:
    - High-Cost Materials: The specified ASTM A514 steel for the backstop is a premium material. Acoustic tiles and panels are also significant cost items.
    - Specialized Systems: The high-volume ventilation system (fans, ducts, possibly filters) and automated target carrier systems are major equipment costs.
    - Labor: Requires skilled labor for certified welding of the backstop, installation of specialized ventilation and target systems, and proper application of acoustic treatments.

Critical Notes and Warnings

- Backstop Safety is Non-Negotiable: The specifications for backstop steel thickness, material type (ASTM A514), and construction are minimums for safety. Use of improper materials can lead to penetration or dangerous backsplatter.
- NRA Does Not Recommend Shooting Booths: This is a strong, explicit warning based on safety concerns (obstructed view for range officers) and shooter experience (reflected muzzle blast).
- Ventilation is a Health Requirement: The specified ventilation rates are not for comfort but are a critical health measure to control exposure to airborne lead dust, a cumulative poison.
- Outdoor Range Baffles: The inclusion of baffles in the outdoor range design is a critical safety feature to prevent rounds from leaving the range, even with a proper backstop (berm) in place.
-

Chapter 10: Recreation and Entertainment (Part 10 of 15: Pages 1149-1157)

Overview

This section completes the standards for outdoor rifle ranges and provides comprehensive guidelines for specialized clay target shooting sports (trapshooting and skeet shooting). The content, sourced from military design manuals and the National Recreation Association, focuses heavily on safety, defining precise "Danger Area" and "Shotfall Danger Zone" layouts based on ammunition type. It details the specific geometric arrangements of shooting stations, trap houses, and target flight paths. The section then transitions to the planning of Marinas, outlining site selection principles, functional building relationships, circulation patterns for vehicles and pedestrians, and requirements for key facilities like launching ramps and docks.

Key Standards and Codes Referenced

- *Outdoor Sports Facilities, Departments of the Army, Navy, and Air Force, Washington, D.C., 1975*: The primary source for all technical data and drawings on outdoor ranges and marinas in this section.
- Walter L. Cook, Management Aids, Bulletin No. 35, National Recreation and Park Association, Inc., Washington, D.C., 1966: Source for the descriptive text and rules for trapshooting and skeet shooting (p. 1152).
- National Rifle Association (NRA): Cited as a source for detailed information on skeet and trap house construction (p. 1153-1155).

Technical Specifications

Outdoor Rifle and Carbine Ranges (p. 1149-1151)

- Safety Area (Danger Area Plot Plan):
    - Impact Area: Defined by a 10° angle fanning out from the firing positions.
    - Side Ricochet Area (Dimension A): The lateral distance measured from the edge of the impact area.
        - .22 Long Rifle: 250 yds.
        - Center Fire Pistol / Caliber .45: 160 yds.
    - Maximum Range + B (Dimension B): The downrange safety distance.
        - .22 Long Rifle: 1,750 yds.
        - Center Fire Pistol / Caliber .45: 1,800 yds.
- Backstop: A suitable backstop must be determined locally (typically a large earthen berm).
- Baffles: Protective baffles are required above the target line to prevent rounds from escaping the range.

Trapshooting (p. 1152-1153)

- Site Requirement: 100 yd wide by 300 yd deep. A full field requires 16 acres.
- Layout:
    - Shooting Stations: Five stations are arranged in an arc, 16 yds behind the trap house. Each station is 16 in. wide.
    - Handicap Positions: Additional firing positions are located at 1-yd intervals from 16 yds to 27 yds from the trap.

    - Target Flight: Target is thrown at varying angles (up to 47° max, 22° left/right recommended) and travels 48 to 52 yds.
- Safety Zone (Shotfall Danger Zone):
    - Minimum Cleared Area: A sector with a 100-yd radius.
    - Shotfall Danger Zone: A sector with a 300-yd radius.
- Orientation: The field should face northeast or north.
- Surfaces: Shooting stations are to be Portland Cement Concrete (PCC). The shooting area is turf.

Skeet Shooting (p. 1154)

- Site Requirement: 600 yd wide by 300 yd deep. A single field requires 29 acres.
- Layout:
    - Stations: Eight stations are arranged on a semicircle with a chord of 120'-9". Station 8 is at the midpoint.
    - Trap Houses: A "High House" (target exit height ~10 ft) and a "Low House" (target exit height ~3 ft) are located at opposite ends of the semicircle baseline.
    - Target Flight: The two targets' flight paths cross at a point 18 ft beyond station 8, at a height of about 15 ft.
- Safety Zone (Shotfall Danger Zone):
    - Minimum Cleared Area: A semicircle with a 100-yd radius.
    - Shotfall Danger Zone: A semicircle with a 300-yd radius.
- Orientation: Preferred for the centerline (station #4 to #8) to run northeast-southwest, with the shooter facing northeast.
- Surfaces: Shooting stations are PCC; walkways may be paved; the shooting area is turf.

Combination Skeet and Trap Field (p. 1155)

- Recommended Area: 30 acres for a combination field.
- Safety Zone: Contained within two superimposed segments with 300-yd radii (36 acres).
- Layout: Integrates the trap and skeet layouts to share a common general area, reducing the overall footprint compared to two separate facilities.
- Surfaces: Walkways, if paved, should be 4-in concrete reinforced with 6x6 in, No. 6 gauge welded wire fabric or bituminous.

Marinas (p. 1156-1157)

- Site Planning:
  - Orientation: Building should be located to be safe from flooding/storm damage. The lounge should have a view of the water but be protected from late afternoon sun glare.
  - Launching Area:
    - Slope: Must be a constant slope between 12 and 16 percent.
    - Water Depth: A minimum water depth of 4 ft is required to launch a boat from a trailer.
    - Capacity: Each ramp can handle approximately 40 launchings per day.
- Parking:
  - Car/Trailer Spaces: Must be provided in addition to normal parking. Each space should be a minimum of 10 ft wide and 40 ft long.
  - Ratio: Combination spaces should normally not exceed 30 percent of the total parking.
- Docking Facilities:
  - Floating Docks: Preferred where water level fluctuates more than 1.5 feet.
  - Roofed Docks: Preferred for rental motor boats to reduce weather damage and maintenance.
- Building Construction: A one-level building is preferred. Heavy flooring and framing are required for boat-repair spaces to support motors and overhead cranes.

Visual Elements Analysis

- Fig. 1 (cont.): Small-bore rifle and carbine ranges (p. 1149): The "DANGER AREA PLOT PLAN" is a critical safety diagram. It uses a plan view with angles and arcs to visually define the total hazard footprint of the range, extending far beyond the physical backstop. The accompanying table provides the specific distances (A and B) for this calculation based on ammunition type. The perspective and section views show the use of earthen berms as backstops and side walls.
- Fig. 2 (cont.): Pistol ranges (p. 1151): This page provides the specific "DANGER AREA PLOT PLAN" for pistol calibers, again linking a diagram of the safety zones to a table of required distances. This reinforces the principle that every range design must start with a safety area analysis.
- Fig. 1: Trap field (p. 1153): This set of diagrams clearly explains the layout of a trapshooting facility. The "TRAP FIELD LAYOUT" shows the arc of the five shooting stations and the 16 to 27 yd handicap lines. The "SHOTFALL DANGER

ZONE" diagram is a simplified plan showing the required 100 yd cleared area and 300 yd total danger zone.
- Fig. 2: Skeet field (p. 1154): The "SKEET FIELD LAYOUT" is a detailed plan showing the precise geometric relationship of the 8 shooting stations, the High House, the Low House, and the target flight paths. The "SHOTFALL DANGER ZONE" diagram shows the required 300-yard semicircular safety area.
- Fig. 1: Diagram of marine buildings (p. 1156): This is a functional "bubble diagram" that illustrates the relationships and circulation paths between different marina functions. It uses different arrow types to distinguish between primary circulation (e.g., Office to Lounge), secondary circulation (e.g., Lounge to Restrooms), and optional functions (e.g., connection to a covered work area). It is a vital tool for preliminary space planning.
- Fig. 2: Marina site diagram (p. 1157): This diagram shows the macro-level site plan, illustrating the flow from the main road to parking, the central building, the launching area, and out to the docks. It visually separates vehicular circulation from pedestrian and boat traffic.

Calculations and Rules

Danger Area Calculation Rules (p. 1149, 1151)

- Purpose: To define the total potential hazard area downrange and to the sides of a firing line.
- Procedure:
    - Define the Limit of Fire / Impact Area by drawing lines at a specified angle (e.g., 5° left and right of the range centerline, creating a 10° total angle).
    - Define the Side Ricochet Area by measuring a distance "A" outward from the Limit of Fire lines.
    - Define the Maximum Range by drawing an arc with a radius equal to the maximum travel distance of the projectile plus a safety factor "B".
- Variables:
    - A: Side Ricochet Distance (e.g., 160 yds for .45 cal).
    - B: Max Range Safety Factor (e.g., 1800 yds for .45 cal).

BOQ Implications

- Earthwork: A massive cost driver for outdoor ranges and marinas. Ranges require the construction of large earthen backstops and side berms. Marinas require significant grading for launching ramps and parking lots.
- Specialized Equipment:

    - Ranges: Automated trap and skeet machines, target carriers, and control systems are major line items.
    - Marinas: Dock systems (floating or fixed), boat hoists/cranes, and fueling systems are significant capital costs.
- Paving: Large areas of concrete (PCC) for shooting stations and asphalt or reinforced concrete for walkways, parking lots, and launch ramps are required.
- Fencing and Signage: Extensive fencing and clear warning signage are mandatory for all shooting ranges to control access and warn of danger, representing a significant quantity of materials.

Critical Notes and Warnings

- Danger Zones are Mandatory: The "Danger Area" and "Shotfall Danger Zone" plans are the most critical element of any shooting range design. The safety of the public and surrounding property depends on adhering to these minimum required distances.
- Separation of Activities: For marinas, separating vehicular traffic (especially cars with trailers) from pedestrian areas and other functions is a key principle for safe and efficient operation.
- Water Level Fluctuation: The choice between fixed and floating docks in a marina is critically dependent on the expected change in water level. A poor choice leads to unusable or damaged facilities.
- Environmental and Legal: For marinas and ranges near water, local regulations regarding construction near water, runoff, and environmental impact must be thoroughly investigated. For shooting ranges, fencing and posting warning signs are critical for liability and safety.

Chapter 10: Recreation and Entertainment (Part 11 of 15: Pages 1158-1168)

Overview

This extensive section transitions from traditional sports facilities to the complex design of public attractions: Zoos, Marinas, and Aquariums. The Zoo planning section, authored by Laurence Curtis, introduces the core concepts of zoo design, categorizing them by theme (Systematic, Zoogeographic, Habitat, Behavioral, Popular) and outlining the fundamental design factors for grounds and animal exhibits. The Marina section, by Charles A. Chaney, provides highly technical standards for designing offshore structures, focusing on slip clearances, widths, and catwalk dimensions based on boat size. Finally, the Aquarium design section introduces the initial planning concepts, emphasizing visitor flow, operational needs, and the layout of tank galleries.

Key Standards and Codes Referenced

- *Zoological Park Fundamentals, American Association of Zoological Parks and Aquariums*: Source for the principles of zoo planning and design (p. 1158).
- *Marina Recommendations for Design, Construction, and Maintenance, 2d ed., National Association of Engine and Boat Manufacturers, Inc.*: The primary source for all technical data and drawings on marina slip and catwalk design (p. 1158).
- *Aquarium Design Criteria, Drum & Croaker, National Fisheries Center and Aquarium, U.S. Department of the Interior*: Source for aquarium planning concepts (p. 1166).

Technical Specifications

Zoos (p. 1158-1162)

- Display Themes:
    - Systematic: Animals grouped by taxonomic relationships (e.g., all cats together).
    - Zoogeographic: Animals grouped by geographic origin (e.g., African, Asian).
    - Habitat/Ecological: Animals and plants from a specific environment (e.g., rainforest, desert) are shown together.
    - Behavioral: Exhibits designed to showcase specific animal behaviors (e.g., nocturnal animals in darkened buildings, flying, swimming).
    - Popular: A collection of popular animals (elephants, lions, monkeys) without a specific scientific theme, common in smaller zoos.
- Grounds Planning:
    - Walks: Must be permanent, non-skid material. Ramps are preferred over steps. Width must be adequate for both walking and viewing.
    - Transportation: Systems like tractor buses, trains, or monorails should be planned from the outset.
    - Barriers: Guard rails, low fences, hedges, and spiny plantings are used to maintain safe visitor distance. The least conspicuous effective barrier is preferred.
    - Perimeter Fence: Essential for visitor control, grounds security, and containment of escaped animals.
- Animal Exhibit Design Factors:

    - Shape: Acute corners in enclosures must be avoided to prevent animals from being trapped.
    - Orientation: The greatest dimension should parallel the public viewing area. Glare must be avoided. Sun exposure must be controlled based on the animal's needs.
    - Materials: Must be non-porous, durable, non-toxic, and easy to maintain.
    - Shift Cages: Enclosures must be designed to allow animals to be easily shifted to an adjacent holding area without being caught or restrained. A "squeeze cage" with a movable wall is a key feature for veterinary access.

Marinas (p. 1158-1162)

- Clearance Principles:
    - Clearances are relative values and should be liberal when space permits, but must be sufficient to prevent boat damage from wind, tides, and maneuvering.
    - Slips with traveler irons can have smaller clearances than those with only cleats.
- Slip Clearances and Dimensions (from Fig. 4 table):
    - Min. Clear Width of Slip (Total): Varies from 8'-10" for a boat under 14' to 24'-11" for a boat 70'-80'.
    - Allowance for Half Fender Pile: Typically 1'-0" to 2'-0" depending on boat size.
    - Gross Slip Width (Type 'A' - single slip): Varies from 10'-9" (for <14' boat) to 26'-7" (for 70-80' boat).
- Catwalk Dimensions:
    - Usable Width: 2'-0" is standard for boats up to 60'. 4'-0" width is required for larger boats (60'-80').
    - Length: Typically two-thirds the length of smaller slips, up to a 34'-0" length for boats 50 ft or longer.

Aquariums (p. 1166-1168)

- Planning Concept:
    - Modern aquariums focus on educational recreation, grouping specimens by themes (environment, locomotion, food habits) rather than just a lineup of tanks.
    - At least 60 percent of the total project cost will be for non-visible facilities, equipment, and design.

- Site & Water Supply:
  - Site must be readily accessible with adequate parking.
  - Water supply is the most vital factor. Its quality and volume must be professionally assessed before design proceeds.
- Visitor Flow & Layout:
  - A flow pattern is desirable. Visitors typically turn right upon entering.
  - Tanks should be placed at angles and in alcoves to avoid monotony and create "surprises."
  - Handrails should be placed about 3 ft from the viewing glass.
  - A step-up for children (approx. 1 ft high x 1 ft wide) should be provided.
- Operations Area:
  - The work-area floor should be about 3 ft higher than the public area floor.
  - A clear passageway about 6 ft wide is needed behind display tanks for transport.
  - Holding Tanks for quarantine and surplus specimens should have a total capacity of about one-third of the display volume.

Visual Elements Analysis

- Fig. 1: Five basic display arrangements (Zoo) (p. 1159): This is a set of conceptual bubble diagrams illustrating the five main zoo planning themes.
  - Systematic: Shows related animal groups clustered (Pachyderm, Feline, Bears).
  - Zoogeographic: Organizes the zoo by continent (North America, South America, Africa).
  - Habitat: Groups animals by environment (Rain Forest, Grasslands, Desert).
  - Behavioral: Groups by function (Swimming, Flying, Burrowing).
  - Popular: A mix of high-interest animals (Elephant, Lion, Giraffe) without a strict theme.
- Fig. 2: Barriers (Zoo) (p. 1162): A series of isometric sketches showing different methods of animal containment.
  - Physical: Fencing, Rails, Bars, Vertical Wires.
  - Topographical: Dry Moat, Wet Moat.
  - Architectural: Glass (tilted to eliminate reflection).
  - Environmental: Thermal (freezer coils for a python), Psychological (a darkened visitor area for birds).
- Fig. 1: Component of seashore facilities (Marina) (p. 1159): A detailed architectural site plan showing the layout for two types of marinas: "Development for Club Type Marina" and "Development for Commercial Use." It includes parking layouts, building footprints for social and service buildings, and the

arrangement of piers and dry storage sheds. The legend provides a key to 38 different room functions, from snack bars to engine shops.

- Fig. 2: Arrangement providing both commercial and social activities (Marina) (p. 1160): A large-scale site plan showing a fully integrated marina with a hotel, social building, pool, and multiple piers. It provides specific dimensions for piers (e.g., Pier 4 is 48'-0" wide), slips, and a service yard. It serves as a master plan example.
- Fig. 3: Required slip widths for various boat lengths (Marina) (p. 1161): A critical graph plotting "Length of Boat in Feet" against "Beam of Boat in Feet". It contains three curves:
  - Curve A: Maximum beam for inboard power boats.
  - Curve B: Beam modification for sailboat hulls.
  - Curve C: Distance center-to-center of fender piles. This curve is the basis for determining the required slip width.
- Fig. 4: Dimensions for Slips and Catwalks (Marina) (p. 1162): The most technical diagram in this section. It is a plan view of a pier layout with key letters corresponding to a large data table. The table provides the precise dimensions required for designing slips for boats from under 14 ft to over 80 ft. It specifies minimum clear width, allowance for fender piles, gross slip width, catwalk width, and total length. This is a primary engineering and design tool.
- Fig. 1: Visitor's flow pattern (Aquarium) (p. 1166): A conceptual diagram showing how angled tanks and open-floor exhibits can be used to guide visitors naturally along a desired path, preventing random wandering and improving the narrative experience.
- Fig. 2: Plan of tank gallery (Aquarium) (p. 1166): A detailed architectural plan of a public gallery space. It shows the arrangement of display tanks of various sizes, the public walkway, a central open-floor "Giant Tank," and the behind-the-scenes service passage.

BOQ Implications

- Zoos:
  - Earthwork and Containment: Major costs are associated with creating moats (dry or wet), artificial rockwork (sprayed concrete grottos), and extensive, secure fencing.
  - Specialized Life Support: HVAC, lighting (including UV), and filtration for specialized habitats (e.g., nocturnal houses, aquatic exhibits) are high-cost systems.
- Marinas:

    - Marine Construction: The primary cost is the construction of piers, piles, docks, and breakwaters. Materials must be marine-grade. Floating dock systems are a major capital expense.
    - Dredging: If required to achieve necessary water depths, dredging is an extremely expensive and highly regulated process.
- Aquariums:
    - Life Support Systems (LSS): The pumps, filters, piping (must be non-metallic), and water treatment systems are the single largest cost. This is a highly specialized MEP (Mechanical, Electrical, Plumbing) scope.
    - Tank Construction: Large display tanks, especially those with thick acrylic viewing panels, are very expensive.
    - Finishes: Public areas require durable, water-resistant finishes. Back-of-house areas require specialized coatings and drainage.

Critical Notes and Warnings

- Zoo Design Requires Expertise: The text stresses that designing a successful zoo exhibit requires deep knowledge of animal biology and behavior to meet the animal's needs first. A zoo architect must work closely with animal experts.
- Marina Clearances are Safety-Critical: Insufficient clearance in slips and channels will lead to costly damage to boats and the marina structure itself. The provided dimensions are minimums and should be increased if local conditions (strong winds/currents) dictate.
- Aquarium Water Quality is Paramount: The text strongly warns that "perfectly potable fresh water or seawater...may be deadly to fishes and aquatic invertebrates." The water supply must be professionally tested and the entire water system must be built of chemically inert materials to avoid poisoning the animals.
- The "Invisible" Costs: The aquarium text explicitly states that 60% of the project cost is for "behind-the-scenes" facilities. This is a critical warning for budget planning, as promoters often underestimate the cost of the complex operational infrastructure required

Chapter 10: Recreation and Entertainment (Part 12 of 15: Pages 1169-1175)

Overview

This section delves into the highly specialized and technical aspects of aquarium design, focusing on water quality management, water systems engineering, and the construction of display tanks. Authored by James W. Atz of the American Museum of Natural History, it provides a scientific explanation of the chemical and biological processes that govern a closed aquatic environment. The text details the critical need for chemically inert materials, the process of biological filtration (the nitrogen cycle), and the various types of water circulation systems. The section concludes with standards for indoor tennis buildings, covering capacity, site selection, building dimensions, and court surface considerations.

Key Standards and Codes Referenced

- James W. Atz, Associate Curator, The American Museum of Natural History: Authored the text on water quality, water systems, and display tank design for aquariums (p. 1169).
- *Community Tennis Facilities Operations, Robert M. Artz, National Recreation and Park Association, Inc., Arlington, Virginia, 1972*: Source for all information on indoor tennis buildings (p. 1175).

Technical Specifications

Aquariums (Water Quality & Systems)

- Water Quality - Chemical Purity:
  - Rule: All aquaria and parts of water systems must be made of chemically inert materials.
  - Toxicity: Even minute amounts of dissolved metals can be lethal. Copper at 2 parts per hundred million can kill fish. Pesticides like Endrin are toxic at less than 1 part per billion.
  - Troublemakers: Common contaminants in municipal tap water include chlorine, excessive hardness, and metals from brass or galvanized piping.
- Water Quality - The Nitrogen Cycle:
  - Ammonia: The principal waste product of fishes and invertebrates. It is exceedingly toxic.
  - Biological Filtration: The only economical way to remove ammonia is through oxidation by nitrifying bacteria, which convert toxic ammonia into much less harmful nitrate.
  - Filter Bed Function: The primary function of a filter bed (sand, gravel) is to provide a massive surface area for colonies of nitrifying bacteria to grow.
- Water Systems:
  - Open System (Use and Waste): Requires a continuous supply of excellent, disease-free water. Turnover rate for a typical tank is one volume every 1 to 2 hours.

- Closed System (Recirculating):
    - Water Replacement: Desirable to replace at least 10 percent of fresh water and 40 percent of salt water each month to prevent buildup of nitrates and other inhibiting substances.
    - Individual Systems: Each display tank has its own dedicated recirculating system with a biological filter.
    - Total System: Water from all tanks overflows to central reservoirs, is filtered, and then pumped back. This poses a risk of spreading disease.
- Display Tanks:
  - Materials: For tanks up to 2,000 gal, fiberglass or plastic-impregnated plywood are satisfactory. For larger tanks, reinforced concrete or steel is required.
  - Construction: Concrete tanks must be independent units, not integral parts of the building structure, to allow for removal/replacement. They must be coated with an epoxy sealer.
  - Reinforcement: Monel reinforcing bars are preferred over standard steel to prevent corrosion from seawater.

Indoor Tennis Buildings

- Capacity: A facility generally has a capacity of 125-150 members per court.
- Building Dimensions:
  - Clear Length: 120 ft in the clear to accommodate the court and space behind the end lines.
  - Wall Height: The walls behind the courts should be a minimum of 16 ft high.
  - Ceiling Height: The center of the building over the net should be a minimum of 35 ft in the clear.
- Layout:
  - It is more economical to place courts side-by-side if there are less than six.
  - A side-court control point is preferred for supervision.
- Safety: Any structural members projecting into the playing area should be padded with foam rubber or other shock-absorbent material from a point 18 in above the floor to a point 6 ft above the playing surface.
- Court Surfaces:
  - All surfaces used outdoors can be used indoors.
  - Porous courts (e.g., clay) require the addition of moisture daily, which can create humidity and condensation problems in cold climates.

    - Nonporous cushioned courts cannot be used for any other purposes besides tennis.
- Lighting:
    - Intensity: Should be above 50 foot-candles for tournament/club play and above 30 foot-candles for recreational play.
    - Type: Incandescent, fluorescent, mercury vapor, or quartz fixtures may be used.
- Ventilation: Should meet local building codes. If no code exists, ½ to 1 air change per hour is considered good practice.
- Interior Finishes:
    - Ceiling: Should be a light color.
    - Background: The background behind the courts should be a medium or dark color for 8 to 10 ft above the playing surface to provide good ball visibility.

Visual Elements Analysis

- Fig. 3: Cross section through coral reef tank (p. 1169): A detailed architectural section showing a large, deep public display tank. Key features include the public viewing area with a handrail, the elevated work area behind the tank (+9'-0" relative to the public floor), and the realistic, irregular coral formations inside the tank. It visually demonstrates the scale and complexity of a major aquarium exhibit.
- Fig. 4: Aquarium Water System Diagram (p. 1170): This is a critical process flow diagram illustrating a closed-loop water system. It shows water moving from the "Gallery Tanks" to a "Giant Tank," then through "Sand Filters" and an "Diatomaceous Earth Filter" to a "Storage Tank." Pumps move the water between stages, and an "Aeration & Storage Tank" is shown at the top, highlighting the need for gas exchange.
- Fig. 5: Simplified diagram of the aquarium water system (p. 1171): This diagram shows the system from a different perspective, integrating it with the building. It illustrates the flow from the "EXHIBITION CORRIDOR" to a "RESERVOIR," then through a "PUMP" and a "ULTRAVIOLET STERILIZER" before returning. It also includes an "AERATION TOWER" and a "HEATING AND COOLING RESERVOIR," showing the full scope of water treatment and conditioning.
- Fig. 6: Typical vanishing side wall tank installation (p. 1172): A set of drawings (plan, top view, section) illustrating a specific tank design technique. The "vanishing side wall" uses angled rockwork to obscure the side walls of the tank from the viewer's perspective, creating a more natural and less box-like appearance. The section view shows how the viewing glass is set back from the rockwork and supported by a deck.

- Fig. 7: Aquarium Work Area Section (p. 1173): This drawing provides a detailed cross-section of the public gallery and the operational service gallery behind it. It clearly shows the 3'-0" height difference between the public floor and the work floor. It details the "Lightweight gallery" (catwalk) used to support pipes and lighting over the tanks, the 6'-0" width of the service passage, and the use of a trench drain in the work area floor.
- Fig. 8: Ocean Shore and Beaver Pond Sections (p. 1174): These are conceptual cross-sections of large, naturalistic habitat exhibits. The "ocean shore tank" shows a wave generator creating a dynamic water environment. The "beaver pond" section illustrates a typical temperate freshwater habitat. They emphasize the trend toward creating immersive, ecosystem-based displays.

BOQ Implications

- Aquariums:
    - Piping, Valves, and Pumps (MEP): This is a massive cost. All piping must be non-metallic (PVC, etc.), and all pumps and valves must be specified for saltwater service, which is a significant cost premium. Quantities are extensive, measured in linear feet of pipe by diameter.
    - Filtration Media: Large quantities of specialized sand, gravel, and diatomaceous earth are required, measured by the cubic yard or by weight.
    - Acrylic Panels: Viewing panels for large tanks are custom-fabricated, extremely thick, and very expensive. This is a major specialty line item.
    - Epoxy Coatings: All concrete surfaces in contact with water must be coated with a two-part epoxy sealer. This is calculated by the square foot and is a specialized application.
- Indoor Tennis:
    - Building Shell: The primary cost is the long-span structure required to create the 120 ft clear length and 35 ft clear height. This can be a pre-engineered metal building or a custom steel/wood frame.
    - Specialized Lighting: The high-intensity, shielded lighting system is a major electrical cost.
    - Court Surfacing: The cost varies significantly depending on the type (e.g., cushioned hard court, synthetic grass, clay), calculated by the square foot.

Critical Notes and Warnings

- Aquarium Chemistry is a Science: The text makes it clear that aquarium management is not just about keeping tanks clean; it is about actively managing a complex biomechanical system. Ammonia must be converted to nitrate via

biological filtration, and pH must be managed. Failure to do so will result in animal death.
- Material Inertness is Non-Negotiable: For aquariums, the warning that even a single metallic fixture can poison an entire system is paramount. This has huge implications for specifying every single component that touches the water.
- Disease Control in Closed Systems: A key warning for "total recirculation" systems is the high risk of rapidly spreading disease from one tank to all others. This makes individual or smaller zoned systems, despite higher initial costs, a safer long-term choice.
- Indoor Tennis Environmental Control: The text warns that using porous courts (which require moisture) indoors can lead to significant humidity and condensation problems, potentially damaging the building structure itself. This requires careful coordination between the court type and the HVAC system design.

Chapter 10: Recreation and Entertainment (Part 13 of 15: Pages 1176-1184)

Overview

This section focuses entirely on the architectural planning and design of large-scale, multipurpose Sports Arenas. Authored by Robert L. Knapp, AIA, of Charles Luckman Associates, it provides a comprehensive framework for designing these complex venues. The section breaks down the design process into three primary sets of requirements: general planning, spectator needs, and operational management. It covers the determination of seating capacity, explores various plan configurations (e.g., straight-row, curved-end, elliptical), and delves into the critical geometry of sightlines and seating tiers. This part is highly conceptual and strategic, providing the foundational principles that guide the detailed design of an arena.

Key Standards and Codes Referenced

- Robert L. Knapp, AIA, Charles Luckman Associates, New York: The author of the entire section on Sports Arenas. The content is presented as professional architectural guidance rather than referencing specific building codes, though it advises checking local codes.

Technical Specifications

General Planning Requirements

- Projected Uses: The design must accommodate a variety of events beyond a primary sport. Common uses include:
    - Ice Hockey, Basketball, Boxing/Wrestling, Indoor Track, Tennis, Circus, Rodeo, Concerts, Stage Events, Conventions, Exhibitions.
- Seating Capacity Factors:
    - Professional Franchises: Hockey and basketball leagues require arenas of 15,000 to 18,000 seats for new franchises.
    - College/University: Typically warrant a smaller capacity of 12,000 to 15,000 seats.
    - Viewing Distance Limitation: The practical limit for normal visual acuity is a radius of 200 ft from the center of action. This physical constraint limits maximum capacity to 20,000 to 22,000 seats.
    - Seating Height Limitation: The combined effect of sightline angles and building code limits on riser heights restricts the maximum seating height to 65 to 70 ft above the floor.
- Plan Configurations:
    - The design must choose a basic seating plan form. Four are discussed:
        a. Straight Rows Ends and Side: Simple, economical, but creates poor viewing angles ("picket fence effect") for seats far to the side of the action.
        b. Straight-Row Sides and Curved-Row Ends: The most common form. Improves end-zone viewing but retains some side-viewing issues.
        c. Circular Seating: Appears optimal for a small central event (like boxing) but becomes highly problematic for a rectangular rink. To clear an 85 x 200 ft hockey rink, the first row of seats would need a radius of about 110 ft, creating a huge void between side seats and the action.
        d. Elliptical-Row Seating: The "optimum plan shape." Best adapts a curved-row configuration to a rectangular hockey rink, minimizing lateral head movement for all spectators.
- Sightline Geometry:
    - "Picket Fence Effect": A critical viewing problem in straight-row seating where spectators' heads in preceding rows block the view of action at the far ends of the playing surface. Curved-row plans are superior because they minimize this effect.
    - Two-Row Vision: It is impractical to provide one-row vision (seeing over the head of the person directly in front). Design is based on seeing

between the heads of people in the row directly in front, and over the heads of everyone two or more rows ahead.
    - Spectator Eye Level: Assume a seated eye level of 3 ft 11 in. above the tread elevation.
    - Arrival Point of Sight (APS): For hockey, the APS should be the top edge of the near dasher (3 ft 6 in. above ice level).
- Truck Access:
    - Vomitories at least 10 ft wide and 14 ft high must be provided for large truck access to the playing floor. Two are preferred for events like the circus.
    - An opening is required at one end of the floor for the 20-yard overrun needed for indoor track dash events.

Visual Elements Analysis

- Figs. 1 & 2: Hockey and Basketball Layouts (p. 1176): These are plan views showing the basic footprint of the two primary sports that dictate arena design. They show how the rectangular ice surface and basketball court fit within the larger seating bowl.
- Fig. 3 & 4: Circus and Track Layouts (p. 1177): These plans show how other events fit within the arena. The circus layout shows three rings. The track layout illustrates an 11 lap per mile track with space for "Dashes" and "High Jump" in the infield and a "Pole Vault" area.
- Figs. 5 & 6: Stage and Boxing Layouts (p. 1177-1178): These show end-stage and center-stage configurations. The boxing layout (Fig. 6) is a classic "theater-in-the-round," demonstrating how a small central event utilizes the space differently than a large rectangular one. The letters (A, B, C) denote different seating price zones.
- Fig. 7: Arena Plan Configurations (p. 1178): This is the most important conceptual diagram in the section. It presents four distinct plan forms:
    - Straight Rows: A simple rectangle. A sightline is drawn from seat "X" to the far goal, illustrating the extreme viewing angle.
    - Straight Sides, Curved Ends: A rectangle with rounded corners. A sightline from seat "Y" shows an improved viewing angle.
    - Composite "Squashed" Shape: An intermediate form between 2 and 4.
    - Elliptical/Circular: Shows a fully curved seating bowl around the hockey dasher.
- Fig. 8: The Forum, Inglewood, California (p. 1179): An architectural plan of a real-world example of the elliptical-row seating configuration. It clearly shows the circular outer wall and the elliptical seating bowl inside, along with the location of vomitories and the fixed bulkhead.

- Fig. 9: Balcony (p. 1180): A schematic plan and section illustrating how a balcony tier is added. The section view is critical, showing the relationship between the main seating tiers and the balcony, the arrival point of sight (APS) at the dasher, and the different floor levels required for hockey vs. basketball.
- Figs. 10 & 11: Vomitory Types A & B (p. 1181-1182): These are detailed plan and section views of egress paths.
    - Type A shows a vomitory where the access stairs flank the main passage, minimizing congestion at the crossover aisle.
    - Type B shows a less desirable option where stairs empty directly into the main traffic path. These diagrams are critical for planning crowd movement.

Calculations and Formulas

This section does not contain explicit mathematical formulas but provides the geometric rules and assumptions for calculating seating tiers and sightlines.

Sightline Calculation Procedure (Graphical Method)

- Purpose: To determine the riser height for each row of seats to ensure an unobstructed view.
- Assumptions:
    i. Seated spectator eye level = 3 ft 11 in. above their tread.
    ii. Top of spectator's head = 5 in. above eye level.
- Procedure:
    i. Establish the Arrival Point of Sight (APS) on the playing floor (e.g., top of hockey dasher).
    ii. Assume a tread height for the first row of fixed seats.
    iii. Draw a line from the APS, just clearing the head of the spectator in the first row.
    iv. Extend this line to the position two rows back. The point where this line intersects the vertical plane of the third-row spectator's eyes determines the required eye-level height for that row.
    v. Subtract the assumed eye-level height (3 ft 11 in.) from this calculated height to find the required tread height for the third row.
    vi. The second row tread is placed midpoint between the first and third.
    vii. Repeat this process for each successive row, working from the bottom up. The riser height will increase with each row, creating a parabolic or "dished" profile.

BOQ Implications

- Structural System: The primary cost driver. A long-span roof system (trusses, space frames, cable-suspended) is required to create the column-free space. The choice of structural system dictates many other aspects of the design.
- Concrete Work: Extensive quantities of precast or cast-in-place concrete are required for the seating treads and risers. The complexity of the parabolic curves can increase forming costs.
- Seating: A major per-unit cost. For an 18,000-seat arena, the seating package is a multi-million dollar item.
- Specialized Equipment: Hockey dasher boards and glass, basketball floors, rigging grids, and the central scoreboard/speaker cluster are all major, high-cost specialty items.

Critical Notes and Warnings

- The "Picket Fence Effect" is Real: The text strongly warns against using purely straight-row seating in large arenas, as it creates genuinely poor and uncomfortable viewing conditions for many spectators.
- Plan Configuration is a Primary Decision: The choice between a rectangular, curved-end, or elliptical plan is one of the earliest and most consequential decisions in the design process, affecting cost, structure, and spectator experience.
- Capacity is Limited by Sight, Not Just Space: The text makes a crucial point that a 200 ft viewing radius is a practical limit. Pushing capacity beyond what this allows will result in a significant number of seats with poor visual quality, which may be difficult to sell.
- Cost vs. Quality Trade-off: The author warns that it is a "shortsighted decision to hold on to capacity at the sacrifice of material and systems quality," which leads to higher long-term operating and maintenance costs.
- Crowd Movement and Egress: The detailed discussion of vomitories, crossovers, and aisle spacing highlights the critical importance of life safety and crowd control in arena design. These elements are heavily regulated by local building codes.

Chapter 10: Recreation and Entertainment (Part 14 of 15: Pages 1185-1198)

Overview

This section concludes the detailed guide on Sports Arenas and begins a highly technical chapter on Swimming Pools. The arena content focuses on operational requirements, including administrative offices, ticketing, storage, and locker rooms, culminating in a detailed space allocation table for a real-world example (The Forum). The swimming pool section, prepared by the National Swimming Pool Institute (NSPI), establishes a clear set of definitions and classifications for public pools. It provides extensive technical standards for structural design, materials, markings, safety equipment, and the precise dimensional requirements for various pool types, including competitive diving pools. The section also includes architectural plans for large-scale recreational pools.

Key Standards and Codes Referenced

- Robert L. Knapp, AIA, Charles Luckman Associates, New York: Author of the Sports Arenas section.
- National Swimming Pool Institute (NSPI): Prepared the minimum standards for Public and Residential Swimming Pools (p. 1193-1197).
- American Water Works Association (AWWA): Referenced for standards regarding potable water supply installation to swimming pools (p. 1197).
- ASME (American Society of Mechanical Engineers): 1956 specifications are cited for the fabrication of noncode pressure vessels for sand filter tanks (p. 1197).
- *Definitive Designs for Naval Shore Facilities, Department of the Navy, Washington, D.C., 1972*: Source for the 50-meter and 25-meter recreational pool plans (p. 1196, 1198).

Technical Specifications

Sports Arenas (Operational Requirements)

- Seating: Recommended width is 19 in. to 23 in. center-to-center. Seats should be self-rising with perforated acoustical treatment on the seat bottoms.
- Concessions/Toilets: Must be located for convenient access from promenades. Counter areas should be recessed to prevent patron lines from blocking circulation.
- Scoreboard: Can be center-hung (often combined with a speaker cluster) or wall-mounted (requiring at least two units for visibility).
- Locker/Dressing Rooms:
    - Permanent facilities are required for home teams (e.g., hockey and basketball).
    - Hockey dressing areas should be larger than basketball due to larger team size and more cumbersome equipment.
    - Separate, smaller rooms are needed for visiting teams and individual performers/officials.

- Storage: Large bulk storage is required for:
  - Temporary seating and riser platforms.
  - Hockey dasher boards and glass.
  - Basketball floor and goals.
  - Indoor track sections.
- Television Broadcasting: Camera locations needed at high-center-ice and low-level positions. A dedicated room for the remote truck or a permanent TV monitor room is required.

Public Swimming Pools (NSPI Standards)

- Pool Classifications:
  - Type "A": Municipal, community, public school, athletic club pools.
  - Type "B": Institutional pools (Scouts, YMCA, etc.).
  - Type "C": Large hotels (>100 units), country clubs, with pools > 1600 sq ft.
  - Type "D": Motels, apartments, small hotels (<100 units), pools < 1600 sq ft, not open to the general public.
  - Type "E": Treatment and therapeutic pools.
  - Type "F": Indoor pools.
- Structural & Material Requirements:
  - Structural Stability: Must be designed to withstand all anticipated loads (full or empty) with a factor of safety of not less than 2.5.
  - Wall & Floor Finish: Must be of masonry, tile, or other inert and impervious material. Finish must be moderately smooth and of a white or light color.
- Dimensions and Slopes:
  - Shallow Depth: Minimum depth of 3 ft, maximum of 3 ft 6 in.
  - Floor Slope (Shallow Area): Not greater than 1 ft of slope in 12 ft (exceptions for small Type B pools).
  - Vertical Wall Depth: Walls must be vertical for a minimum depth of 2 ft 6 in.
- Safety and Egress:
  - Obstructions: A completely unobstructed clear distance of 13 ft must be maintained above any diving board.
  - Ladders: Provide a minimum of one ladder for each 75 ft of perimeter.
  - Lifeguard Chairs: One elevated chair is required per 2,000 sq ft of pool surface area.
  - Walks: Must be continuous around the pool. Minimum width is 8 ft (exceptions for pool types B, C, D, E, F, which require 4 ft). Minimum slope of ¼ in. per foot. Must be non-slip.
  - Fencing: A 4 ft minimum height enclosure with a maximum mesh of 2 in. is required around the entire pool area.

Diving Pools (NSPI Standards)

- Depths and Clearances (from table on p. 1195):
  - 1-Meter Springboard:
    - Water Depth below board end (I): 10' min.
    - Water Depth at 12' in front (J): 9' min.
    - Clear Overhead Height above board (G): 12'.
  - 3-Meter Springboard:
    - Water Depth below board end (I): 11½' min.
    - Water Depth at 12' in front (J): 10' min.
    - Clear Overhead Height above board (G): 12'.
  - 10-Meter Platform:
    - Water Depth below board end (I): 15' min.
    - Water Depth at 35' in front (J): 14' min.
    - Clear Overhead Height above board (G): 12'.

Residential Swimming Pools (NSPI Standards)

- Wall Slopes: To a depth of 5 ft, wall slope shall not be more than 1 ft horizontal in 5 ft vertical.
- Floor Slopes: Shall not exceed 1 ft vertical to 7 ft horizontal in the shallow end.
- Filter System: Must be capable of filtering the entire pool contents in 18 hours or less, at a maximum filter rate of 5 gallons per minute per sq ft of filter area.
- Piping Test: The entire pool piping system shall be tested with a water test of 50 psi and proved tight.

Visual Elements Analysis

- Fig. 12: Dressing rooms (Arena) (p. 1192): A functional layout showing two home-team dressing rooms sharing a central shower and training area. It illustrates efficient space planning by providing common facilities for multiple teams. The layout includes areas for dressing, storage, showers, toilets, and a trainer/first aid office.
- Fig. 1: Diving Pool Dimensions Diagram (p. 1193): This is a critical engineering diagram showing a cross-section of a competitive diving pool with 1-meter, 3-meter, 5-meter, and 10-meter platforms. Key letters (A-N) are used to label every critical dimension, from the distance from the plumb line to the back wall (E), to the clear overhead height (G), to various water depths (I, J, K, etc.). This diagram is designed to be used with the data tables on p. 1195.

- Figs. 1 & 2: 50-Meter and 25-Meter Recreational Pools (p. 1196, 1198): These are full architectural site plans for large public swimming facilities.
    - Layout: They show a main pool, a separate wading pool or diving area, extensive sunbathing/deck areas, and an integrated bathhouse building.
    - Dimensions: Key dimensions are clearly marked, including pool size, lane widths, and graduated depths (e.g., 3'-6", 5'-0", 12'-0").
    - Bathhouse: The plans detail the bathhouse layout, including separate men's and women's dressing booths, showers, toilets, a control/checkout counter, and an equipment room.
    - Capacity: The plans note the design capacity: the 50m pool accommodates 775 bathers, and the 25m pool accommodates 340 bathers.

Calculations and Formulas

Arena Space Allocations - The Forum (18,424 seats) (p. 1192)

This table provides a real-world data set for programming and estimating the non-seating areas of a large arena.

- Total Area Breakdown:
    - Play floor surface: 26,900 sq ft
    - Lobby promenade: 20,000 sq ft
    - Home team lockers/toilets: 4,300 sq ft
    - Visiting team lockers/toilets: 2,100 sq ft
    - Storage (Bulk, Concessions, Seating): 8,800 + 6,000 + 6,600 = 21,400 sq ft
    - Administrative offices: 9,000 sq ft
    - Ticketing facilities: 7,000 sq ft
    - Private club dining and kitchen: Not specified, but a major area.
    - Total specified support area is over 90,000 sq ft, illustrating the vast scale of back-of-house operations.

BOQ Implications

- Arenas:
    - The space allocation table provides a direct quantity takeoff list for all major functional areas. Each area (e.g., locker rooms, offices, storage) will have its own set of finishes, MEP requirements, and specialty equipment.
    - Quantifying storage space is critical; the need for over 20,000 sq ft of storage highlights a major, often underestimated, cost center.
- Swimming Pools:

    - Excavation and Backfill: Major quantities calculated in cubic yards.
    - Concrete/Gunite/Shotcrete: The primary structural material for the pool shell, measured in cubic yards.
    - Interior Finish: Plaster or tile is a large surface area calculated in square feet.
    - MEP Systems: The filtration and circulation system is a complex assembly of pumps, filters (sized by capacity), piping (by linear foot and diameter), and valves. This is a specialized BOQ section.
    - Decking: Large areas of concrete or other paved surfaces, measured in square feet.

Critical Notes and Warnings

- Arena Back-of-House is Massive: The Forum space allocation table is a critical warning to designers and owners that the operational and support spaces in an arena can be as large or larger than the public-facing areas.
- Pool Structural Integrity is Key: The NSPI standard requiring a safety factor of 2.5 and design to withstand both full and empty loads is a critical engineering requirement to prevent catastrophic failure.
- Diving Safety Clearances are Non-Negotiable: The precise water depths and overhead clearances specified for diving boards and platforms are absolute minimums required to prevent serious injury or death.
- Pool Water Purity and Treatment: The text repeatedly emphasizes that pool water must be continuously filtered, circulated, and treated. The specified filtration rates and turnover times are essential for maintaining sanitary conditions.
- Accessibility and Fencing: Fencing around public pools is a mandatory safety and liability requirement to prevent unauthorized access and drowning.
-

Chapter 10: Recreation and Entertainment (Part 15 of 15: Pages 1199-1221)

Overview

This final section of the chapter provides a comprehensive guide to the planning, design, and operation of Camps and Camp Facilities. The information is primarily sourced from the Boy Scouts of America's engineering service, presenting a structured approach to developing large-scale outdoor recreational areas. The content covers the layout of troop sites, central facilities, waterfronts, and specialized activity areas like shooting ranges and campfire circles. It includes detailed requirements for infrastructure such as water supply, sewage disposal, and food service. The section is rich with data tables outlining the requirements for different types of camps (short-term, long-term, multiple-camp reservations) and architectural drawings for key camp buildings and structures.

Key Standards and Codes Referenced

- *Campsites and Facilities, Engineering Service, Boy Scouts of America*: The primary source for all information related to camp planning and design in this section.
- U.S. Soil Conservation Service: Noted as having wide experience in the design of small lakes (p. 1222).

Technical Specifications

Camp Planning Principles

- Troop Site Requirements:
    - Area: Approximately 3 to 4 acres of usable land per troop site to accommodate 8-10 patrol sites.
    - Terrain: Good terrain with not more than 7 percent slope.
    - Spacing: Troop sites to be at least 450 ft apart, center to center, and at least 450 ft from any central program area.
    - Distance: Maximum distance from a troop site to central facilities (waterfront, lodge) should be about 1,800 ft.
- Central Area: Approximately 10 acres should be selected for central service facilities.
- Waterfront Layout:
    - Requires three separate areas: Nonswimmers (max depth 3 ft 6 in.), Beginners (max depth 6 ft), and Swimmers (max depth 12 ft).
    - The layout should accommodate one-third to one-half of the troops at one time (about 100 boys), allowing 50 sq ft per person.
    - Boat and canoe areas must be separate from the swimming area, at least 200 ft away.
- Rifle Range (Camp .22 Caliber):
    - Distance: 50 ft from firing point to target face.
    - Backstop: An earthen embankment (hillside or constructed berm) is required. It should be at least 10 ft high and extend beyond the target butts.
- Archery Range:

    - Area: Approximately 150 ft by 250 ft for a six-target, 50-yd range.
    - Orientation: Shooters should face in a northerly direction.
- Central Lodge / Dining Hall:
    - Capacity: Designed to serve about 125 people family-style (160 max).
    - Kitchen Wing Area: Total of about 1,600 sq ft (640 for prep, 310 for serving/dishwashing, 400 for commissary).
    - Dining Hall Area: About 2,000 sq ft, including 1,280 sq ft for 16 tables (80 sq ft each).
    - Water Demand: Daily demand is 750 gal (at 6 gal/person). Peak demand is 22 gpm.
    - Hot Water: Requires a heater with 110,000 BTU rating and a 300-gal insulated storage tank to provide water at 110-120°F (and 180°F for sanitizing rinse).
    - Sewage: Generates about 750 gpd, requiring a 1,000-gal septic tank and disposal field.

Visual Elements Analysis

- Fig. 1: Typical camp with central dining (p. 1221): A master site plan for a large camp. It shows the logical zoning of the property, with the entrance leading to a central administrative and dining area, from which trails lead out to dispersed troop sites. It clearly illustrates the buffer zones between troop areas and the separation of program areas like the waterfront and shooting range. Contour lines indicate the use of natural topography.
- Fig. 2: Typical cross section of earth-fill dam (p. 1222): An engineering detail showing the construction of a small dam to create a man-made lake. It specifies the "impervious core," "rip-rap" on the upstream face, "sod slope" on the downstream face, and the inclusion of an "overflow pipe" and a "drop inlet" for water level control.
- Fig. 3 & 4: Typical waterfront layout (p. 1222, 1223, 1224, 1225): These are comprehensive diagrams detailing a safe swimming area.
    - Layout: Shows the three distinct swimming areas (Non-Swimmers, Beginners, Swimmers) defined by float lines and piers.
    - Structures: Details the location of a diving platform, guard tower, lookout tower, and wood fences to control access.
    - Dimensions: Specifies maximum water depths for each area and a minimum clear deck height of 1' 6" above normal water level.
- Fig. 5 & 6: Pier Details (p. 1227): Fig. 5 shows a removable pier with a fixed foundation, suitable for areas with winter ice. Fig. 6 shows a floating pier, detailing its construction and anchoring. These provide construction options based on site conditions.

- Fig. 8: Typical canoe rack (p. 1228): A construction detail for storing canoes. The section view shows a rack made of 2x6 and 1x3 lumber, designed to hold canoes on their sides. The plan view shows a tie-up system using a galvanized pipe and sleeve set in concrete, allowing canoes to be secured.
- Fig. 10: Typical rifle range (p. 1231): A detailed set of plans for a camp rifle range.
    - Range Plan: Shows the layout from the ready line and bench area to the firing line and the 50-yd targets.
    - Sections: Show a high earth backstop and the alternative of covered firing line construction.
    - Details: Provides construction drawings for a portable rifle rack.
- Fig. 11: Rifle range - bullet stops (p. 1232): Illustrates two types of earthen backstops: a natural hillside and a constructed earth-filled wood crib. This provides options for sites with different topographies.
- Fig. 14 & 15: Council Ring / Fire Platform (p. 1234): Fig. 14 shows a plan for a classic camp council ring, a semi-circular amphitheater with a central fire area. Fig. 15 provides construction details for both the seating (concrete supports) and the fire platform (stone or concrete).
- Fig. 16: Waterfront storage building (p. 1235): A plan and sectional elevation for a building designed to store canoes and rowboats. It shows sliding doors for access and a rack system made of 2x4s to hold boats vertically.
- Fig. 17 & 18: Central Lodge and Kitchen Wing (p. 1236, 1237): These are full architectural plans for the main camp building. They show the layout of the dining hall, serving area, and a complete commercial kitchen with delineated spaces for dishwashing, food prep, and storage (including a walk-in refrigerator). The legend (Fig. 18) identifies every piece of specified kitchen equipment, from the range (A-1) to the mixer (A-12).

Data Tables Analysis

- Table 1: Requirements for Short-Term Camp (p. 1219):
    - Land: 100-200 acres minimum.
    - Sites: 10-14 troop sites.
    - Facilities: Focuses on basic needs: scoutcraft areas, field sports, water system, access road, service building, and a ranger residence.
- Table 2: Requirements for Small Long-Term Camp (p. 1220):
    - Land: 200 acres minimum.
    - Sites: 6-8 troop sites.
    - Facilities: Expands on short-term camp to include a full waterfront (swimming/boating), more extensive shooting ranges (rifle, archery,

    shotgun), a health lodge, and a central dining facility or commissary for patrol cooking.
- Table 3: Requirements for Typical Long-Term Camp (p. 1220):
    - Land: 200 acres minimum.
    - Sites: 10-14 troop sites.
    - Facilities: A fully developed camp with a comprehensive list of program areas, administration building, staff housing, and a central kitchen/dining lodge.
- Table 4: Requirements for Multiple-Camp Reservation (p. 1221):
    - Land: 1,000 acres minimum (approx. 200 acres per camp).
    - Concept: A large reservation hosting several distinct long-term camps.
    - Facilities: Each camp has its own program facilities, but they share central administrative services, maintenance, and potentially food service logistics (e.g., a central kitchen delivering prepared food to satellite camps).

BOQ Implications

- Infrastructure is Key: The primary costs are not in the buildings but in the site development: roads, water supply systems (wells, storage tanks, distribution lines), sewage systems (large-scale septic fields), and electrical distribution.
- Earthwork: Significant quantities for road construction, building pads, dam construction (if creating a lake), and shooting range backstops.
- Specialized Construction:
    - Waterfront: Piers, docks, floats, and towers are specialized marine construction.
    - Kitchen: The central lodge requires a full commercial kitchen equipment package, which is a major cost center.
    - Dams/Pools: Construction of a dam or a large swimming pool is a major civil engineering project with high costs for earthmoving, concrete, and specialized mechanical systems.
- Building Materials: Simple, durable materials are prioritized. Wood frame construction is common, with concrete floors and foundations.

Critical Notes and Warnings

- Safety First: The document repeatedly emphasizes safety in all activity areas. Waterfronts must have clearly separated areas for different skill levels. Shooting ranges require secure backstops and controlled access.
- Environmental and Legal Compliance: The text warns that dam construction, water use, and sewage disposal are all subject to legal regulations (e.g., riparian rights) and health codes. Competent local engineers must be involved.

- Phased Development: The tables outlining requirements for different camp sizes provide a clear roadmap for phased development. An organization can start with a short-term camp and expand facilities over time as funds become available.
- Function over Form: The design of camp facilities is driven by function, durability, and ease of maintenance. The provided plans emphasize logical flow and robust construction over elaborate architectural statements.
- Professional Expertise is Required: The text consistently advises that amateurs should not design complex facilities like dams, pools, or large utility systems. The use of qualified local engineers, architects, and other professionals is essential.

Chapter 11: Miscellaneous

Section: FARMSTEADS (Pages 1241-1242)

Overview

This section provides a systematic approach to planning new or remodeled farmsteads using a "zone planning" methodology. The purpose is to organize the farmstead into distinct activity areas to ensure efficiency, safety, and a desirable living environment, while also allowing for future expansion. The planning considers factors such as prevailing winds, road access, drainage, and the specific type of farm enterprise (livestock, grain, or mixed-use).

Key Standards and Codes Referenced

- Primary Source Document: `Farmstead Planning Handbook`, Midwest Plan Service, Iowa State University, Ames, Iowa, 1974.

Technical Specifications

This section outlines a four-zone planning system, originating from a central point (either the house or a central farm court). Each zone is presented as a 100-ft-wide band, though the text notes that wider zones are often desirable.

Zone 1: Family Living

- Purpose: To contain all family and residential activities.
- Contents: Lawns, recreation space, flower and vegetable gardens, guest parking.
- Performance Criteria: Must be protected as much as possible from noise, odor, and dust generated by other zones.

- Dimensional Standard: Typically the central area. The example shows Zone 1 as 0.7 acres. The house should be set back further than 100 ft from a busy road, or if a tree windbreak is present between the house and road.

Zone 2: Machinery Center

- Purpose: To house farm machinery, workshops, and related services.
- Contents: Shop, machinery storage, and related services. May also contain much of the driveway and farm court. Fuel and chemical storage.
- Performance Criteria: Activities in this zone should be relatively quiet, dry, and odor-free. Consideration should be given to screening this center from the family's view.
- Dimensional Standard: The second 100-ft band from the center. The example shows Zone 2 as 1.6 acres.
- Critical Placement: Fuel and chemical storage should be placed toward the outer edge of this zone to mitigate fire danger and hazards to children, with a recommended distance of perhaps 200 ft from the home.

Zone 3: Grain, Feed, and Some Livestock

- Purpose: To house activities that generate significant dust, noise, traffic, and odor.
- Contents: Grain and feed handling/processing facilities. Small animal units.
- Performance Criteria: Requires good electric power and vehicle access. Heavy equipment, large dryers, and fire hazards should be kept away from the house.
- Dimensional Standard: The third 100-ft band. The example shows Zone 3 as 2.3 acres. It is considered a "compromise" zone.

Zone 4: Major Livestock Facilities

- Purpose: For large-scale livestock operations.
- Contents: Large animal units, whether confined in a building or on an open drylot.
- Performance Criteria: Generates significant noise, dust, traffic, and odors. Requires adequate space, drainage, waste management, access, loading facilities, and feed distribution. Space for future expansion is usually important. A small livestock unit (e.g., for maternity/nursery, pets, hobby animals) may be located closer to the house for convenience.
- Dimensional Standard: The fourth 100-ft band and beyond. The example shows Zone 4 as 2.8 acres.

General Siting and Planning

- Flexibility: The master plan should allow for future changes, such as a grain farm converting to a livestock farm and vice-versa.

- Expansion: Moving away from an old, established farmstead is often the most economical and satisfactory way to accommodate major expansion.
- Prevailing Winds:
    - Winter: Assumed to be from the Northwest (NW) or West (W).
    - Summer: Assumed to be from the Northwest (NW), Southwest (SW), and Southeast (SE).
- House Placement: The house should be positioned so that the fewest winds blow toward it from the other farmstead zones, especially during times of the year when dust, noise, odors, and insects are problematic.

Visual Elements Analysis

Figure 1: Farmstead planning zones

Description: This figure consists of three diagrams (1a, 1b, 1c) illustrating the zone planning concept. The zones are depicted as concentric areas around a central point.

- 1a. Four planning zones: This diagram shows the idealized four-zone layout. The `House` is in the center (Zone 1). Zones 2, 3, and 4 are shown as 100-ft wide concentric bands around Zone 1. Arrows indicate the types of facilities that belong in each zone: `Machinery Storage` (Zone 2), `Grain & Feed Storage Supplies` and `Small Animal Units` (Zone 3), and `Large Animal Units` (Zone 4).
- 1b. Example: Livestock enterprise north of the road: This diagram shows a practical application on a specific site. The house is in Zone 1. A patio is shown adjacent to the house. The `Machinery Storage` and an `Old Barn` are in Zone 2. A `(Grain)` facility is shown in Zone 3. A `New Livestock` facility is shown beyond Zone 3, with a potential `Alternate Drive` to serve it. The main driveway serves all centers. The layout demonstrates how a living area can be screened while maintaining convenience and allowing for expansion.
- 1c. Example: Grain enterprise north of the road: This diagram shows an alternative enterprise. The house and patio are central. An `(old) Barn` and `Machinery` are in Zone 2. A `Grain` facility is shown in Zone 3. The layout prioritizes convenience and accessibility for machinery and supply areas. Technical Details:
- Zone Width: 100 ft each.
- Zone Areas: Zone 1 = 0.7 acres; Zone 2 = 1.6 acres; Zone 3 = 2.3 acres; Zone 4 = 2.8 acres.
- Total Area (Zones 1-3): Approximately 4.6 acres. Relationship to Text: These diagrams visually define the zone planning concept described in the text, providing both an abstract model (1a) and two practical examples (1b, 1c) for different farm types.

Figure 2: Farmstead and main road relationships

Description: This figure contains four site plan diagrams (2a, 2b, 2c, 2d) showing different relationships between the farmstead, main road, and prevailing winds. They illustrate how to orient the major activity centers (House, Shop & Machinery, Grain & Feed Center, Livestock Center) for optimal environmental control.

- 2a. Farmstead west of the road: The main road is on the eastern edge. The layout includes a `House`, `Court`, `Shop & Machinery`, `Livestock Center`, `Grain & Feed Center`, and a `Tree Windbreak` on the western edge. A wind diagram shows winter winds from the NW and summer breezes from the SW. The text notes this layout is problematic as winter winds can carry livestock odors to the house.
- 2b. Farmstead south of the road: The main road is on the northern edge. The driveway is curved to avoid creating a wind tunnel through the windbreak. The `House` is south of the `Shop & Machinery` and `Grain & Feed` centers. An `Alternate Drive` is shown. The text suggests this layout could be improved by moving the house further south, the livestock area to the northeast, or by reversing the house and machine center locations.
- 2c. Farmstead north of the road: The main road is to the south. The layout shows the `House` near the road, with the `Shop & Machinery` and `Livestock Center` located behind it, protected by a `Tree Windbreak`. The text describes this as a good, easy layout.
- 2d. Farmstead east of the road: The main road is to the west. This is a mirror image of 2c and is also described as a good layout, assuming drainage and other factors are favorable. Construction Notes: The diagrams emphasize the strategic placement of tree windbreaks on the north and west sides to block winter winds. Driveways should be designed to avoid channeling wind directly into the farm court. Relationship to Text: These diagrams provide visual examples for the text's discussion on orienting the farmstead relative to roads and prevailing winds to minimize the negative impacts of odors, dust, and noise on the living area.

Calculations and Formulas

Area Calculation

- Formula: No formula is provided, but acreages for the zones are given, derived from their radii.
- Variables:
  - Zone Width = 100 ft
- Example Data:
  - Zone 1 Area: 0.7 acres
  - Zone 2 Area: 1.6 acres

- Zone 3 Area: 2.3 acres
- Total Area (Zones 1-3): 4.6 acres

BOQ Implications

- Site Clearing and Grading: The total area of the farmstead (e.g., 4.6+ acres for Zones 1-3) must be cleared. Topography and drainage requirements, as mentioned in the text, will dictate the extent of earthworks (cut and fill) required, which is a major cost factor.
- Paving and Surfacing: The length of driveways, as depicted in the diagrams (e.g., Fig 2b's curved drive vs. a straight one), will determine the quantity of gravel or asphalt needed for the farm court and access roads.
- Landscaping: The installation of a `Tree Windbreak` (Fig 2) is a specific line item. This involves costs for purchasing mature trees, planting labor, and initial irrigation/maintenance.
- Fencing: Although not explicitly detailed, separating zones and containing livestock implies significant fencing quantities.
- Utilities: The sprawling layout across several acres dictates the length and cost of utility trenches and lines for water, sewage, and electricity to service the house, machinery shop, and livestock/grain centers.

Critical Notes and Warnings

- Environmental Control: Failure to properly site the house relative to livestock areas and prevailing winds will lead to significant odor, dust, and noise problems in the family living area.
- Safety: Fuel and chemical storage must be isolated from the home (recommendation of 200 ft) to reduce fire hazards and risk to children.
- Future Expansion: A common error is not leaving enough space for expansion. The zone system encourages spreading the farmstead out to preserve land for future growth, protecting long-term efficiency and property sale value.
- Site Suitability: The text warns that final layout is determined by other factors like drainage, water/electric lines, sewage systems, and topography. A visually appealing layout may not be feasible if these site conditions are not met.
-

Chapter 11: Miscellaneous

Section: FARMS AND FARM BUILDINGS (Pages 1243-1246)

Overview

This section provides detailed guidelines for arranging farm buildings and their associated service areas. The focus is on creating a functional, efficient, and safe farmstead by considering traffic flow, natural environmental factors (sun, wind, drainage), and the specific requirements of different agricultural centers such as machinery, grain, dairy, and poultry. The principles aim to optimize daily operations, minimize labor, and integrate the farmstead with its natural surroundings.

Key Standards and Codes Referenced

- Primary Source Document: `Farm Arrangements`, published by the Boy Scouts of America.

Technical Specifications

General Building Arrangement

- Accessibility: All buildings must be reachable by truck.
- Service Yard: Must provide ample room for traffic and turning machinery.
- Building Design: Should feature large doors with sufficient headroom and no interior posts to facilitate cleaning and other tasks with machinery like a tractor with a blade.

Living Center

- Siting: Should be integrated with its surroundings, considering sunlight, prevailing winds, views, and road location.
- Garage: Doors located on the east or south side are preferable to minimize snow-related issues.

Farm Service Yard

- Function: Unifies activity centers, provides maneuvering space, reduces the need for gates, and offers fire protection.
- Dimensions: A minimum width of 80 ft is required for vehicles to turn around; greater width is better.
- Surfacing: Gravel or crushed rock is recommended for high-traffic areas. Other areas should be sodded.
- Utilities: Central lighting is recommended to illuminate approaches to all buildings.

Machinery Center

- Location: A central storage building is preferred over multiple scattered sheds. It may be located along the lane to the fields if farmstead space is limited.
- Setbacks:
  - Warehouse-type buildings (end doors) can be set just to one side of a lane.
  - Side-opening structures require a setback of at least 30 ft from the lane for easy access.
- Expansion: The location should allow for future extension on at least one end.

Grain Center

- Location: Best located within the service yard, preferably near one side to allow ample room for trucks, wagons, and elevators. Should be accessible without opening gates.
- Siting: For natural drying, a location with good exposure to sunlight and air is critical.
- Arrangement: Bins can be placed in a circle around an elevator or in a straight line along the service yard border. On livestock farms, they may be adjacent to the feeding area.

Feeding Center

- Feed Lots: Paved feed lots are highly recommended.
- Feed Transport: For modern feeding equipment where the feed center is distant from bunks, a mechanical conveyor or a blower-pipe arrangement can be used.

Dairy Center

- Stanchion Barn System:
  - Orientation: Long axis should typically run north-south to allow sunlight on both sides of the building.
  - Layout: The milk house is preferably located near the middle of the stanchion area on the service yard side. The silo and feed room should be about halfway from each end of the stanchion lines, usually on the side opposite the milk room.
- Loose-Housing System:
  - Arrangement: An L-shape arrangement is effective for wind protection. A straight-line arrangement is also possible but offers less protection.
  - Access: Doors for hay and bedding storage must be accessible from the service yard or a connecting lane.
  - Milking Unit: Should be located between the bedding and feeding areas to reduce steps. The milk house should be near the milking unit.
- Piping: Minimize the length of piping, especially with pipeline equipment.

Poultry Center

- Siting: Locate where prevailing summer winds carry odors and feathers away from the living area.
- Orientation: A southern exposure is important to admit the maximum amount of sunlight.
- Utilities: Water should be piped directly into the house.

Sanitation Facilities

- Sewage System: The sewer line from the house to the septic tank and to the distribution box must be watertight and rootproof.
- Disposal Field: Must be located on open ground, generally out of range of tree roots.

Windbreak

- Location: Should be planted on the north and west sides of the farmstead.
- Distance from Protected Areas:
  - Ideal: 150 ft (approx. 15 poles).
  - Maximum: 300 ft (approx. 30 poles).
  - Minimum: Not closer than 5 poles (approx. 82.5 ft), with 8 to 10 poles (132 ft to 165 ft) being better to avoid snow accumulation and poor summer air circulation.
- Construction:
  - Rows: Three rows of trees.
  - Spacing: Trees spaced 14 ft apart.
  - Fence: An essential permanent fence must be located at least 6 ft from the tree rows.
  - Total Width: Minimum of 40 ft (approx. 4 poles).
- Length: Should extend 5 to 10 poles past the area needing protection.

Visual Elements Analysis

Figure 1: Traffic Flow Diagram

Description: A schematic flow chart showing the movement of materials and products on a farm. `PASTURES AND FIELDS` are the source/destination for `FERTILIZER`, `LIME`, `FEED`, and `MANURE`. `STORAGE` acts as a central hub. `LIVESTOCK` consumes feed and produces manure and products. `PRODUCT PREPARATION` leads to the `MARKET`.
Relationship to Text: This diagram visually represents the complex traffic flows that a well-designed farmstead must accommodate efficiently.

Figure 2: Sun and Wind Diagram

Description: A perspective view of a farm building on a plowed field, illustrating the impact of natural elements. Arrows show `WINTER WIND` from the northwest, `SUMMER WIND` from the southwest, and the `SUN'S DAILY PATH` from east to west. An arrow indicates `DRAINAGE` sloping away from the building. Relationship to Text: This supports the text's emphasis on orienting buildings to take advantage of the sun for heat and light while protecting against cold winter winds.

Figure 3: Living Center Layout

Description: A site plan showing a farmhouse with designated outdoor zones: a `PRIVATE` area (likely a backyard), a `PUBLIC` area (front yard/approach), and a large `SERVICE YARD` adjacent to the house and garage for farm operations. Relationship to Text: This visualizes the concept of separating the living center from the working areas of the farm to maintain a desirable residential environment.

Figure 4: Cattle Guard

Description: A perspective drawing of a farm lane entrance. It shows a wooden gate next to a `cattle guard`—a grate embedded in the roadway that allows vehicles to pass but deters livestock from crossing. Relationship to Text: This illustrates a practical alternative to gates, improving convenience and traffic flow in the service yard, as mentioned in the text.

Figure 5: Machinery Shed Siting

Description: A diagram illustrating the correct placement of a side-opening machinery shed relative to the `SERVICE YARD`. Arrows show the path of machinery moving in and out of the shed's bays, demonstrating why a significant setback (specified as 30 ft in the text) is necessary. Relationship to Text: This visually explains the dimensional setback requirement for side-opening machinery storage buildings.

Figure 6: Grain and Feeding Center Layouts

Description: Two diagrams illustrating combined grain and feeding centers.

- Top Diagram: A perspective view showing `GRAIN STORAGE` situated between a `HOG SHED`/`HOG LOT` and a `CATTLE SHED`/`CATTLE LOT` with `HAY STORAGE`.
- Bottom Diagram: A plan view showing a more integrated layout with a central `DRIVE` and `SERVICE YARD`. `GRAIN STORAGE` is located next to a `CATTLE SHED` and `CATTLE LOT` with a `FEEDING FENCE`. `FEEDERS` are shown between the grain storage and the lots. Relationship to Text: These diagrams show practical layouts for combining grain storage and feeding operations for livestock, a key topic in the text. *Note: The text references a "Fig. 7" which appears to be a typo in the*

source document; these diagrams (Fig. 6) accurately depict the concepts being described.

Figure 8: Stanchion Barn Layout

Description: A perspective drawing of a dairy facility. A `STANCHION BARN` is the main structure, with an attached `SILO` on one side and a `MILKROOM` on the other, opening onto a `SERVICE YARD`. Relationship to Text: This illustrates the compact layout of a stanchion barn system as described in the Dairy Center section.

Figure 9: Loose-Housing Dairy Layout

Description: A perspective drawing of a loose-housing dairy system. It shows an L-shaped arrangement with `HAY STORAGE` and a `FEEDING AREA` forming one leg, and `BEDDING STORAGE` and a `BEDDING AREA` / `PAVED LOT` forming the other. A `SELF FEEDING BUNKER SILO` is located at the end of the feeding area. Relationship to Text: This visualizes the multi-unit loose-housing system, showing how components are arranged for efficiency and animal comfort.

Figure 10: Poultry Yard Rotation

Description: A site plan for a poultry operation. A central `POULTRY HOUSE` is adjacent to a `SERVICE YARD`. Three distinct, fenced areas are shown: `POULTRY YARD THIS YEAR`, `POULTRY YARD LAST YEAR / GARDEN THIS YEAR`, and `POULTRY YARD NEXT YEAR / GARDEN THIS YEAR`. Relationship to Text: This diagram perfectly illustrates the concept of rotating poultry yards with gardens for sanitation and soil fertility.

Figure 11: Water System Schematic

Description: A plan diagram showing the layout of farm utilities. A central `PUMP HOUSE` supplies water via pipelines to the `FARMHOUSE`, `POULTRY AND GARDEN`, `LIVESTOCK`, `GRAIN`, and `MACHINERY` centers. Relationship to Text: This supports the section on Power, Water, and Sanitation, showing a practical layout for a centralized water distribution system.

Figure 12: Windbreak Diagram

Description: A cross-section of a tree windbreak. It shows a row of trees and illustrates how the `ZONE OF PROTECTION` extends downwind for a distance of 10 x TREE HEIGHT. Relationship to Text: This provides the visual representation of the formula used to calculate the effective area of a windbreak.

Calculations and Formulas

Windbreak Effectiveness

- Formula: `Zone of Protection = 10 * Tree Height`
- Variables:
  - `Zone of Protection`: The downwind distance from the windbreak that receives noticeable protection.
  - `Tree Height`: The height of the trees in the windbreak.
- Example: The text implies that for a windbreak to protect an area 300 ft away, the trees must be 30 ft high (300 / 10).

BOQ Implications

- Materials:
  - Site Work: Gravel, crushed rock for service yards and drives.
  - Structures: Specific building materials for barns, sheds, silos (bunker, upright), cribs, and bins.
  - Fencing: Significant quantities of fencing and gates are required for service yards, poultry yards, and livestock lots. Cattle guards are a specific alternative to gates.
  - Utilities: Water pipes, electrical wiring, pumps, septic tanks, and drain field materials.
- Labor:
  - Mechanization: The design emphasis on large, open buildings is intended to reduce manual labor by allowing the use of tractors for cleaning.
  - Layout Efficiency: A well-planned layout as described reduces daily labor by minimizing travel distance between activity centers.
- Cost Factors:
  - Paved Lots: Identified as "highly recommended," implying a higher initial cost for long-term benefits in cleanliness and animal health.
  - Building Systems: A loose-housing dairy system is noted as "less expensive to build" than a traditional stanchion barn but requires more land.

Critical Notes and Warnings

- Fire Hazard: Placing grain storage close to other structures increases the risk of fire from lightning or spontaneous combustion; precautions are necessary.
- Natural Drying: If relying on natural drying for grain, proper siting for sun and air exposure is critical to prevent spoilage.
- Windbreak Management: Windbreaks require a significant land area (min. 40 ft width) and must be fenced to protect them from livestock. Improper placement (too close) can cause problems with snow drifts and poor summer ventilation.

- System Integration: The text repeatedly emphasizes that all centers must be planned in relation to one another. Access to the milk room is more critical than access to the silo; access for filling storage (hay, silage) is key. Failure to consider these relationships results in an inefficient farmstead.

Section: ANIMAL FACILITY, LABORATORY (Pages 1247-1250)

Overview

This section outlines the essential design, construction, and environmental control standards for modern laboratory animal facilities. The primary goal is to create a physical environment that ensures the health and welfare of the animals, promotes the efficiency and economy of operations, and maintains the integrity of scientific research. The guidelines cover functional area planning, detailed construction specifications for all building components, and strict environmental parameters for ventilation, temperature, and sanitation.

Key Standards and Codes Referenced

- Primary Source Document: `Guide for Laboratory Animal Facilities and Care`, National Institute of Health, Department of Health, Education, and Welfare, Washington, D.C., 1968.
- Additional Reference: `Institute of Laboratory Animal Resources`, National Academy of Sciences-National Research Council (for more detailed housing standards).

Technical Specifications

Functional Area Requirements

A modern animal facility is considered to require the following essential functional areas:

1. Animal Housing: A separate building, wing, floor, or rooms, physically separated from human occupancy areas. Must provide sufficient rooms for species separation, project isolation, and quarantine.
2. Specialized Laboratories: Areas contiguous to housing for surgery, necropsy, intensive care, radiography, special diet preparation, and disease control. Special provisions are required for radioisotopes, toxic substances, or pathogens.
3. Receiving and Storage: Areas for food, bedding, supplies, and equipment.

4. Administrative Office: For facility supervision and direction.
5. Personnel Areas: Showers, sinks, lockers, and toilets.
6. Washing and Sterilizing Area: For equipment and supplies, including cage washers, rack washers, autoclaves, and separate areas for soiled vs. clean equipment.
7. Waste Disposal: An incinerator or a dedicated area for safe and sanitary storage of waste before removal.
8. Personnel Eating Area: If staff regularly eat within the facility.

Service Area Sizing Rules

- General Rule: Service areas (washing, storage, labs, offices, etc.) should constitute an area equal to at least 25% of the total animal housing space.
- Facility < 1,000 sq ft: Service functions may be carried out in a multi-purpose area, but a separate facility for washing and sanitizing animal cages must be available.
- Facility up to 10,000 sq ft: Separate rooms or areas must be provided for: (a) receipt/quarantine, (b) food/supply storage, (c) cleaning/sanitizing, (d) refuse, (e) lavatory, (f) office, and (g) laboratory facilities.
- Facility > 10,000 sq ft: All areas listed for the 10,000 sq ft facility are required, plus dedicated clinical laboratory facilities for diagnosing animal diseases.

Construction Guidelines

- General Material Requirements: Materials should be durable, waterproof, fire-resistant, and seamless. Surfaces must be resistant to chemical solvents, cleaning agents, high-pressure sprays, and impact.
- Corridors:
  - Width: Must be at least 7 ft wide.
  - Junctions: Floor-to-wall junctions must be coved to facilitate cleaning.
  - Wall Protection: Walls should be protected from equipment damage by curbs, guardrails, or bumpers. Exposed corners must be reinforced with steel or other durable material up to a height of 6 ft.
  - Noise Control: Corridors leading to dog kennels should feature a noise trap, such as a double-door entry lock.
- Animal Room Doors:
  - Size: Minimum dimensions of 42 in. wide and 84 in. high.
  - Material: Must be metal or metal-covered.
  - Features: Doors should be equipped with kickplates, be self-closing, have recessed handles, and viewing windows are desirable. They must fit tightly within sealed frames to prevent vermin entry.

- Exterior Windows: Not required if adequate ventilation and lighting are provided. If used, they should be non-opening, without sills, of insulating construction, and effectively sealed.
- Floors:
    - Performance Criteria: Must be smooth, waterproof, non-absorbent, non-slip, wear-resistant, acid/solvent resistant, and able to support heavy equipment without damage. A continuous waterproof membrane is required.
    - Material Requirements: Recommended materials include terrazzo, cupric oxychloride cement, smooth hard-surfaced concrete, neoprene terrazzo, and special hardened rubber-base aggregates.
- Walls: Must be monolithic, waterproof, and smooth (painted or glazed), free of cracks or imperfect joints, especially at corners and penetrations. Must withstand high-pressure water and be protected from movable equipment.
- Ceilings: Poured concrete ceilings are satisfactory if smoothed and sealed. Furred ceilings of plaster or fire-code plasterboard should be sealed and painted. Exposed pipes and fixtures are undesirable.
- Drainage:
    - Requirement: Floor drains are not essential in rooms for smaller species (rats, mice) where wet vacuuming or mopping is sufficient.
    - Pipe Size: Drainpipes must be no less than 4 in. in diameter. In heavy-use areas like dog kennels, drains at least 6 in. in diameter are recommended.
    - Floor Pitch: Where drains are used, floors must have a minimum pitch of ¼ in. per foot.
    - Features: Flushing drains (like a toilet bowl set in the floor) are effective. Drains should have short, steeply pitched runs and be fitted with lockable, sealed covers when not in use. Porous trap buckets to screen solid waste are an effective alternative.
- Storage Areas:
    - Food/Bedding: Must be stored in a separate, vermin-proof room, off the floor on pallets or racks. It is good practice to hold packaged feeds at 50°F or less.
    - Refuse: Must be stored separately. The area should be kept below 45°F to reduce putrefaction.
- Washing and Sterilizing Facilities:
    - Location: Centrally located is best.
    - Design Factors: Must consider (a) traffic flow separating "clean" and "dirty" areas, (b) soundproofing, (c) utilities (hot/cold water, steam, drains), (d) proximity to storage, (e) insulation, (f) ventilation for steam, and (g) sufficiently wide access doors.

Environmental Control (HVAC)

- Ventilation: Mechanical ventilation is necessary. The system should provide 10 to 15 air changes per hour. Recirculation of air is not permitted unless it is filtered to remove contaminants. Animal and human areas must be ventilated separately.
- Temperature:
    - Standard Range: The system must permit adjustments within a range of 65°F to 85°F.
    - Standard Tolerance: Individual rooms should be controllable within ± 2°F.
    - Typical Operation: A setting of 74°F ± 4°F is acceptable for routine housing.
- Humidity:
    - Standard Range: Relative humidity must be maintained between 30% to 70% year-round.
    - Typical Operation: A setting of 50% ± 20% is acceptable for routine housing.
- Precision Control (for specific experiments):
    - Temperature Tolerance: ± 1°F.
    - Humidity Tolerance: ± 5%.
    - Air Supply: 100% fresh air may be required.
    - Monitoring: Such rooms require recording devices and failure alarm systems.

Visual Elements Analysis

Table: Suggested Space for the Routine Housing of Laboratory Animals

Description: A comprehensive two-page table providing minimum space recommendations for various laboratory animals. It details cage/pen dimensions and housing density based on species, weight, and age. The data is critical for facility planning and equipment specification.

Technical Details: The following is a complete extraction of the table data from pages 1248 and 1249.

Species	Weight or age	Type of housing	Overall size (inches)	Number of animals	Housing area/animal

| :--- | :--- | :--- | :--- | :--- | :--- |

| | | | **Width** | **Depth** | **Height** | **Sq ft** | **Sq in.** |

| **Dogs*** | Up to 15 kg | Pen or run | 48 | 72 | | 3 | 8 |

| | 15 to 30 kg | Pen or run | 48 | 72 | | 2 | 12 |

| | Over 30 kg | Pen or run | 48 | 72 | | 1 | 24 |

| | Up to 15 kg | Cage | 36 | 32 | 32 | 1 | 8 |

| | 15 to 30 kg | Cage | 48 | 36 | 36 | 1 | 12 |

| | Over 30 kg | Cage | *Refer to footnote 1* | | | | |

| **Cats** | Up to 4 kg | Cage | 18 | 24 | 24 | 1 | 3 |

| | Over 4 kg | Cage | 24 | 24 | 24 | 1 | 4 |

| | | Group cage or pen | 36 | 48 | 72 | 3-6 | 2-4 | |

| **Nonhuman primates†** | Up to 1 kg | Cage | 18 | 10 | 18 | 1-2 | 0.6-1.2 | |

| | 1-3 kg | Cage | 24 | 18 | 24 | 1-2 | 1.5-3 | |

| | 4-6 kg | Cage | 24 | 24 | 30 | 1-2 | 2-4 | |

| | 6-10 kg | Cage | 30 | 30 | 36 | 1 | 6 | |

| | Over 10 kg | Cage | 36 | 30 | 48 | 1 | 7.5 | |

| **Rabbits** | Up to 4 kg | Cage | 18 | 24 | 16 | 1-2 | 1.5-3 | |

| | 4-5 kg | Cage | 24 | 24 | 16 | 1 | 4 | |

| **Guinea pigs** | Up to 350 g | Individual cage | 8 | 12 | 8 | 1 | | 96 |

| | Over 350 g | Individual cage | 12 | 12 | 8 | 1 | | 144 |

| | Up to 350 g | Group cage | 14 | 20 | 8 | 2-4 | | 70-140 |

| | Over 350 g | Group cage | 18 | 20 | 8 | 2-4 | | 90-180 |

Hamsters		Individual cage	8	12	8	1-6		16-96
		Group cage	14	20	8	Up to 10		28 or more
Rats	150-250 g	Individual cage	8	12	8	1-3		32-96
		Group cage	14	20	8	4-10		28-70
Mice	20 g	Small group cage	8	12	5	5-10		10-20
		Large group cage	12	18	5	10-20		11-22
Chickens (adult)‡		Individual cage	8	18	21	1	1	
		Group cage	36	24	24	2-4	1.5-3.0	

(Continued Table from Page 1249)

Species	Weight or age	Type of housing	Overall size (inches)	Number of animals	Housing area/animal
			Width	**Depth**	**Height**		**Sq ft**	**Sq in.**
Pigeons	0.5-0.8 kg	Cage	30	30	15	5-7		130-180
Small birds	100-130 g	Cage	6	10	6	1-2		30-60
	100-130 g	Group cage	24	30	8	24		30
Cattle (adult)	350 kg	Stanchion	42	56		1		
	450 kg	Stanchion	45	60		1		
	550 kg	Stanchion	48	64		1		
	650 kg	Stanchion	51	68		1		
	750 kg	Stanchion	54	72		1		
	550 kg	Pen	120	144		1	120	

| | 650 kg | Pen | 120 | 168 | | 1 | 140 | |

| | 750 kg | Pen | 120 | 180 | | 1 | 150 | |

| **Cattle (calves)** | 50-75 kg | Pen | 48 | 72 | | 1 | 24 | |

| | 1½-10 mo | Group pens | | | | Up to 10 | 20-25 | |

| | Over 10 mo | Group pens | | | | Up to 10 | 30-40 | |

| **Cattle (adult)** | | Loose housing‡ | | | | | 50-80 | |

| **Horses** | 500-750 kg | Tie stall | 66 | 96 | | 1 | 44 | |

| | 500-750 kg | Pen | 144 | 144 | | 1 | 144 | |

| **Sheep and goats**| | Pen | | | | | 15-22 | |

| Female with young | | Pen | | | | | 20-30 | |

| Adult male | | Pen | | | | 1 | 20-30 | |

| **Hogs** | Adult sow | Pen | | | | 1 | 25-40 | |

| Sow with pigs | | Pen | | | | 1 | 48-88 | |

| Adult boars | | Pen | | | | 1 | 30-80 | |

| | 18-45 kg | Pen | | | | | 6-12 | |

| | 45-100 kg | Pen | | | | | 12-16 | |

Footnotes:

- ***** (Dogs): For cage dimensions over 30 kg, recommends cage height be the dog's height at the withers + 6 in; width/depth be the dog's length (nose to tail base) + 6 in.

- **†** (Primates): Requires ample head room to stand erect without crouching.

- **‡** (Chickens/Cattle): Loose housing is outdoor housing with an open shed for shelter.

Calculations and Formulas

- Service Area Ratio: `Required Service Area (sq ft) = 0.25 * Animal Housing Area (sq ft)`
- Floor Pitch: `Rise/Run = 0.25 in / 12 in` (or a 1:48 slope, ~2.1% grade).
- HVAC Operating Ranges:
    - Temperature: 74°F ± 4°F (standard); 65-85°F (full range)
    - Humidity: 50% ± 20% (standard); 30-70% (full range)

BOQ Implications

- High-Performance Finishes: The specified flooring (terrazzo, neoprene terrazzo, cupric oxychloride cement) and wall finishes (glazed tile, epoxy paint) are high-cost items selected for durability and hygiene. This represents a major cost category over standard construction.
- Specialized Architectural Details: Coved floor-to-wall junctions, reinforced corners, recessed door hardware, and vermin-proof sealing are labor-intensive and require specialized materials.
- Mechanical, Electrical, Plumbing (MEP):
    - HVAC: The HVAC system is a primary cost driver due to the requirement for 10-15 air changes per hour, tight temperature/humidity control (±2°F, ±20%), and separate zoning. Precision control rooms (±1°F) are even more expensive.
    - Plumbing: Extensive use of large-diameter floor drains, hot/cold water mixing stations for wash-down, and potentially stainless steel components adds significant cost.
    - Electrical: Waterproof and explosion-proof outlets and fixtures are specified for safety, increasing material and installation costs.
- Fixed Equipment:
    - Caging/Racks: A major line item, with costs depending on material (stainless steel vs. plastic) and design. The tables provided are used for quantifying this equipment.
    - Sanitation Equipment: Industrial-grade cage washers, rack washers, bottle washers, and autoclaves are expensive, large-footprint capital items.
    - Storage: Refrigerated and cold storage rooms (50°F and 45°F) require insulated panels and dedicated refrigeration units.

Critical Notes and Warnings

- Cross-Contamination: The physical separation of clean/dirty flows, quarantine/isolation rooms, and controlled air handling are critical to prevent the spread of disease, which could invalidate years of research. This is a paramount design driver.

- Material Selection is Critical: Improper material selection for floors, walls, and ceilings can lead to premature failure due to harsh chemicals, high-pressure washing, and physical abuse from carts and racks. This can compromise facility hygiene.
- Environmental Control is Not Optional: The validity of experimental data is directly dependent on maintaining stable environmental conditions. HVAC failure can be catastrophic to research outcomes. Alarm systems are essential.
- Vermin Proofing: The facility must be designed as a fortress against vermin. All potential entry points (door frames, pipe penetrations) must be perfectly sealed.
- Noise Control: Noise is a stressor for both animals and personnel. The text warns that barking dogs can become a major public relations problem if the facility is near residential areas. Noise traps and physical separation are key mitigation strategies.
- Professional Judgment: The space recommendations in the tables are a "guide." The text emphasizes that final decisions on cage size and density are matters of professional judgment based on specific research needs.
-

Chapter 11: Miscellaneous

Section: GREENHOUSES (Page 1251)

Overview

This section details the fundamental design principles and considerations for various types of greenhouses. The primary objective of a greenhouse is to admit maximum sunlight while providing a strictly controlled environment for plant growth. The text emphasizes that a greenhouse is not a conventional building; it is a specialized transparent structure requiring specific horticultural systems for temperature, humidity, and ventilation control. Design considerations vary significantly based on the greenhouse's function, from small hobby units to large commercial or research facilities.

Key Standards and Codes Referenced

- Primary Source Document: `The Greenhouse Design Manual`, Ickes-Braun Glasshouses, Inc., Deerfield, Ill., 1971.

Technical Specifications

Core Design Principles

- Light Admission: The structural system must be minimal in bulk yet strong enough to support the glazing system. Site selection, building orientation, and roof pitch are critical for maximizing light.
- Glazing: The glazing material must have high light transmission and be framed to minimize breakage.
- Environmental Control:
    - Temperature & Humidity: Must be precisely controlled, in some cases to within a degree and a half. This requires specialized horticultural control systems, not conventional building HVAC.
    - Ventilation: The facility must have a means of introducing and circulating fresh air evenly. This can be achieved with ventilating sash or a negative pressure system that distributes air through transparent ductwork. All ventilating systems should be thermostatically controlled.

Siting Requirements

- Sunlight Exposure: The site must not be shaded by buildings or trees. Good natural exposure is preferable to a site where hills block the late afternoon sun.
- Wind Protection: A windbreak positioned 100 or more feet away in the direction of the prevailing wind is beneficial for reducing heating costs.
- Air Quality: Avoid sites downwind of heating plants, incinerator stacks, or chemical laboratories where toxic fumes could be drawn into the greenhouse.
- Ethylene Avoidance: Avoid proximity to fruit or vegetable storage areas, as plants are sensitive to ethylene gas.
- Heat Buildup: Avoid sites with adjacent dark paved surfaces or heat-absorbing walls, which contribute to excessive summer heat buildup.
- Drainage: Avoid low-lying ground that has a tendency to flood during thaws.
- Safety/Security: Greenhouses should not be located adjacent to playgrounds or playing fields.

Visual Elements Analysis

Table: Greenhouse Guidelines

Description: This table provides specific design considerations for greenhouses based on their intended use. It outlines the function of the operation and provides corresponding spatial, environmental, and design requirements. Technical Details: The following is a complete extraction of the table data.

Table: Greenhouse Guidelines

Description: This table provides specific design considerations for greenhouses based on their intended use. It outlines the function of the operation and provides corresponding spatial, environmental, and design requirements.

Technical Details: The following is a complete extraction of the table data.

Greenhouse for use by	Function of greenhouse operation	Greenhouse design considerations
High school	Growing and/or maintaining a small number of plant specimens for observation.	**Space**: **10 sq ft per student enrolled** in the course. **Control**: Requires consistent, day-to-day control of the environment.
Vocational school	Providing basic experience in commercial crop production.	**Space**: **20 sq ft per student enrolled** in the course. **Design**: Should be a small-scale version of a commercial operation with three separate temperature zones: **50-55°F min., 60°F min., & 65+°F min.**
Liberal arts college, university	Growing and/or maintaining plant specimens. Simple research projects involving a small number of plants.	**Space**: **10 sq ft per student using the department**. **Design**: Often part of a Science Building complex and must conform to other architecture. Many configurations are possible.
Agricultural colleges	Simulating commercial production. Propagating and finishing zones for crops like cut flowers, pot plants, vegetables, ornamentals.	**Space**: **100+ sq ft per student in the department**. **Design**: Layout, facilities, equipment, and controls must be designed for horticultural applications and be equal to those used by commercial growers.

| **Scientific research** | Complex research projects with numerous plants, multiple compartments for separate climates, precise data recording. | **Space**: Varies from **250 sq ft and up** per growth chamber or compartment. **Design**: May require a separate cluster of working greenhouses for major research projects. |

| **Public conservatory** | Display of plant collections. Usually provides three climates: **tropic, temperate, arid**. Often includes separate working greenhouses for plant production for all civic planted areas. | **Space**: **1½ acres per million population**. Ratio of **40,000 sq ft working greenhouses to 20,000 sq ft display area**. **Glazing**: Display buildings enhanced by **acrylic glazing**. **Structure**: Use of design-oriented structural systems. |

| **Commercial growing operation** | Actual production of plant materials, from propagation to finishing. | **Space**: **40,000 sq ft minimum for profit**. **Service Area**: Provide **1,000 sq ft of service area for every 6,000 sq ft of growing area**. **Glazing**: Glass, fiberglass, or a combination. **Structure**: Sloping or curved roof profile. Can be single or multiple units, compartmentalized, or open ridge/furrow designs. |

| **Hobby gardening** | Growing/maintaining small plant collections, forcing bulbs, rooting seedlings, etc. | **Space**: **100 sq ft minimum**. **Design**: Typically a small prefabricated building with an environmental package providing a neat-appearing, horticulturally adequate unit. |

Calculations and Formulas

This section uses ratios and per-unit metrics as design guides rather than explicit formulas.

Educational Space Planning:

High School: 10 sq ft / student

Vocational School: 20 sq ft / student

Agricultural College: 100+ sq ft / student

Public Facility Planning:

Conservatory Space: 1.5 acres / 1,000,000 population

Working to Display Ratio: 40,000 sq ft (working) / 20,000 sq ft (display) or 2:1

Commercial Space Planning:

Service to Growing Area Ratio: 1,000 sq ft (service) / 6,000 sq ft (growing) or 1:6

BOQ Implications

Structural System: Costs will be driven by specialized lightweight steel or aluminum framing designed for greenhouses, not conventional structural steel.

Glazing System: A primary cost driver. The choice of material (glass, fiberglass, acrylic) and its configuration (single-pane, double-wall) will significantly impact the budget.

MEP Systems:

HVAC: Budgeting must account for specialized horticultural systems (heating pipes, radiant heat, fan-jet ventilation, pad-and-fan cooling), which differ in cost and complexity from standard commercial HVAC.

Controls: Thermostatic and potentially humidistatic control systems are essential line items.

Equipment: Costs for growth chambers, separate compartments, benches, and irrigation systems must be included.

Site Work: Budgeting must include costs associated with proper site selection, such as grading for drainage and potentially planting a windbreak.

Floor Area Calculation: The metrics provided (e.g., sq ft/student) are the primary tool for determining the total building footprint, which is the foundational unit for the entire BOQ.

Critical Notes and Warnings

Structural Integrity vs. Light: The core design conflict is balancing the need for a minimal structure to maximize light against the need for a structure strong enough to support the glazing, wind, and snow loads.

Environmental Control Precision: Maintaining temperature to within ±1.5°F in a fully glazed, uninsulated building is a significant technical challenge and requires specialized, reliable systems.

Siting is Non-Negotiable: The list of sites to avoid is critical. Poor siting can render a greenhouse ineffective or dramatically increase operating costs (e.g., heating costs without a windbreak, loss of plants from toxic fumes).

Function Dictates Design: A common error would be to apply a single design approach to all greenhouses. The table clearly shows that the requirements for a high school hobby greenhouse are vastly different from a commercial operation or a scientific research facility.

Chapter 11: Miscellaneous

Section: HORSE BARNS (Pages 1252-1254)

Overview

This section provides comprehensive guidelines for the design, construction, and arrangement of horse barns and related facilities. The content addresses the needs of various scales of operation, from small pleasure horse establishments to large-scale breeding farms. Key considerations include providing a safe and healthy environment for the horses, ensuring labor efficiency for attendants, and creating an attractive and functional layout. The section covers specific building types, environmental control systems, feed and water equipment, and detailed fencing specifications.

Key Standards and Codes Referenced

- Primary Source Document: `Breeding and Raising Horses`, Agriculture Handbook #394, U.S. Dept. of Agriculture, Washington, D.C., 1972.

Technical Specifications

General Building Standards

- Ceiling Height: Should be 9 ft high in all standard barns.
- Door Dimensions: Doors should be 8 ft high and 4 ft wide.
- Breeding Shed: Requires a higher ceiling of 15 to 20 ft and a door wide enough to permit vehicle entry.

Types and Sizes of Stalls & Barns

- Small Horse Establishments (1 to a few animals)
    - Box Stalls: Should be 12 ft square.

    - Tie Stalls: Should be 5 ft wide and 10 or 12 ft long.
    - Layout: For one or two stalls, a combination tack and feed room is sufficient. For three or more, use separate tack and feed rooms.
- Large Horse-Breeding Establishments
    - 1. Broodmare and Foaling Barn:
        - Stall Size: Most stalls are 12 ft square, but can be up to 16 ft square.
        - Foaling Stall Size: A stall of 16 ft square is desirable for foaling.
        - Ancillary Rooms: Requires an office, toilet facilities, hot water supply, veterinary supply room, tack room, and storage for hay, bedding, and grain.
    - 2. Stallion Barn:
        - Stall Size: Stalls should be 14 ft square.
        - Paddock: Requires a nearby paddock; each side should be at least 300 ft long.
    - 3. Barren Mare Barn:
        - Configuration: An open shed or rectangular building.
        - Space Requirement: Allow 150 sq ft of space per animal.
    - 4. Weanling and Yearling Quarters:
        - Stall Size: Stalls should be 10 ft square. Two weanlings or yearlings may be kept together.
    - 5. Breeding Shed:
        - Size: Should be a 24 ft square roofed enclosure.
        - Facilities: Must have a laboratory for the veterinarian, hot water, and preparation stalls.
    - 6. Isolation Quarters:
        - Purpose: For sick or new animals.
        - Stall Size: Stalls should be 12 ft square.
- Riding, Training, and Boarding Stables
    - Box Stalls: Should be 10 to 12 ft square.
    - Tie Stalls: Should be 5 ft wide and 10-12 ft long.

Environmental Control

- Temperature:
    - Satisfactory Range: 45°F to 75°F.
    - Optimal Temperature: 55°F is considered best.
    - Newborn Foal: Requires 75°F to 80°F until dry (can be provided by a heat lamp).
- Humidity:
    - Acceptable Range: 50% to 75% relative humidity.

    - Preferred Humidity: 60% is preferred.
- Ventilation: The barn must be free from drafts, moisture, and odor.
    - Winter Rate: Provide 60 cubic feet per minute (cfm) for each 1,000 lb of horse.
    - Summer Rate: Provide 160 cfm for each 1,000 lb of horse. This can often be achieved by opening doors and installing hinged walls or panels near the ceiling.

Feed and Water Equipment

- Design: Should be simple and effective, preventing waste and hazards.
- Placement: Should be located so they can be filled without the caretaker entering the stall or corral.
- Type: Detached, specialty equipment is favored over old-style wood mangers and concrete/steel tanks for sanitation and flexibility.
- Bulk Storage: Bulk-tank feed storage is advantageous for large establishments.

Fencing Specifications

- Woven Wire Fences: The mesh should be small enough that horses cannot get their feet through it.
- Board and Pole Fences: Deficiencies include needing paint, splintering, breaking, rotting, and being chewed by horses.
- Detailed Fence Specifications (from Table 1):

```
#### **Fencing Specifications**

- **Woven Wire Fences**: The mesh should be small enough that horses cannot get their feet through it.

- **Board and Pole Fences**: Deficiencies include needing paint, splintering, breaking, rotting, and being chewed by horses.

- **Detailed Fence Specifications (from Table 1)**:



| Post and fencing material | Post length and diameter | Size of rails, boards, or poles and gage of wire | Fence height (Inches) | Number of rails, boards, or poles and mesh of wire | Distance between posts on centers (Feet) |

| :--- | :--- | :--- | :--- | :--- | :--- |
```

Steel or aluminum posts and rails[1]	7½ ft	10 or 20 ft. long	60	3 rails	10
	7½ ft	10 or 20 ft. long	60	4 rails	10
	8½ ft	10 or 20 ft. long	72	4 rails	10
Wooden posts and boards	7½ ft; 4 to 8 in	2 x 6 or 2 x 8 in. boards	60	4 boards	8
	8½ ft; 4 to 8 in	2 x 6 or 2 x 8 in. boards	72	5 boards	8
Wooden posts and poles	7½ ft; 4 to 8 in	4 to 6 in. diameter	60	4 poles	8
	8½ ft; 4 to 8 in	4 to 6 in. diameter	72	5 poles	8
Wooden posts and woven wire[1]	7½ ft; 4 to 8 in	9 or 11 gage staywire	55 to 58	12-in. mesh	12

- **[1]Footnote**: The strength of metal allows for fewer rails and posts. For woven wire, the text recommends adding **1 or 2 strands of barbed wire** (with barbs 3 to 4 inches apart) on top of the fence.

Visual Elements Analysis

Figure 1: Horse barn floor plan

Description: A detailed architectural floor plan for a small horse barn measuring 34'-0" x 22'-0". It features a covered way in front, providing access to two box stalls, a feed room, and a tack room. Technical Details:

- Structure: Timber frame with a girder over the covered way, supported by posts on concrete footings. Footing sizes are specified as 20"x20"x12" and 24"x24"x12". Diagonal bracing is noted for corners.
- Box Stalls: Two stalls, each measuring 12'-6" wide. The floor is specified as Clay Floor. Partitions are "Solid partition to top of 2' stall lining OR slotted partition above 5'". Dutch doors provide access.
- Feed Room: Measures 9'-0" wide with a Concrete Floor.
- Tack Room: Measures 7'-6" wide with a Concrete Floor and a 2'-6" x 7'-0" entry door.

- Windows: Sliding sash type.
- Equipment Callouts: Shows placement for a Hay Rack and Grain or Water Bucket in each stall. Relationship to Text: This plan provides a concrete example of a barn for a "Small Horse Establishment," meeting the stall size recommendations and layout suggestions in the text.

Calculations and Formulas

Animal Heat and Moisture Production

- Heat Production:
  - 1,000-lb horse: ~1,790 British thermal units (Btu) per hour.
  - 1,500-lb horse: ~2,450 Btu per hour.
- Moisture Production:
  - A horse breathes approximately 17.5 lb (2.1 gal) of moisture into the air per day.

BOQ Implications

- Fencing: Table 1 provides direct inputs for quantity takeoffs. For a given length of fence, one can calculate the number of posts, linear feet of rails/boards, or rolls of woven wire required. This is the most direct BOQ data in the section.
- Concrete: Quantities are required for the floors of the feed and tack rooms (as per Fig. 1) and for all post footings.
- Sitework: Clay fill is specified for stall floors. The site must be on high ground for good drainage.
- Structural Materials: Lumber for framing, posts, girders, and board fencing. Metal for roofing and potentially for rail fencing.
- Stall Equipment: Line items for hay racks, water buckets, Dutch doors, and all associated hardware.
- MEP Systems: Costs for bringing water and electricity to the barn. The ventilation system requires quantification of fans, louvers, and controls based on the CFM requirements and the total volume of the barn.

Critical Notes and Warnings

- Safety is Paramount: All projections that might injure horses must be removed. Attendants should not have to walk behind horses to perform feeding and watering tasks.
- Fire Risk: Use of fire-resistant materials and fire-retardant paints/sprays is recommended to provide added protection.

- Healthful Conditions: Barns must be easy to keep clean to provide a healthy environment. A dry, well-drained site is essential.
- Rodent and Bird Control: Feed and tack storage areas must be designed to be rodent- and bird-proof.
- Expandability: Barns should be designed to be easily expandable without interference from other structures or utilities. This requires forward planning.
- Fencing Safety: For woven wire, the mesh size is critical to prevent horses from getting their feet caught. The text also suggests barbed wire on top, which itself can be a hazard and requires careful consideration.
-

Chapter 11: Miscellaneous

Section: HORSE STABLES (Pages 1255-1260)

Overview

This section, written from a British architectural perspective, provides an in-depth guide to the planning, siting, and construction of horse stables. It moves beyond basic shelter to address the specific needs of keeping horses for work and sport, where maintaining peak fitness and cleanliness is paramount. The text covers the fundamental requirements for stable buildings, detailed considerations for the layout of various functional units within a stable complex, and specifications for fixtures and fittings. The underlying principle is that a well-designed stable minimizes labor, ensures the health and safety of both horses and staff, and is tailored to the specific operational routine of the owner.

Key Standards and Codes Referenced

- Primary Source Document: `The Design & Construction of Stables`, by Peter C. Smith, Associate of the Royal Institute of British Architects, published by J.A. Allen & Co., Ltd., London, 1967.

Technical Specifications

Principal Requirements of Stables

The six basic needs controlling the design and construction of stable buildings are:

1. Dryness
2. Warmth

3. Adequate ventilation with freedom from draughts
4. Good drainage
5. Good lighting (daylight and artificial)
6. Adequate and suitable water supply

Siting of Stables

- Ground Conditions: Ideally, the ground should be naturally well-drained (chalk or gravel). Clay soil, which retains water, is unsuitable and requires sub-surface drainage.
- Orientation: Buildings containing horses must be protected from northerly or easterly winds. Doors and windows of stalls should face in a southerly direction.
- Air Circulation: While protected from wind, the site should allow for free circulation of air around the stables. Avoid sites hemmed in by trees or other buildings.
- Topography: Avoid siting stables on top of a hill (too exposed) or in a hollow (which become frost pockets and collect water).
- Proximity to Housing: Stables should be positioned well away from adjoining houses to prevent odors from being carried into living areas. Local authorities will likely enforce this.

Layout and Required Units for a Stable Group

For a stable accommodating 20 horses with five grooms, the following 15 units are required:

1. Twenty loose boxes
2. One sick box
3. Feed room
4. Hay store
5. Straw store (or storage for alternative litter)
6. Feed store
7. Washing and cleaning room (incorporating drying facilities) *
8. Saddle and bridle room (tack room)
9. Utility box or boxes
10. Litter drying shed *
11. Manure bunkers
12. Office (in some cases) *
13. Lavatory accommodation
14. Sitting-room for grooms
15. Garage or covered area for horse box/trailer (* Items often omitted in smaller establishments)

Loose Boxes and Stalls

- Loose Box Size:
    - Suitable Size: 12 ft x 12 ft (comfortably houses a 16.0-17.0 hh hunter).
    - Minimum Size: 10 ft x 10 ft. It is unwise to reduce below this, as a pony's box today may need to house a horse tomorrow.
- Stall Size: Minimum of 6 ft wide and 9 to 10 ft long.
- Sick Box:
    - Size: Should be approximately 50% larger than a standard loose box.
    - Structural: The roof must be strong enough to support a sling attachment.
    - Location: Must be isolated from other horses but positioned for convenient observation.
- Utility Box: A multi-purpose box for clipping, grooming, shoeing, washing, etc. For efficiency, a ratio of one utility box per three horses (one per groom) is recommended.

Feed Rooms and Storage

- Feed Room: For daily feed preparation. Should contain separate bins for oats, bran, nuts, etc., a sink with hot and cold water, and racks for equipment.
- Feed Store: For bulk storage of feed sacks. Should open directly into the feed room.
- Hay/Straw Stores: Must be situated next to the feed store with easy access to the loose boxes. Must be dry and well-ventilated.
- Alternative Litter Storage: Materials like peat, sawdust, wood shavings, fern leaves, or fir needles must be stored in a dry, well-ventilated building.

Tack, Washing, and Cleaning Rooms

- Tack Room (Saddle & Bridle Room): Should be positioned close to and ideally connected under cover to the loose boxes. The size depends on the number of horses and tack. It typically accommodates a medicine cabinet, poison cupboard, bit case, and blanket chests.
- Washing & Cleaning Room: Highly advantageous. It should open from the tack room and have an external door to the yard. It requires a large, deep sink with hot and cold water, saddle horses (racks), and ceiling-suspended bridle cleaning holders.

Ancillary Facilities

- Manure Bunkers: Must be positioned well away from loose boxes but easily accessible for daily mucking out and for collection vehicles.
- Weighing Machine: A weighing platform may be required in large establishments, positioned at the stable entrance.

- Office: Required for large establishments and riding schools. A room of 100 to 150 sq ft is ample. Must be positioned to command supervision over the yard.
- Mounting Block: Positioned at the side of the stable yard where it will not obstruct traffic. Requires adequate free space to lead a horse up and ride away in a straight line.
- Fences and Gates:
  - Fencing: Should be of stout construction, typically post and rail.
  - Gate Opening (Vehicle): At least 10 ft clear opening, with 12 ft being better.
  - Gate Opening (Hand): 4 ft clear opening for horse and rider.
  - Gate Hardware: Should be fitted with hunting latches to allow opening by mounted riders.
- Stable Furniture (per box/stall):
  - Manger: Metal container fixed at a height of about 3 ft from the floor. Combined manger/water troughs are not recommended.
  - Hay Rack: Can be low-level or high-level. High-level racks should be no higher than 5 ft to the top to facilitate filling and prevent dust in the horse's eyes.
  - Water: Provided via a bucket or a 2-gallon automatic drinking trough.
  - Tying Rings: Two rings per box/stall are adequate. Should be fixed at a height of 5 ft to 5 ft 6 in.
  - Salt Lick Holder: Fitted over or to one side of the manger at a height of about 5 ft.

Visual Elements Analysis

Figure 1 & 2: Loose box and Section

Description: Fig. 1 is a simple plan of a single loose box. Fig. 2 is a corresponding cross-section. This represents the simplest, most common layout where a box opens directly to the open air. The text notes this can be improved with a roof overhang to create a covered walk.

Figure 3: Internal Passage Layout

Description: A plan showing loose boxes contained within a larger building structure, with an adjacent internal passage. This is a more expensive layout that offers better control of ventilation, warmth, and quietness.

Figure 4 & 5: Double Banked and Central Passage Layouts

Description: These plans show more compact layouts for restricted sites. Fig. 4 shows loose boxes "double banked" back-to-back. Fig. 5 shows the more common and economical layout with two rows of boxes facing each other across a central passage.

Figure 6: Small Stable Site Plan

Description: A detailed site plan for a small stable (scale provided). It shows a U-shaped arrangement of 8 stalls/boxes around a central yard, opening into a larger paddock. Technical Details: Components are labeled: U.B. (Utility Box), S.P. (Stand Pipe), T.R. (Tack Room), H/S. (Hay/Straw Store), M. (Manure Bunker), M.B. (Mounting Block). The layout includes an existing house and garage.

Figure 7: Large Stable Site Plan

Description: A site plan for a larger, symmetrical stable complex for 18 horses. It features a central block with feed/tack/cleaning rooms, flanked by two wings of loose boxes, all connected by a "Line of covered way." Technical Details: The layout is highly organized. Components include: UB (Utility Box - 4 total), CLNG. (Cleaning), TACK ROOM, FEED STORE, HAY STORE, STRAW STORE, MANURE bunkers, and M.B. (Mounting Block). Stand pipes (SP) are located strategically.

Figure 8: Tack Room Layout

Description: A detailed floor plan of a tack room. It contains precise dimensions and arrangement for fixtures. Technical Details:

- Saddle Racks: Positioned at 24 in. centers on center (c/c).
- Girth Hooks: Wall length needed for 6 girths is 26 ½ in.
- Bridle Racks: Spaced at 6 in. to 9 in. c/c.
- Hooks for Halters: Spaced at 6 in. c/c.
- Bandage Compartments: Each is 9 in. x 6 in. x 9 in. deep.
- Rug Chests: Each chest measures 33 in. x 22 in. x 22 ½ in.
- Hooks for Stirrup Leathers: Called out.
- A "Line of bit case over" indicates vertical storage planning.

Figure 9: Detail of Loose Box

Description: A detailed floor plan of a single 12 ft x 12 ft loose box. Technical Details:

- Furniture: Shows the placement of a "Combined manger and hay rack," a "Salt Lick," and "The ring."
- Lighting: Shows two potential lighting positions: one centrally if partitions are part-height, and one over the partition if partitions are full-height.
- Door: A 4'-0" wide door is shown with "ROLLERS FITTED" and a "Cabin hook."

- Construction: "Bullnosed bricks used at all external angles" is noted for safety and durability.

Calculations and Formulas

- Ratio for Utility Box: 1 utility box : 3 horses
- Sick Box Area: 1.5 x (Area of standard loose box)
- Office Area: 100 to 150 sq ft
- Gate Opening Widths: 10 ft - 12 ft (vehicle), 4 ft (hand)
- Fixture Heights:
  - Manger: ~3 ft
  - High Hay Rack: ~5 ft
  - Tying Rings: 5 ft to 5 ft 6 in
  - Salt Lick Holder: ~5 ft

BOQ Implications

- Master Checklist: The list of 15 essential units for a 20-horse stable serves as a primary checklist for scoping quantities and line items.
- Specialized Joinery/Metalwork: The detailed tack room plan (Fig. 8) provides exact dimensions for fabricating custom saddle racks, bridle racks, and storage chests. This is a key cost center.
- Site Work: Requires well-drained fill (gravel) if on poor soil. Quantities for manure bunkers, paving, and fencing are significant.
- Fencing: Post and rail fencing quantities can be calculated based on fence length, with posts at 8 ft centers (for wood) and gates of specified widths.
- Fixtures and Equipment: Line items must be included for mangers, hay racks, automatic waterers, salt lick holders, saddle horses, bridle hooks, sinks, and potentially a weighing machine.
- Labor Efficiency: The text emphasizes that good design reduces labor costs over the life of the building. Investing in a covered walkway, for example, increases initial cost but improves all-weather work efficiency.

Critical Notes and Warnings

- Client Consultation is Key: The owner's specific routine for feeding, cleaning, and managing horses will materially affect the design. This must be established before planning begins.
- Material Durability: Bullnosed bricks at corners, stout fencing, and durable fixtures are required to withstand wear and tear from large animals.
- Animal Safety and Welfare:
  - Avoid sharp corners and projections.

    - Combined manger-waterers are bad for digestion and hygiene.
    - High hay racks can cause eye irritation from dust and seeds.
    - Sick animals need to be isolated but should still be able to see other horses to reduce stress.
- Layout Logic: Poor layout increases labor dramatically. Carrying heavy bales of hay and straw long distances is inefficient and taxing. The relationship between storage areas, feed prep, and the stalls is the most critical planning consideration.

Chapter 11: Miscellaneous

Section: RIDING SCHOOLS (Pages 1261-1262)

Overview

This section provides design and construction standards for indoor riding schools (also known as arenas). The primary purpose of this building is to provide a controlled environment for schooling horses and riders, free from inclement weather and external distractions. The guide covers critical aspects such as the building's size, siting, floor construction, wall safety features, lighting, and access. The design must accommodate the specific needs of different equestrian disciplines, such as general instruction or formal dressage.

Key Standards and Codes Referenced

- Primary Source Document: `The Design & Construction of Stables`, by Peter C. Smith, Associate of the Royal Institute of British Architects, J. A. Allen & Co., Ltd., London, 1967.

Technical Specifications

Building Size and Dimensions

- Full-Size Military School:
    - Dimensions: 60 ft x 180 ft.
    - Capacity: Allows for three instructional groups ("rides") to work simultaneously, each within a 60 ft x 60 ft area.
- Standard Dressage Arena:
    - Dimensions: 66 ft x 132 ft (20 meters x 40 meters). This size is noted as being in more demand.

- Span: It is not recommended to reduce the shorter dimension (span) as it needs to be wide enough to longe a horse on a full-length 25 ft rein.

Wall Construction

- Lower Wall (Kick Wall):
    - Height: Must be of stout construction up to a minimum height of 4 ft.
    - Angle: The wall must be sloped (splayed) inwards at an angle of approximately 12° to 15°. This is a critical safety feature to prevent the rider's leg/knee from being crushed against the wall.
    - Construction: The splayed section must be a continuous, unbroken surface, clear of any structural posts or piers. It is often constructed of stout timber or steel framing faced with matched boarding.

Floor Construction

- Sub-base: One method involves excavating the area to a depth of 24 in.
    - Fill the bottom 18 in. with tightly packed birch or hazel faggots (or gorse).
- Surface (Topping): The final 6 in. is filled with a suitable riding surface material.
    - Materials: Tan, sawdust, peat, or wood shavings.
        - Tan: Has a disadvantage of "balling" in a horse's feet.
        - Sawdust/Wood Shavings: Have a disadvantage of being a fire danger.
        - Peat: Considered a more satisfactory finish.
- Maintenance: The floor will require periodic damping with a fine spray of water to keep dust down. This can be supplied by a hose from a standpipe or via a permanently installed overhead sprinkler system.

Doors and Entrances

- Size:
    - Minimum Height: 10 ft (to allow a rider to enter while mounted).
    - Minimum Width: 8 ft.
- Type: Sliding doors are often used and are satisfactory if fitted with suitable gearing.
- Hardware: Handles must be fitted both externally and internally at two heights:
    - One at approximately 4 ft high for ground-level operation.
    - One at approximately 7 ft high for use by a mounted rider.

Siting and Orientation

- Ground Conditions: The building must be sited on level, well-drained ground.
- Relationship to Stables: Should be in a convenient position relative to the stables, but separated enough so that horses at rest are not disturbed by the noise from training activities.

- Relationship to Paddocks: Should be positioned adjacent and easily accessible from schooling paddocks.
- Orientation for Lighting:
  - With Roof Lights: Can be oriented in any direction.
  - With Side Windows: Should preferably be sited with the long axis oriented due north and south.

Visual Elements Analysis

Figure 1: Military Riding School - Full Size & Dressage Arena

Description: Two plan diagrams showing standard arena sizes.

- Top Diagram (Military Riding School): A simple rectangle labeled with dimensions of 180'-0". The corresponding text states the dimensions are 60 ft x 180 ft.
- Bottom Diagram (Dressage Arena): A rectangle dimensioned as 40 metres x 20 metres. The standard dressage letters (A, K, E, H, C, M, B, F) are shown in their correct positions around the perimeter. The dimensions are also provided in imperial units as 132 ft x 66 ft. Relationship to Text: These diagrams visually specify the two standard arena sizes discussed in the text, providing clear dimensional and layout information.

Figure 2: Riding School Wall Section

Description: A detailed cross-section of the lower portion of the riding school wall (the kick wall). Technical Details:

- Slope Angle: Labeled as "Angle of 12°-15°".
- Wall Height: Labeled as "Min. 4'-0"".
- Floor Base: The sub-base is shown as "2'-0" deep and composed of "Base formed with hazel or birch faggots or gorse." *(Note: This dimension of 24 inches conflicts with the 18 inches stated in the text.)*
- Floor Surface: The top layer is labeled "Topping of peat, sawdust, tan, or wood shavings." Relationship to Text: This drawing provides a critical construction detail for the sloped safety wall and the specialized floor system described in the text.

Figure 3: Stalls. (a) Plan; (b) elevation.

Description: These diagrams illustrate the design of tie stalls, which are typically part of a stable building, not a riding school. Their inclusion on this page appears to be a layout error in the source book.

- (a) Plan: Shows a row of stalls, each measuring 6'-0" wide. A "Steel channel as end pillar" is noted, indicating a method of construction.
- (b) Elevation: Shows the front view of a stall from the inside of a barn aisle.
    - Technical Details:
        - Partition Height: Labeled as "6'-0" min.".
        - Total Ceiling Height: Labeled as "9'-0" min.".
        - Stall Width: Labeled as "5'-0" to 6'-0"".
        - Fixture Callouts: Shows the typical placement for a "Hay rack," "The ring," "Salt Lick," "Manger," and a lower "Ring for pillar rein."

Relationship to Text: This figure does not relate to the "Riding Schools" text on the page. It provides standard dimensions and fixture information for tie stalls, as might be found in the "Horse Stables" or "Horse Barns" sections.

Calculations and Formulas

This section uses direct dimensional standards rather than formulas. Key dimensions are summarized in the specifications above.

BOQ Implications

- Earthwork: Excavation of the entire arena footprint to a depth of 24 inches represents a significant quantity of earthmoving.
- Specialized Materials:
    - Sub-floor: Sourcing and installing a large volume (18 to 24 inches deep) of birch or hazel faggots/gorse is a highly specialized and potentially costly item.
    - Riding Surface: Quantity calculation for the 6-inch deep topping material (peat, tan, sawdust).
- Structural System: The wide span of the arena (60 ft or 66 ft) requires large-span roof trusses (wood or steel), which are a primary cost driver for the building shell.
- Wall System:
    - Kick Wall: Requires calculating the material and labor for the stout, sloped lower wall, including framing and the specified boarding.
    - Upper Wall/Cladding: Standard cladding for the walls above the kick wall.
- Doors: Costs for large, custom sliding doors (min 8'x10') and their specialized hardware (tracks, rollers, handles).
- Utilities: Costs for a water supply system for damping the floor, including a standpipe or a more complex overhead sprinkler system. Electrical system for even, high-quality lighting.

Critical Notes and Warnings

- Safety is Paramount: The sloped 12°-15° kick wall is not an aesthetic choice; it is a critical safety feature to protect riders and must be built correctly.
- Floor Performance: The choice of floor material impacts horse soundness and maintenance. Tan can cause issues ("balling" in hooves), while sawdust presents a fire risk.
- Siting and Noise: Siting the school too close to the stables can cause stress to resting horses. The acoustic design and location must be considered.
- Door Design for Riders: Doors must be operable by a mounted rider. This requires correctly placed handles at a height of ~7 ft.
- Dimensional Standards: The dimensions of the arena are standardized for specific equestrian disciplines. Building to a non-standard size may limit the facility's use for competitions or formal training.

Chapter 11: Miscellaneous

Section: KENNELS (Pages 1263-1264)

Overview

This section provides guidelines for the design and layout of dog kennels, based on principles from the 1935 publication "Sporting Stables and Kennels." The focus is on creating a practical, hygienic, and comfortable environment for the dogs, suitable for various scales from a small private kennel to a larger commercial or breeding operation. The core design philosophy separates the facility into two main parts: the living compartments for the dogs and a functional workroom for their care. The section presents three distinct kennel layouts, each with a different approach to scale, expandability, and environmental control.

Key Standards and Codes Referenced

- Primary Source Document: `Sporting Stables and Kennels`, by Richard U. N. Gambrill and James Mackenzie, Derrydale Press, New York, 1935.

Technical Specifications

Siting Requirements

- Drainage: The site should be on ground that drains well.

- Environmental Exposure: Should offer protection from cold winter winds and allow for cooling breezes in the summer.
- Shade: A few large shade trees around the kennel are described as a "necessity."
- Acoustics: If possible, the kennel should not be built where barking can annoy neighbors.

Workroom Requirements

- Floor: Must have a floor that can be washed down daily, with a drain in the middle.
- Utilities: Must contain a stove, and have access to hot and cold water and a sink.
- Equipment:
  - A large, solid table for trimming and stripping dogs.
  - A washtub with a division for washing and rinsing.
  - Suitable bins or closets for feed and bedding.
  - A large, well-stocked medicine closet.
  - A refrigerator and meat chopper are noted as "invaluable" if raw meat is used.

Compartment (Living Quarters) Requirements

- Standard Size: A compartment size of 5 ft square is used as the basis for the plans. This size is considered sufficient for any dog breed up to the size of a setter, especially if only one dog is kept per room. The text notes this size can be easily altered.
- Layout Principle: Each indoor lodging room must lead into a small, private concrete yard. All concrete yards must then open into a larger, shared grass yard for exercise.

Visual Elements Analysis

Figure 1: Simple Kennel Layout

Description: A plan for a very simple, four-compartment kennel suitable for a few dogs, for temporary housing, or for raising litters. It consists of a single, linear building. Technical Details:

- Workroom: Measures 21'-6" x 5'-0". It is equipped with a stove, two washtubs, a table, and feed bins.
- Compartments: Four compartments, each measuring 5' x 5'.
- Yards: Each compartment opens to its own cement yard. The four cement yards collectively occupy a space of approximately 15' x 20' (derived from component

dimensions). These yards then open to a larger grass yard. Relationship to Text: This plan visually represents the "very simple kennel" described, providing a basic, functional layout for a small-scale operation.

Figure 2: Private or Commercial Kennel Layout

Description: A larger, symmetrical, and expandable kennel design suitable for a private or commercial breeder. It features a central workroom with two wings of compartments. Technical Details:

- Workroom: A large central room measuring 20' x 15'. It contains a table, sink, tubs, and designated storage areas for "BEDDING" and "FEED".
- Compartments: Sixteen total compartments (eight per wing), each measuring 5' x 5'. The wings are separated from the workroom by solid walls.
- Yards: Each compartment has a private cement yard. The two wings of yards are separated by a central "CEMENT PASSAGE." All yards open onto a large shared "GRASS YARD."
- Construction Notes: The text suggests this design allows for a "hospital" wing. A solid partition could be built across the wings (e.g., below the fourth compartment), allowing the eight compartments closest to the workroom to be heated. The remaining compartments would be unheated. Relationship to Text: This plan illustrates the expandable and more complex kennel layout suitable for housing different breeds or creating separate zones (like a hospital), as discussed in the text.

Figure 3: Alternate Kennel Layout with Show Room

Description: A different kennel arrangement designed to improve ventilation and reduce odor circulation. It features a detached workroom and a central "show room." Technical Details:

- Workroom: A separate building at the rear, measuring 9' x 18'. It is separated from the main kennel by an open "PASSAGE."
- Ventilation Feature: The open-ended passage allows air to flow freely between the workroom and the main building, preventing smells from circulating into the kennel.
- Main Building: Contains a central "SHOW ROOM" (18'-0" x 17'-6") flanked by two wings with a total of 20 compartments.
- Compartments: Each measures 5' x 5'.
- Yards: The compartments on the south side have individual "CEMENT YARDS" (each 5' x 15') which open to a "SHOW YARD" (20' x 14') and then a large "GRASS YARD."

- Design Flaw: The text explicitly notes a disadvantage: the compartments on the north side have not been supplied with cement yards due to the cold in winter. It is suggested these north-facing compartments can be used for "whelping pens." Relationship to Text: This diagram presents an alternative design focused on odor control, but highlights a significant trade-off in functionality based on the building's orientation, a key consideration mentioned in the text.

Calculations and Formulas

This section uses dimensional standards, not mathematical formulas.

- Standard Compartment Size: 5 ft x 5 ft
- Cement Yard (Fig. 3): 5 ft x 15 ft
- Workroom (Fig. 2): 20 ft x 15 ft

BOQ Implications

- Concrete: A primary material and cost. Required for the floors of all compartments and workrooms, as well as for all the individual cement yards and passages shown in the plans.
- Fencing: Significant quantities of fencing will be required to enclose the large grass yards depicted in all three layouts.
- Masonry and Framing: Materials for constructing the kennel buildings themselves, including any interior or exterior solid walls.
- Plumbing: Cost for running hot and cold water to the workroom, installing sinks, washtubs, and a central floor drain.
- Mechanical: Cost for a stove in the workroom. In larger designs like Figure 2, a boiler and piping system would be required to heat a "hospital" wing.

Critical Notes and Warnings

- Outdated Standards: The source document is from 1935. Some advice, particularly the suggestion of having kennel rooms with no outdoor access (the north side of Fig. 3), may not align with modern animal welfare standards.
- Odor Control: A key design consideration. The layout in Figure 3 is specifically designed to mitigate the circulation of smells by physically separating the workroom from the housing with a breezeway.
- Neighbor Nuisance: The text explicitly warns that barking can be a major issue, making site selection critical to maintain good relationships with neighbors.
- Hygiene: The repeated emphasis on washable concrete floors and a central drain highlights that maintaining a clean, sanitary environment is fundamental to kennel design.

- Flexibility: While a 5'x5' standard is used, the text states that this can and should be adjusted based on the size of the breed being housed.

Chapter 11: Miscellaneous

Section: NATURE CENTER (Pages 1265-1267)

Overview

This section outlines the philosophy, components, and design guidelines for a modern nature center and its interpretive building. It distinguishes the modern center from traditional museums by emphasizing passive recreation, hands-on learning, and habitat management. The interpretive building is presented as the functional and administrative hub of the center, designed to orient visitors and support educational programs. The guidelines cover everything from high-level site selection criteria to specific interior design considerations, with a strong focus on functionality, sustainability, and accessibility.

Key Standards and Codes Referenced

- Primary Source Document: `Guidelines for Interpretive Building Design`, edited by Richard J. Manly, National Audubon Society, New York, 1977.
- Example Project: Cincinnati Nature Center; Sponsoring agency: Cincinnati Nature Center Association; Architect: Harry Hake and Partners, Cincinnati, Ohio 45206.

Technical Specifications

Four Basic Components of a Nature Center

1. Natural Resource Base: A diverse area of land, ranging from as little as twenty acres to hundreds of acres.
2. Physical Facilities: Roads, trails, indoor/outdoor displays, a maintenance building, and an interpretive building.
3. Programs: Varied, inspirational, instructional, and recreational activities.
4. People: Professional and volunteer staff, and the visiting public.

Building Site Location Criteria

The location of the interpretive building must consider:

- Construction Suitability: Favorable soil drainage and slope conditions.

- Access: Proximity to significant interpretive features of the center.
- Aesthetics: An esthetic setting.
- Conservation: Avoiding biologically significant areas.
- Climate: Avoiding localized climatic extremes (frost pockets, high winds, drifting snow).
- Expansion: Ample space for future building expansion.
- Security: Protection from vandalism, fire, flooding, geologic faulting, and soil subsidence.
- Utilities: Accessibility to existing roads and utilities.

Overall Building Design Considerations

- Profile: Low-profile buildings are generally less visually obtrusive.
- Exterior Finishes: Should be faced with materials like wood or stone that blend with the natural surroundings.
- Circulation: Entrances, exits, and interior spaces should support a one-way traffic flow pattern for unsupervised groups.
- Energy Conservation: The building should be a model of energy conservation, incorporating:
    - Siting for protection from climatic extremes.
    - Thermal windows.
    - Efficient insulation.
    - Natural draft ventilation (to minimize AC).
    - Maximizing natural lighting.
    - Use of alternative energy (solar, water, or wind power).

Interior Building Design Considerations

- Exhibit Area: Needs flexible and efficient traffic flow, ample usable wall and floor space, and good lighting/ventilation.
- Offices: Permanent staff should have individual offices or work areas affording a reasonable degree of privacy.
- Classrooms: Centers anticipating large school attendance need several classrooms for orientation and indoor activities.
- Auditorium: Required if the program includes activities for large audiences.
- Restrooms: Must be designed to accommodate peak visitor traffic. Should have external access for after-hours use.
- Bookstore/Shop: Should be readily accessible but not conflict with traffic flow or be an audible distraction.
- "Mud" or "Wet" Room: A space (often in the basement) for cleaning up after messy outdoor programs and for storing related equipment (dip nets, snowshoes, hip boots).

- Workshop: An absolute necessity for designing and building exhibits. Due to noise, smells, and hazards, it is best located in a separate maintenance building.
- Storage: Lack of adequate storage is a universal complaint; providing plenty of storage space should be a prime concern.
- Darkroom: Can be a key feature for successful nature photography programs.
- Accessibility: Must be designed for small children, the aged, and the handicapped, with features like ramps, special water fountains, and accessible exhibits.
- Windows: Large windows can be problematic:
  - They limit wall display space.
  - They make it difficult to darken rooms for audiovisual presentations.
  - They increase heating/cooling costs if not thermally insulated.
  - They create a collision hazard for migrating birds (mitigated by attaching hawk silhouettes).
- Flooring: Carpet is recommended for the exhibit area, auditorium, classrooms, and library due to its durability, warmth, and sound-muffling properties.
- Lighting/Electrical:
  - Movable light fixtures on ceiling-mounted tracks are recommended for flexibility in exhibit and classroom areas.
  - Continuous-track electrical outlets are preferred to standard fixtures.

Visual Elements Analysis

Figure 1: Interpretive building design concept

Description: A bubble diagram illustrating the functional relationships between the spaces in an interpretive building. It shows a central "EXHIBIT/MULTIPLE USE SPACE" (including Reception/Bookstore) as the core. Technical Details:

- Flow: Arrows show the primary flow of visitors "TO TRAIL SYSTEM." There is a "PRIMARY OUTWARD ORIENTATION" from the main spaces toward the trail, and a "SECONDARY OUTWARD ORIENTATION" from the administrative spaces. The main entry has an "INWARD ORIENTATION."
- Adjacencies:
  - `RESTROOMS`, `CLASSROOM SPACE`, and `ASSEMBLY SPACE` are directly connected to the central exhibit area.
  - The `ADMINISTRATIVE SPACE` (Offices/Library) is connected but distinct.
  - A `VIEWING AREA` is shown as a key outward-focused feature. Relationship to Text: This diagram provides the conceptual framework for laying out an interpretive building, visualizing the circulation patterns and spatial relationships discussed in the text.

Figure 2: Cincinnati Nature Center

Description: A detailed architectural floor plan of the Cincinnati Nature Center, serving as a case study. The plan is organized around a central axis from the entrance to a "fireside seating" area and a large `display` space. Technical Details:

- Entry Sequence: Visitors enter into a vestibule, with access to a coat room, janitor closet, and restrooms (`women's toilet`, `men's toilet`). A reception desk commands the entry.
- Public/Exhibit Space: A large `display` area with a `bookstore & nature shop` and `fireside seating`. "Clearstory windows above" are noted.
- Meeting/Classroom Space: A block of four `meeting rooms` is shown, separated by `folding doors`, allowing for maximum flexibility.
- Administrative/Support Space:
  - A wing contains the `director`'s office, `general` office, `bookkeeper`, and a `library` and `board room`.
  - A separate support block includes `naturalist preparation`, `mech. equip. rm.`, a `kitchen`, and a `volunteers' lounge` with a `shower` and `closet`.
- Outdoor Space: A large `balcony` is accessible from the library, and a `porch` is accessible from the meeting rooms. Relationship to Text: This plan is a real-world application of the principles outlined. It demonstrates the zoning of public, administrative, and support spaces; the use of flexible meeting rooms; the inclusion of amenities like a volunteer lounge and library; and the strong connection to the outdoors via the porch and balcony.

Calculations and Formulas

This section does not contain mathematical formulas. It uses qualitative and comparative guidelines (e.g., "ample space," "as little as twenty acres").

BOQ Implications

- Specialized Construction:
  - Energy Efficiency: Budget must account for high-performance items like thermal windows, high levels of insulation, and potentially alternative energy systems (solar panels, etc.).
  - Exterior Finishes: Sourcing and installing natural materials like stone and high-quality wood siding are key cost factors.
- Interior Finishes:
  - Carpet: The recommendation for carpet in high-traffic public areas means specifying commercial-grade, durable carpeting.

    - Flexible Partitions: The use of operable (`folding doors`) partitions between meeting rooms is a significant cost compared to standard fixed walls.
- Fixed and Loose Equipment:
    - Exhibitry: A major cost center. Includes custom displays, cases, interactive elements, and AV equipment.
    - Workshop Equipment: Tools and machinery for the exhibit workshop.
    - Darkroom Equipment: If included, this requires specialized plumbing, ventilation, and photographic equipment.
- Accessibility (ADA Compliance): Costs associated with ramps, accessible restrooms and fixtures, and potentially elevators must be included.
- Site Work: Beyond the building pad, costs will include creating trails, outdoor display areas, and potentially habitat restoration or management as part of the overall center's mission.

Critical Notes and Warnings

- Storage is Critical: The text repeatedly warns that a lack of storage is a universal problem. This must be a primary design concern from the beginning.
- Workshop Location: For safety (fire, fumes) and acoustic reasons, the exhibit workshop should ideally be in a separate building.
- Window Hazard: The text highlights the serious and often overlooked issue of large windows causing bird fatalities. Proactive mitigation (e.g., hawk silhouettes) is necessary.
- Design for People: The building must serve a broad cross-section of the community. This means prioritizing accessibility and creating welcoming spaces for all visitors, from children to the elderly.
- Function Over Form: A caution is given that the interpretive building should not become an "impractical architectural oddity." Its primary goal is to be a functional and efficient structure that supports the center's mission.