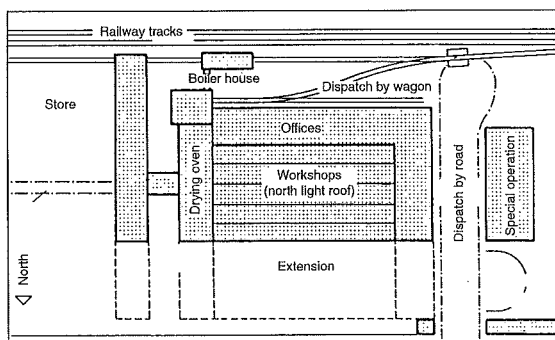


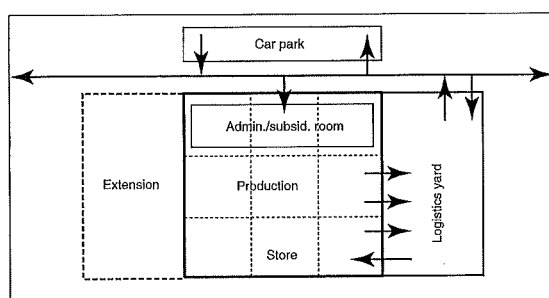
1 Planning diagram of a factory

Environmental protection
federal emissions protection law with criteria for an approval process, possibly including environmental impact assessment (EIA) technical instructions for the avoidance of noise nuisance technical instructions for clean air preservation groundwater protection law
Workplace Regulations
Workplace Regulations Workplace Guidelines, revised to 2010, newly available are A 1.3 (2007) and A 2.3 (2007) guidelines of the federal association of commercial accident insurers accident prevention regulations of the accident insurers and the federal association of accident insurers German engineers' association (VDI) standards
Fire protection
industrial construction guideline with minimum requirements for fire protection in industrial buildings → p. 500 structural fire protection in industrial building technical rules for flammable liquids technical rules for hazardous substances

2 Basic planning regulations for the construction of industrial and commercial buildings (selection)



3 Additive typology: Fagus Werk, Alfeld Architect: Walter Gropius



4 Integrated typology: 'open workspace'

Industrial buildings, directly or indirectly, are designed for the production of goods. In addition to the actual **production buildings** (preparation, manufacture, consignment, packaging) these are also **warehouses** (raw materials, finished products), **technical and administration buildings** and **transport systems**. The spectrum of production ranges from labour-intensive heavy industry to 'smart' low-emission and highly automated light industry. The requirements for the design are accordingly varied: if the traditional factory hall is little more than a tool, the requirements extend to 'corporate identity', from recognition value to sympathetic and communication-oriented workplaces.

Layout planning

The layout is the classic basis of factory building. The various parameters of the planned production plant are defined and systematised in the layout → 1. It is processed in various stages (ideal, trial, rough and precise layout). One of the results of layout planning is the room allocation plan as a scaled functional scheme of the planned plant and as the basis for the design of the building. The structure designed in line with the layout is product-specific. In the course of the various non-specific design work (e.g. start-up centres) and the simultaneous development of product and production plant, the layout becomes ever less significant as a design basis, being replaced by more flexible concepts.

Design basis

The design of industrial buildings is subject to numerous laws, guidelines, standards and regulations. In addition to the public planning law → p. 56, these are mainly environmental, health and safety, and fire protection requirements → 2. Further, there are various state laws and product-specific regulations.

Life cycles

Analogous to the life cycles of the product, industrial building is subject to various economic phases → 5. Ever shorter product cycles (5–7 years) are not in accord with the life of a normal building. Aspects of adaptability, suitability for letting and resale value are therefore becoming increasingly significant in the design of industrial buildings.

Product					
5 years					
product development	market introduction	growth	maturity	market saturation	decline
idea	design	construction	use	rebuilding	demolition

Building					
25 years					
idea	design	construction	use	rebuilding	demolition

5 Life cycles of products (above) and buildings (below)

Typologies

The basic types of industrial building can be split into additive and integrative plants.

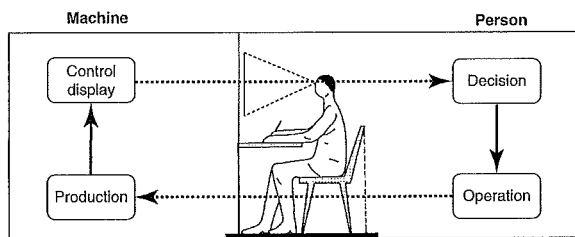
In additive plants, the individual functional units are shaped according to their purpose and added to planar or linear structures (often along a production line). The units can be extended, developed and exchanged separately → 3.

In integrative plants, the functional units are assembled to form a neutral structure → 4. The advantages here are the minimisation of access areas and reusability. Possibilities for extension have to be planned into the building structure.

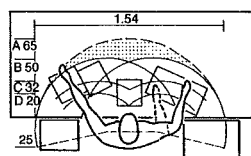
Industry and trade

INDUSTRY

Basics
Shed
construction
Multi-storey
industrial
buildings
Transport
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Subsidiary rooms
Examples

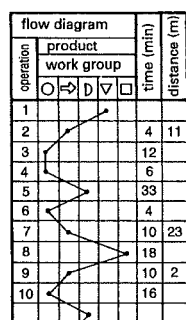


1 Human performance – mechanical performance



2 Reach zones at a workplace (according to Stier)

A maximum possible reach (≈65 cm)
B physiological limits of reach (≈50 cm)
C normal reach (≈32 cm)
D physiological inner limits of reach (16–20 cm)

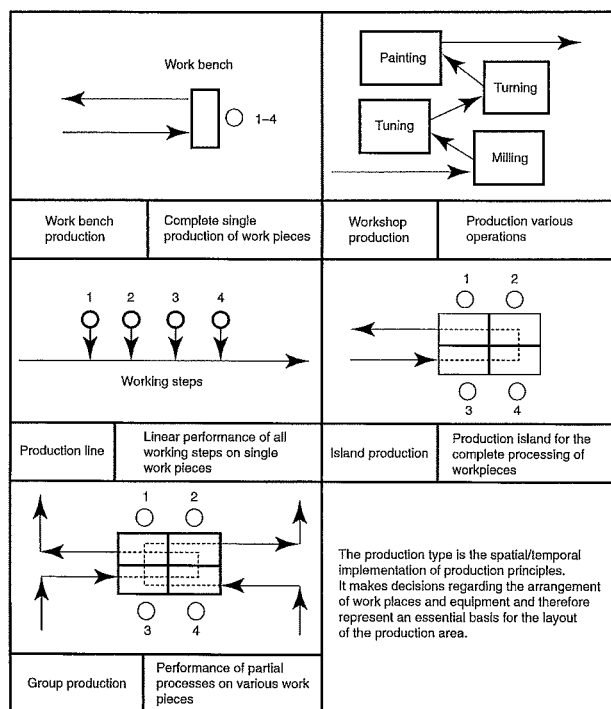


3 Production flow chart for an item (example)

planning symbols		AMSE	VDI
no.	action		
1	process	○	○
2	store	▽	△
3	delay	▷	▷
4	test	□	□
5	transport	⇨	⇨
6	handle	○	○
7	finish + test	⊙	⊙

The VDI (Association of German Engineers) symbols apply in Germany; the ASME (American Society of Mechanical Engineers) symbols are recommended for international use.

4 Planning symbols



5 Types of production (examples)

Production

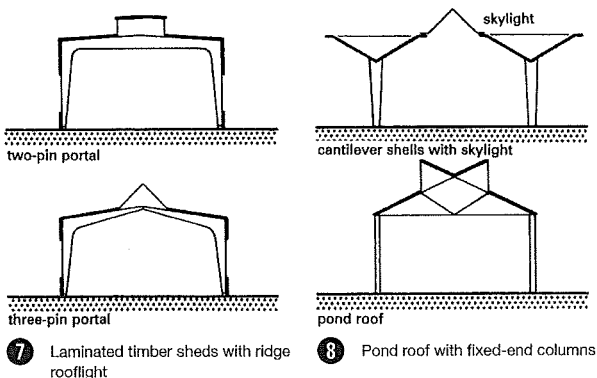
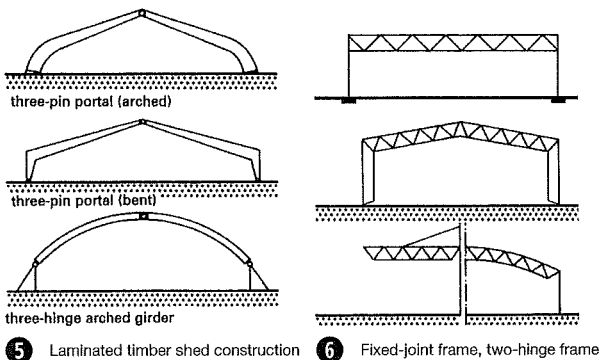
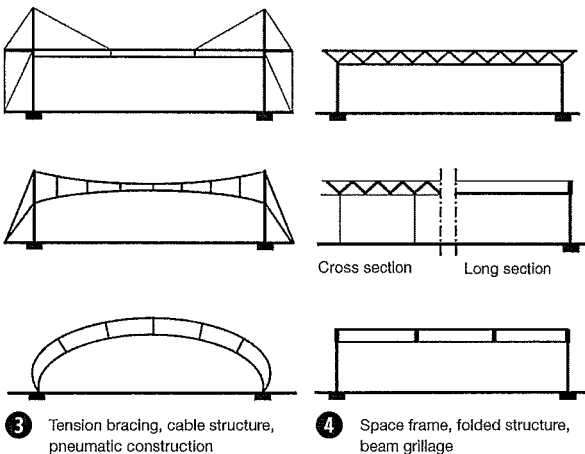
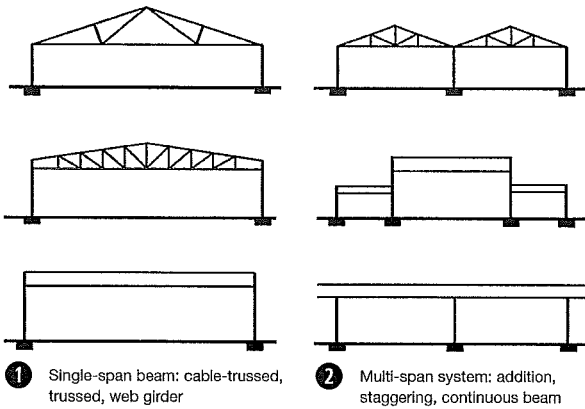
Production is the assembly over space and time of work, material and tools (machines, raw material etc.) to produce products and services. The performance required for production (work/time unit) is described as relevant performance and is a combination of **human performance** (motor and exploratory skills) and **machine performance**.

Human and machine collaborate in the **production cycle** → 1. This comprises various forms of production → 5 and can be planned using flow charts → 3. Human performance is not constant, but is subject to numerous individual and collaborative factors (strain – tiredness – recovery, age, sex, health).

The general requirements for workplaces are collected in the **Workplace Regulations** (2004) of the Federal Ministry for Industry and Employment → 6, of which detailed expansion is laid down in the **Workplace Guidelines** (→ p. 263 2).

Buildings in general	Construction and strength according to type of use
Dimensions of workplaces, air space	sufficient floor area and clear height (depending on size of floor area) for the performance of the work without impairment of safety, health or well-being; air space measured depending on the number of employees and the type of physical effort.
Floors, walls, ceilings, roofs	surfaces must be formed according to the requirements of the business and be easy to clean, with sufficient insulation against heat, cold and damp at the workplace; floor without unevenness, tripping hazards, dangerous slopes; must be load-bearing, safe for walking, not slippery; glass walls near workplaces must be clearly marked, non-breakable or shielded, and roofs which are not safe must be walked on only when adequate safety equipment is provided.
Windows, fanlights	must be safe to open, close, adjust and fix, must pose no danger in the opened position, and be safe to clean.
Doors, gates	location, number, construction according to type and use of the rooms and areas, transparent doors are to be marked at eye level, non-breakable or constructed with protection against breakage; construct hinged doors to see through with a view window; secure doors against levering out and falling out or over; provide highly visible doors for pedestrians in the immediate vicinity of gates for vehicle traffic; powered doors and gates must be safely usable, and in emergency capable of being opened automatically or manually.
Transport routes	must be easily and safely usable (including stairs, access ladders and ramps), sized according to number of users and type of business; where vehicles are used on access routes, sufficient space for pedestrians; transport routes for vehicles must run with sufficient distance from doors, footpaths, stair exits, etc. if necessary mark borders of transport routes.
Escape routes and emergency exits	number, size and arrangement according to use, equipment and size of workplace and number of people present, shortest possible route into the open air/into a safe area, permanent marking in suitable form, if necessary safety lighting, escape doors easily operable at any time, open outward, revolving and sliding doors are not permissible as emergency exits.

6 General requirements for building (elements), Workplace Regulations 2004 (excerpts)



Production and warehouse buildings are often built as industrial sheds without internal floors but with large spans and room heights.

Construction, spans and heights

Timber, steel or reinforced concrete construction with spans of 5–50 m according to client requirements (arrangement of machines, access routes and turning circles of vehicles) and room heights of 3–6 m. Built as solid, trussed or cable-trussed structures with fixed-end columns → 1, frames → 5 – 6 or as a framed construction stiffened with bracing, often as added or staggered buildings. Shed height and load assumptions are often dependent on the proposed overhead crane → p. 287.

Advantages of shed construction

Low construction cost due to light roof construction and omission of expensive floor slabs; uniform natural lighting with rooflights, even for very deep spaces; heavy floor loading possible; few(er) fire protection requirements; flow of materials and people on one level.

Disadvantages of shed construction

Large area of land required; unfavourable ratio of plan area to volume; unfavourable thermal behaviour (heat loss, heat build-up in summer).

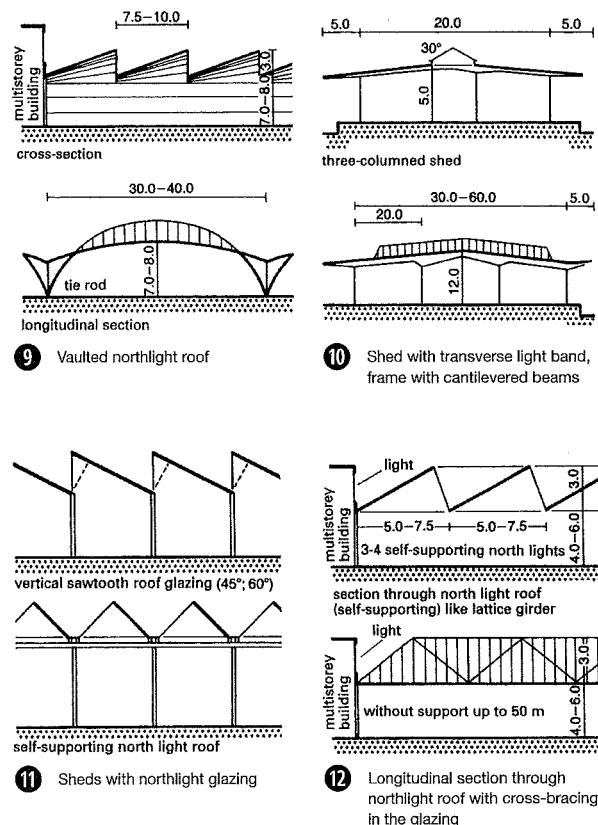
Lighting, ventilation, building services

Lighting and ventilation (and smoke extraction) are provided by light bands, north lights or light domes in the roof construction → 7 – 12 or also strip windows in the façade.

Heating is normally (central/decentralised) air heating or overhead radiant heating (temporary heating of single areas).

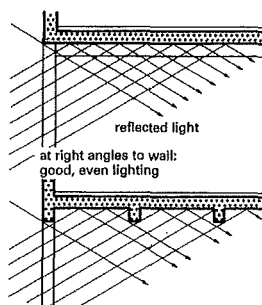
Industry and trade

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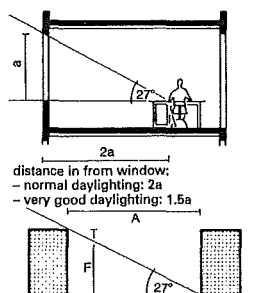


INDUSTRY

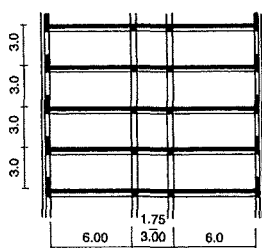
Multi-Storey Industrial Buildings



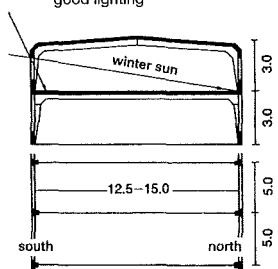
1 Joists running along the external wall; uneven, weak lighting



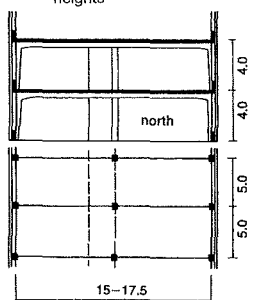
2 Optimal spacing of buildings for good lighting



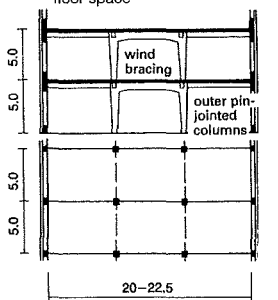
3 Building depths for given storey heights



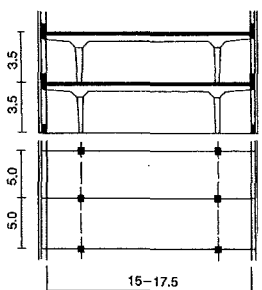
4 Truss spanning room, free use of floor space



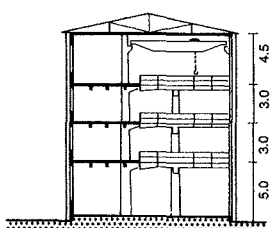
5 Central column determines layout of middle passage with columns to right or left; larger space to the north



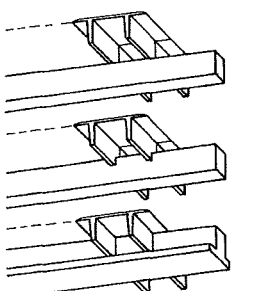
6 Cantilever beams offer structural advantages, but the columns mostly obstruct the working area



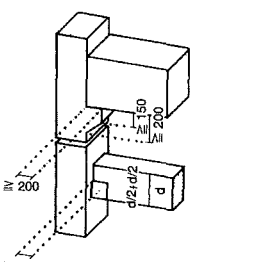
7 Deepest space with two internal columns providing bracing. External pin-ended columns



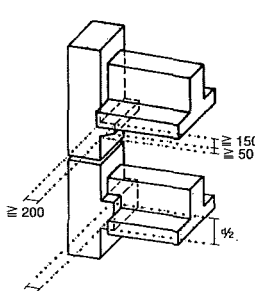
8 Multi-storey building with crane shed, also acting as lifting shaft for transporting work items to the offset balconies projecting on the upper floors



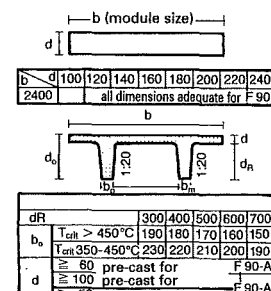
9 Floor slab supports: TT section



10 Joist/cross member support, rectangular cross-section



11 Joist supports, inverted T



12 TT-section pre-cast concrete elements, floor slabs

Production facilities can be located over a number of storeys if required for town planning, development or operational reasons: this type of structure is particularly suitable for breweries, paper mills, warehouses and other buildings, where the working material is conveyed once to the uppermost floor and then descends under gravity, and also electronic, precision mechanical and other branches of light industry.

Advantages/disadvantages of multi-storey buildings

Compact, space-saving but expensive construction method, limited floor loadings, short (installation) routes through vertical connections, good operating costs, simple ventilation, good light from side.

Construction, spans, room heights

Room heights should be determined depending on building depth and working room height (guideline 3.00 m for working rooms larger than 100 m²).

A good ratio is 2:1 (plan depth : room height) for free-standing multi-storey factory buildings with windows without visible lintels (traffic routes in centre of building not included in calculation) → 1.

Economic building depths are 12.0–15.0 m (3 m clear height) for rooms without columns → 3–4, 15.0 or 17.5 m (4 m clear height) with 1 or 2 columns → 5, 20 or 22.5 m (5 m clear height) with two columns → 6.

Lighting

Multi-storey buildings with windows on one side should face northeast, and, with windows on both sides facing north and south, they should be oriented east–west. The summer sun thus only shines into the interior to a limited extent and is easy to shade with blinds (possibly continuously motorised sun awnings), but in winter the room is pleasantly sunlit (no disturbing shadows in the working area) → 4. The distance of the working area from the window should be twice as long as the clear window height → 2.

Stairs and toilets (cool) can be located on the north side.

The best lighting is provided by free-standing buildings which are twice as far from each other as they are high (ground floor angle of light = 27°) → 2; single-storey buildings with rooflights can be located between these.

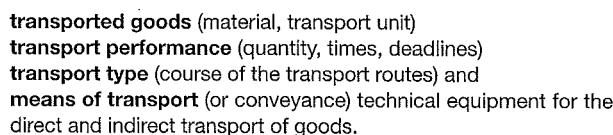
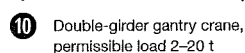
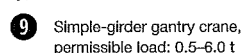
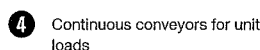
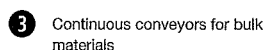
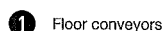
Approx. figures for window areas: 1/10 of the floor area for rooms up to 600 m² (Workplace Guidelines 7/1 → p. 263); for fine work, provide 1/5 of the floor area.

If the room depths are large, a scattering of the light coming in is advantageous (sun shades, venetian blinds, light-scattering glass etc.), in which case the spanning direction of the main supporting beam is significant → 1–2.

Industry and trade

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Examples



Means of transport can be divided into continuous and discontinuous conveyors:

Continuous conveyors are mechanical, hydraulic or pneumatic systems with a defined transport route (permanent or mobile), along which the transported goods are continuously (regularly, in cycles or with variable speed) moved between loading and unloading locations. Continuous conveyors are particularly suitable for the transport of similar goods over a fixed route, but the high automation and transport capacity comes at the cost of high investment and low adaptability.

Continuous conveyors include:

Conveyor belts → ⑤, track and chain conveyors → ⑥, screw conveyors, slides → ③, endless overhead chain and rope conveyors, moving tables → ④, pneumatic (pressure and suction) conveyors (bulk goods and liquids), centrifugal conveyors and bucket chain conveyors.

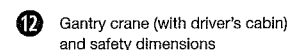
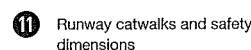
Discontinuous conveyors work discontinuously. They can be differentiated into industrial trucks (running on wheels on a floor) and lifting devices (mostly cranes).

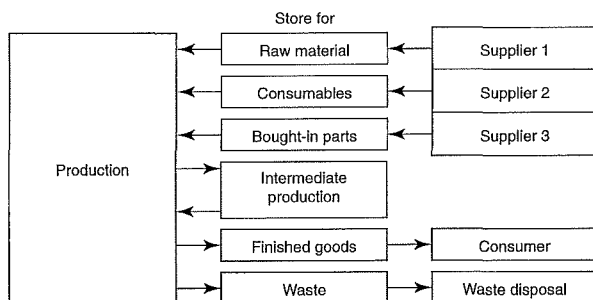
Industrial trucks are manually or mechanically driven, mostly without being on tracks, for stacking heights up to 6 m, in special cases up to 10 m. The advantages are the low plant costs and good suitability for medium distances between unloading and loading locations on a flat road or floor.

Floor conveyors include hand sack trucks, platform trolleys, pallet trucks and fork lift trucks → ❶ – ❷ → p. 269.

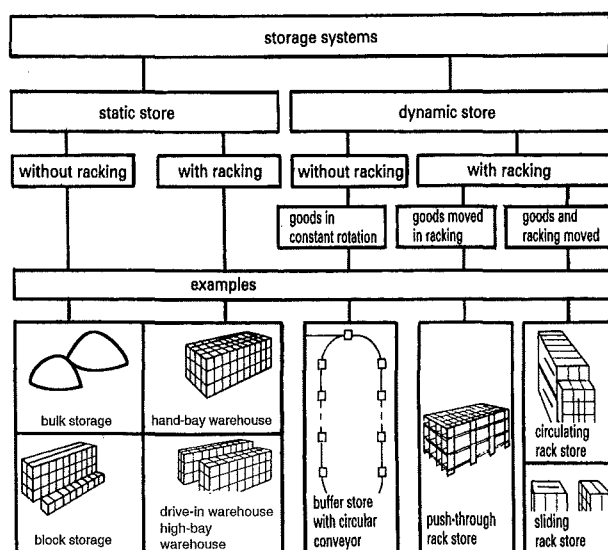
Cranes are machines for the vertical lifting of large and heavy goods. Horizontal mobility can also be provided through wheeled trolleys or winch trolleys → **9** – **12**.

Swivel cranes → ⑦ – ⑧ enable the lifting of objects from any point in their radius of operation.

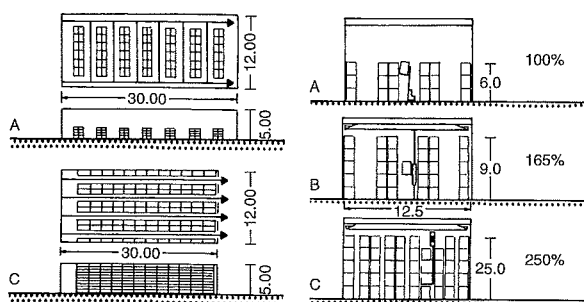




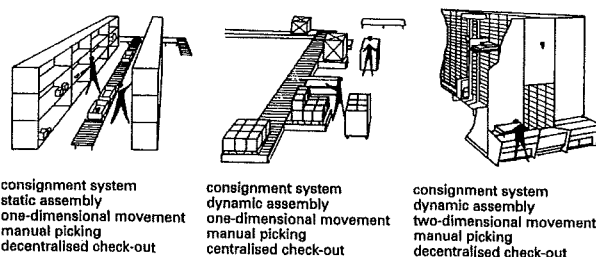
1 Warehouse as a buffer between market and production
(Führer, Störmer → refs)



2 Classification of warehouse systems (excerpt)



3 Comparison of possible uses of a warehouse

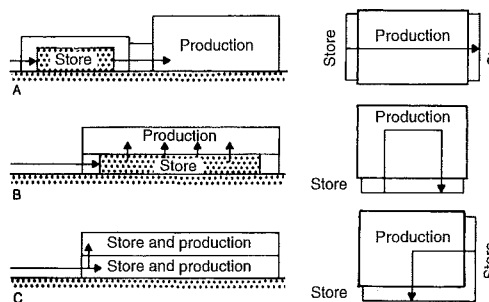


4 Alternative systems of picking

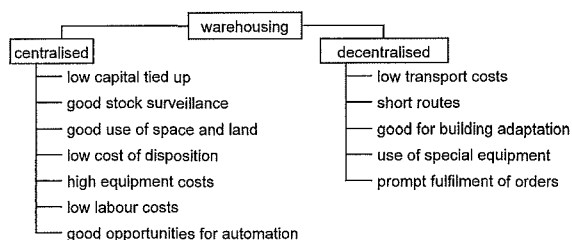
Basics

Storage is part of the material flow process and logistically forms the connection between production and marketing → 1. Storage is cost-intensive and does not create economic value, leading to attempts to minimise the storage quantities and times or effectively combine the storage and transport of materials and goods through flexible 'just-in-time production'.

There is a wide range of different static and dynamic storage systems available for each storage situation and the goods needing storage → 2. The spatial arrangement of the different warehouses in the production process can also be dealt with in various ways → 5.



5 Storage requirements and material flow within the production process



6 Advantages of centralised and decentralised storage

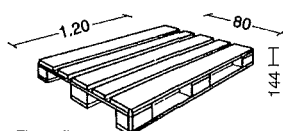
traffic routes inside warehouses	
pedestrians	min. 1.25 m
pedestrians and powered stackers	vehicle width + 2 x 0.50 m
passage widths between racks	
with manual operation	min. 0.75 m
with forklift operation (swivelling forks)	forklift width + 2 x 0.50 m
with forklift operation (rigid forks)	forklift + fork + 0.50 m
rack heights (depending on equipment)	
hand shelves single-storey (two-storey)	up to 3.0 m (up to 6.0 m)
pallet warehouse with forklift operation	up to 6.0 m
high-bay warehouse with high-bay forklifts	up to 9.0 m
high-bay warehouse with stacking crane	up to 25.0 m

7 Basic dimensions in warehouses (MBO, Workplace Regulations, Industrial Building Guidelines, ZH, Health and Safety Regulations)

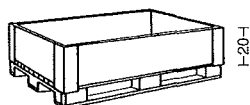
Picking

Picking, or order assembly, denotes collecting articles out of the warehouse and making them ready for dispatch in accordance with an order. This can be single-stage picking (specific to one order) or two-stage picking, with an intermediate picking zone for temporary storage and assignment of the articles to a number of orders.

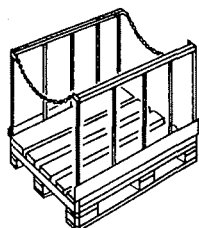
The work is performed flexibly and with no technical support, or very little, as a 'man to goods' system → 4, left, or for more capacity with partly or fully automated transport vehicles and complex infrastructure as a 'goods to man' system → 4, centre and right.



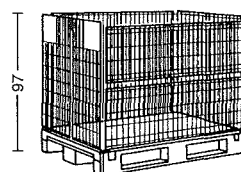
Flat pallet
(DIN 15141, RAL HG 993)



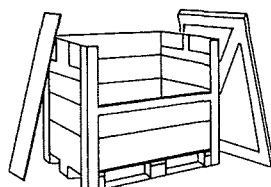
Flat pallet collars
(DIN 15148/49)



Flat pallet with a stack frame

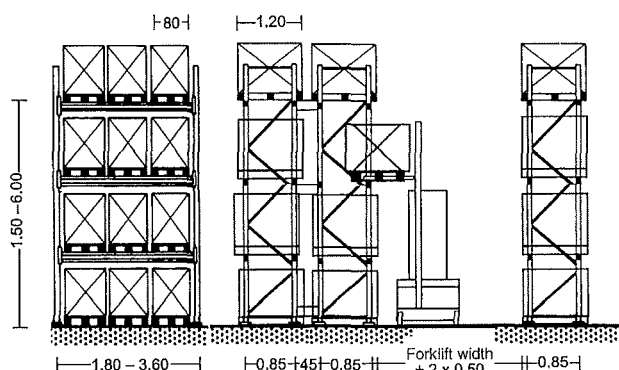


Collapsible pallets
(DIN 15155)

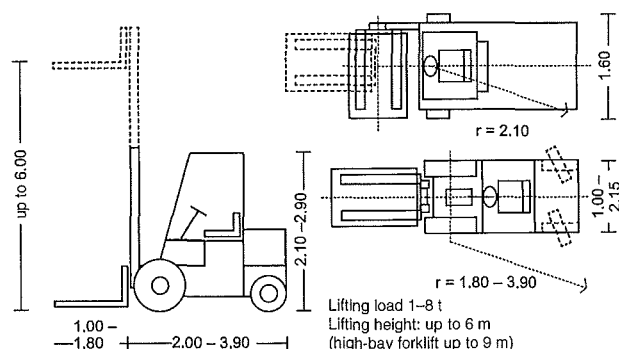


Box pallet with detachable
lid and removable side wall
(DIN 15142)

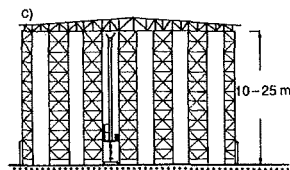
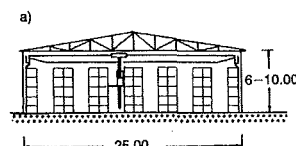
1 Pallets and accessories



2 Pallet rack for forklift operation (swivelling fork), elevation, section



3 Forklifts with rigid and swivelling forks (elevation, plan)



4 a) universal warehouse with stacking crane, b) warehouse with installed pallet racking, c) high-bay system

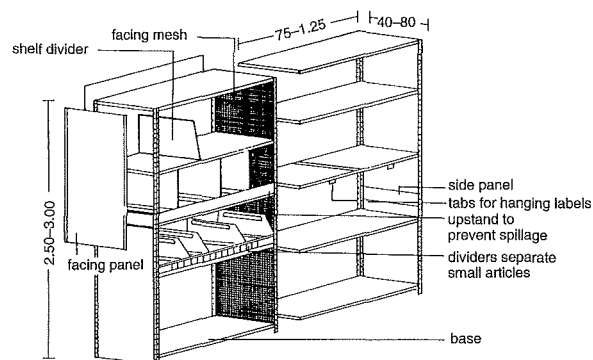
Storage and shipping containers

Storage containers serve to combine the goods into loading units with the purpose of maximising the exploitation of space and transport capacity and the avoidance of handling. The most common storage containers for unit goods are **stackable crates** made of timber or plastic, **pallets** (flat pallets, pallets with side rails and additional equipment) and also increasingly **containers**.

On order to simplify international transport, the European pallet pool has introduced the **standardised transport pallet** (Europallet, Pool pallet, 800 × 1200 × 144 mm) with various stacking attachments → 1.

Standardised pallets can be exchanged within the pool without reloading. Numerous standard sizes for packaging, transport and storage have been derived from the dimensions of the Europallet.

On account of the variety of uses and the rough handling and loading, storage pallets are subject to many quality standards.



5 Flat shelving system

System: Hofe

Warehouse equipment

The selection of warehouse equipment has a similar importance in the design of warehouses. This depends on the quality, quantity, weight and handling frequency of the stored goods and also warehouse organisation and means of transport. Warehouse equipment is subject to numerous regulations (an overview can be found, for example, in Association of Commercial Accident Insurance Companies 234 → p. 263). The traditional storage system in industrial warehouses is **flat shelves** → 5 as manual shelving for small parts. These are constructed as bolted or slot-in systems (e.g. angle profiles with holes) with inserted steel shelves, wire mesh compartments, drawers or doors. These systems can be up to approx. 4.50 m high (with accessible hop-up level) and are suitable for loadings of 250 kg/shelf.

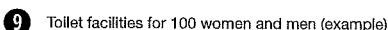
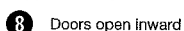
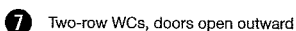
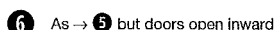
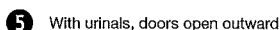
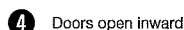
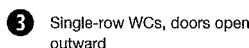
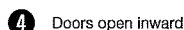
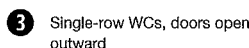
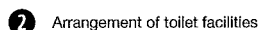
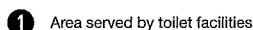
For larger loadings and heights, **pallet racks** are available as standardised modular systems made of channel and I-beam profiles. Bays with an axial spacing of approx. 2.80 m (for three Europallets horizontally) have become established. Using forklift trucks, heights of up to 6.00 m are practical → 2. The passage width between the racks depends on the size and type of the forklift truck to be used (rigid forks, swivelling forks) and the requirements of Health and Safety Regulations / ZH 1 (vehicle width + 2 × 50 cm) → 3.

In order to store items still more densely, fully automated **high-bay warehouses** are used, often independent of production location. These have special swivelling stacking cranes that stack at heights of up to 25.00 m. They are normally supplied by specialist firms as an integrated system (racking and building envelope) → 4.

Industry
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INDUSTRY

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These are to be provided at a distance from each workstation of not more than **100 m** or, at the farthest, one storey height (if no escalator is available). Toilets should also be provided near social, readiness, washing and changing rooms → **①**. If there are more than **five employees**, separate toilets must be provided for women and men and these should be available exclusively to employees. The number of necessary toilets depends on the number of employees → **⑩**: the site and arrangement are shown → **③ – ⑪**. Disability-friendly toilets are to be provided in accordance with regulations → p. 21 ff.

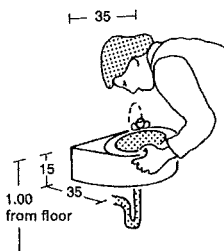
Toilet facilities consist of a **lobby** with washbasins (at least one washbasin per five WCs) and a **completely separate room** with at least one WC (unless the facilities contain only one toilet and have no direct access to a work, social, changing, wash or sanitary room). Toilet cubicles must be lockable and, if light partitions (incompletely separated WC cubicles) are used, the partition should have a height of at least 1.90 m, and at the bottom a gap of 10–15 cm. Urinals must be placed so as not to be visible from the entrance. **Toilet facilities should not contain more than 10 WC cubicles and 10 urinals.** Further details of the requirements for toilets are contained in Workplace Guidelines 37/1. With **natural ventilation**, the minimum ventilation sections are: with window ventilation on one side 1700 cm²/WC, 1000 cm²/urinal; with through ventilation (ventilation shaft and opening window opposite) 1000 cm²/WC, 600 cm²/urinal. **Ventilation equipment** is to be designed for 30 m³/WC and 15 m³/urinal (altogether at least five air changes/h).

Men							Women					
number of employees	flushing WCs	urinals	gutter (m)	washbasins	additional flushing WCs	additional urinals	number of employees	flushing WCs	washbasins	additional flushing WCs	waste bins	bucket sink
10	1	1	0.6	1	1	1	10	1	1	1	1	1
25	2	2	1.2	1	1	1	20	2	1	1	1	1
50	3	3	1.8	1	1	1	35	3	1	1	1	1
75	4	4	2.4	1	1	2	50	4	2	2	1	1
100	5	5	3.0	2	1	2	65	5	2	2	1	1
130	6	6	3.6	2	2	2	80	6	2	2	1	1
160	7	7	4.2	2	2	2	100	7	2	3	1	1
190	8	8	4.8	2	2	3	120	8	3	3	1	1
220	9	9	5.4	3	3	3	140	9	3	4	1	1
250	10	10	6.0	3	3	4	160	10	3	4	1	1

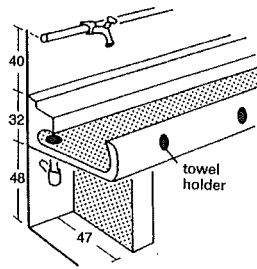
10 Required number of WC fittings (according to Workplace Guidelines 37/1, → p. 263 **2**)



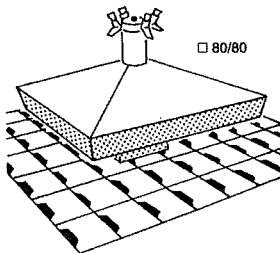
Urinal



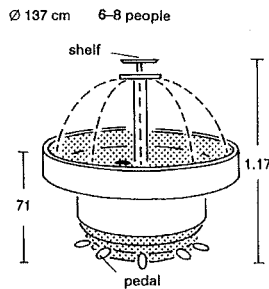
1 Drinking fountain for free drinking, activation by lever, <100 m from workstation



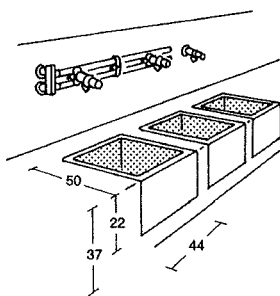
2 Row washing trough, Rotter system



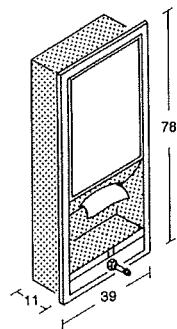
3 Foot washing system



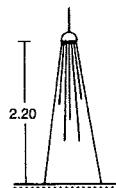
4 Washing fountain: 25% space saving compared to rows of basins → **2** - **11**



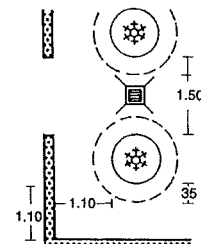
5 Foot baths



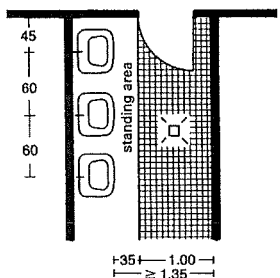
6 Paper towel dispenser, shelf and soap dispenser



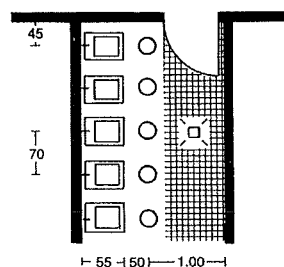
7 Clear height of shower heads



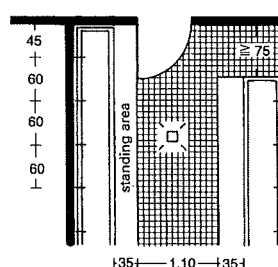
8 Space required for circular washbasins



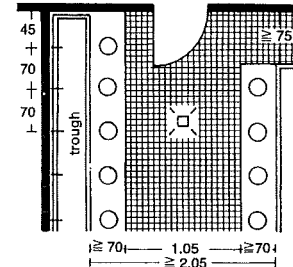
9 Washing facilities with washbasins



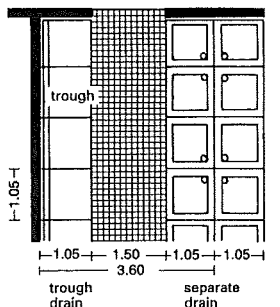
10 Washing facilities with foot baths



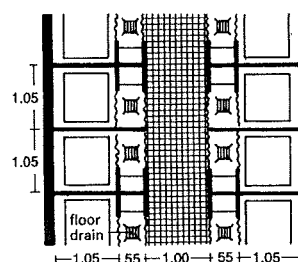
11 Washing facilities with washing trough



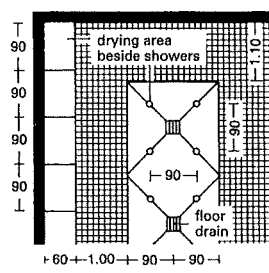
12 Washing facilities with foot washing trough



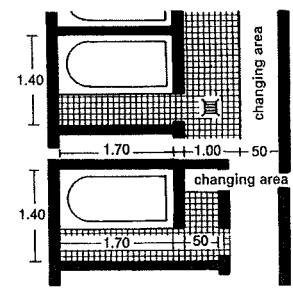
13 Semi-open showers



14 Single showers with changing booth



15 Open showers with drying places



16 Bath cubicles

Washrooms

Washrooms are to be provided for employees engaged in activities dangerous to health or with strongly odorous substances, or who are subjected to the effects of heat or damp. Washing and changing rooms → p. 273 must be easily accessible from each other.

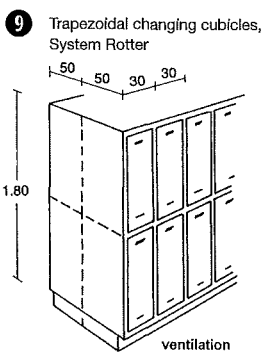
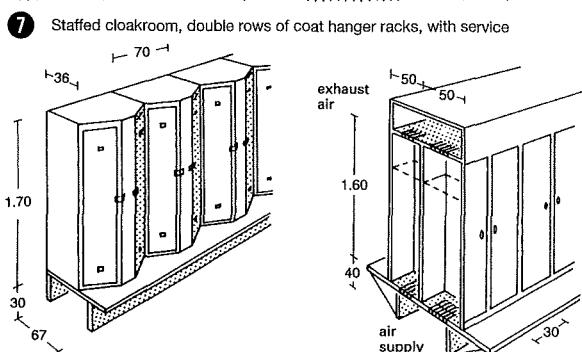
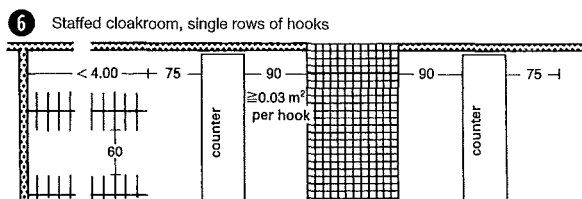
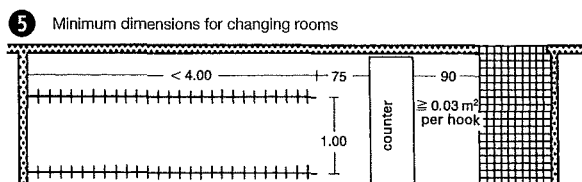
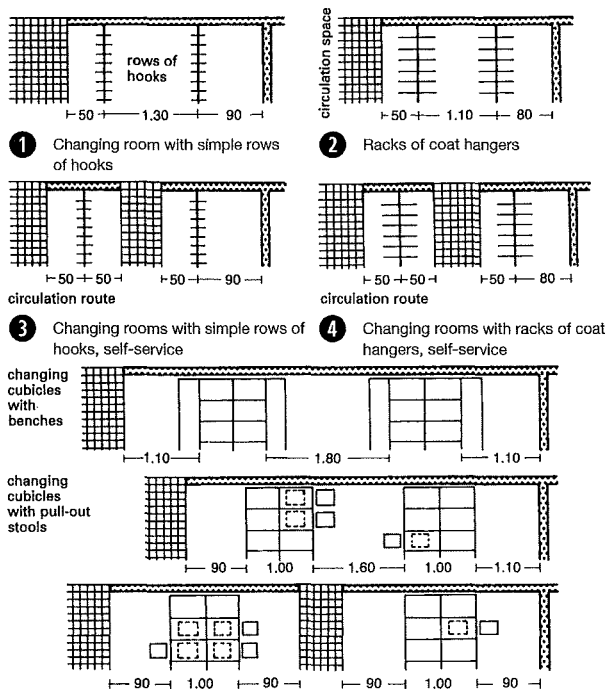
For every four employees (or in case of only moderately dirty activity every five employees), **one washroom** is to be provided, dimensions and layout → **9** - **16**, designed for the largest shift. Special washrooms are to be provided for disabled people according to regulations → p. 21 ff. Permissible washing equipment: wash places (sluice, washbasin, washing fountain) and showers. Wash places: width and depth min. 70 × 55 cm, upper edge 70-80 cm above floor level, equipped with towel holder, soap dish, disposable towels (for hand drying) and waste bins. Provide at least **one shower**, and in the case of very dirty activity 30% of the washing facilities as showers; for employees engaged in activities dangerous to health or with strongly odorous substances, one shower per four employees. Provide a **foot wash** for every 10 wash places. With **natural ventilation**, minimum sections are to be observed: for ventilation from one side 400 cm² /m² floor area; or with through-ventilation from opposing windows 120 cm² (80 cm² with ventilation shafts) for supply and extract openings. **Ventilation equipment** is to be designed for at least 10 air changes/h.

Industry and trade

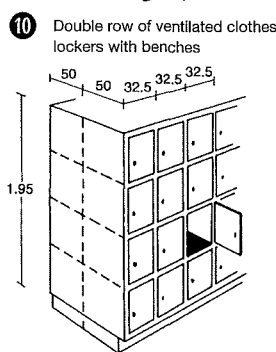
INDUSTRY

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see also:
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→ p. 263 **2**



13 Two-level row of lockers



14 Small lockers

Changing rooms, clothes storage/lockers

Changing rooms are intended for changing clothes and the storage of house, street and working clothing, by the employees of a company. They are required when the employees wear working clothes at work and changing elsewhere is not reasonable.

Changing rooms should be on the direct route between entrance to the site and the working area. Separate washing and changing rooms should be easily accessible from each other: there must be room for unobstructed changing in light of the number of users at the same time. If changing rooms are not required, clothes storage must be provided for each employee → **13** – **14**.

They must be separate for men and women and be secure against draughts and view from outside.

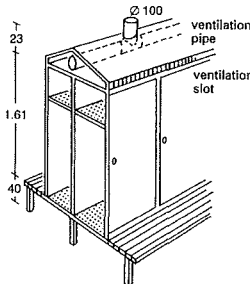
Changing rooms are to be equipped with seating, lockers (for storing the clothing of all employees), waste bins, mirrors and, if appropriate, a shoe cleaning machine. It is a good idea to align rows of cupboards and racks at right angles to the window wall. Window sills should if possible be at locker level.

Minimum dimensions for changing rooms → **1** – **6**. Passage widths between changing rooms → **8**.

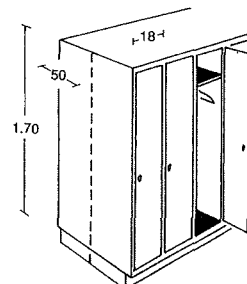
No. people	Width $a_p^{1)}$
1 up to 5	0.88
2 up to 20	1.00
3 up to 100	1.25
4 up to 250	1.75
5 up to 400	2.25

¹⁾ building guideline

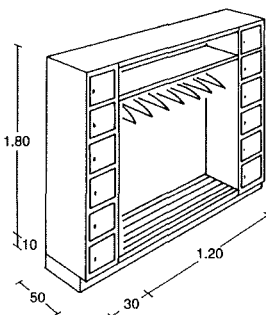
8 Width of passages



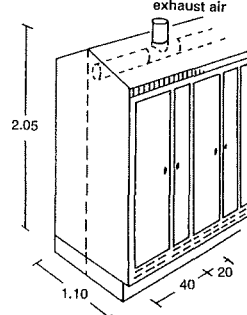
11 Clothes locker with sloping roof and ventilation pipe



12 Narrow clothes locker



15 Small lockers with open coat rack



16 Clothes locker, two compartments 20 and 40 cm wide, for street and working clothes

Industry and trade

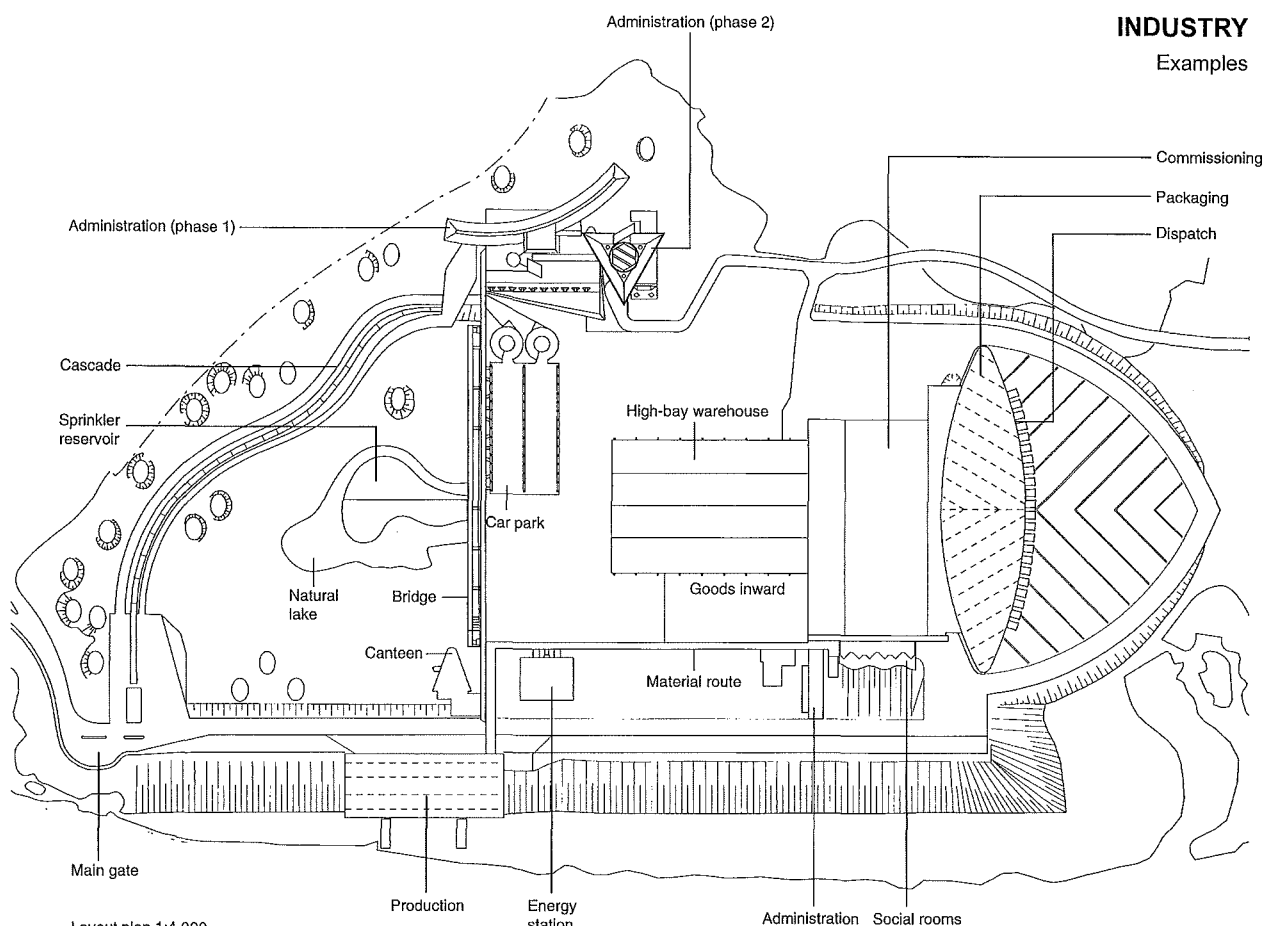
INDUSTRY

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Workplace Guidelines 34/1-5

see also:
Industry/Basics
p. 263 **2**

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Examples



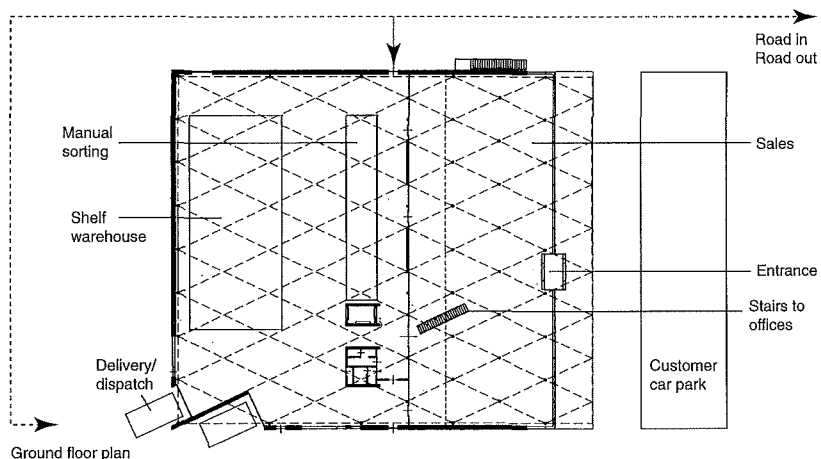
1 B. Braun Melsungen AG, Pfiwwiesen works

Arch.: (1st section): James Stirling, Michael Wilford and Associates in assoc. with Walter Ngeli
Arch.: (2nd section): Wilford Schupp Architekten GmbH

Industry
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industrial
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2 Industrial shed for Aug. Hlden GmbH in Dren

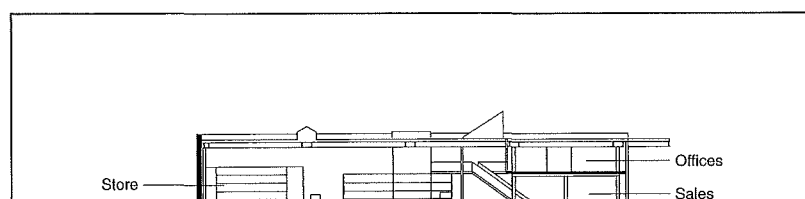
Arch.: Klster Scheithauer Gross

Additive industrial plants → 1:

The functional units (administration, production, multi-storey car park, high-bay warehouse, picking, goods dispatch) are developed according to their requirements, architecturally independent and grouped in a naturally laid out landscape. The units are connected by a branching access system (material route, access bridge).

Integrated industrial plants → 2:

Warehouse, status two-storey sales and administration area, and delivery at the back are combined in a cubical block. This consists of a free-standing steel structure (span length 40 m) with diamond-shaped beam grille on fixed-end columns projecting on the entrance side and diamond-shaped grille of secondary beams.

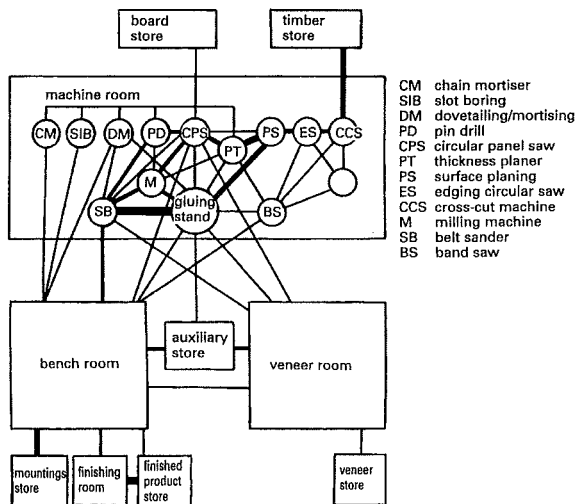


3 Section → 2

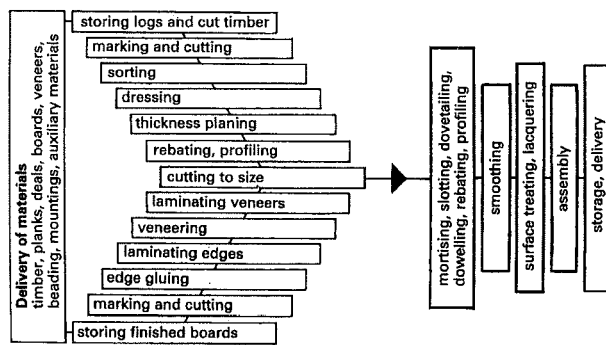
scale 1:1250

WORKSHOPS

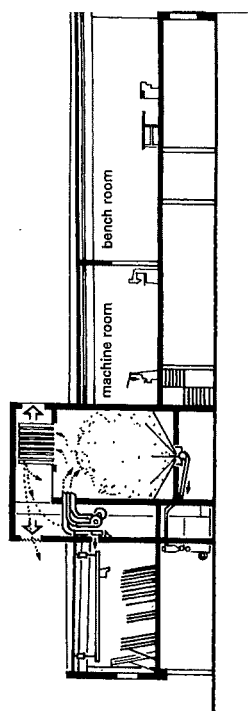
Joinery



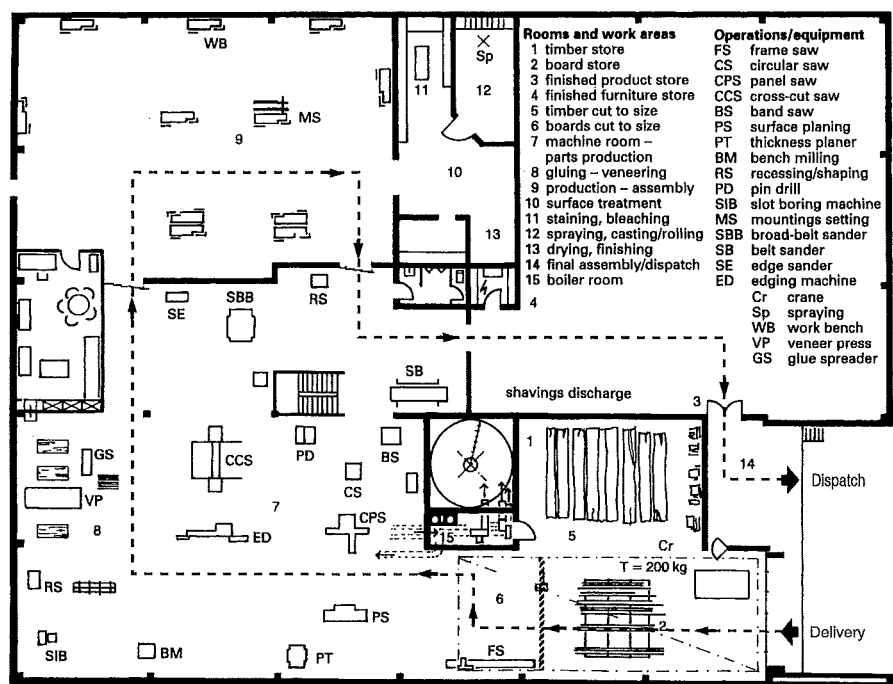
1 Relationships of equipment and rooms in a joinery. Line thickness denotes internal traffic density



2 Production sequence, approximate



3 Section → 4



4 Example of a joinery

The development of plan forms from long sheds to more compact buildings → 1 has been altogether more economical (better exploitation of the site, shorter working routes for mixed production, shorter supply pipework and cables, lighting also from above). Multi-storey buildings are not appropriate for production areas, but can be recommended for offices, subsidiary rooms, stores for small parts and valuable furniture.

Predominant construction types: framed construction of steel, reinforced concrete or timber. Walls and roof of large-format building elements, with good thermal and sound insulation. Double-glazed windows, mostly without opening lights, with a smaller proportion of opening windows according to regulations for ventilation and to see out.

The space requirement for the illustrated examples is approx. 70–80 m² per employee (without open storerooms).

General production flow: in small businesses with up to approx. 10 employees: linear, angled-shaped. In medium-sized businesses with over 10 employees: U-shaped or circular (square) layouts are better for workflow.

Working sequence: timber store, cutting area, drying room, machine room, bench workshop, surface treatment, storage, packing. The machines are placed according to working sequence: door, loading and unloading, ramp, supervision, testing, acceptance, delivery.

There is separation between machine and bench rooms consisting of a wall with doors. Company office and foreman's office are glazed with a view of the workshop. Workshop flooring: wood, wood-block paving or magnesite/sawdust screed. It should be possible to work against the light in all places. Continuous strip windows, high sills (1.00–1.35 m).

In order to deal with chips, sawdust and fine dust, an extraction system is required in almost all cases, even in the smallest joineries, for working in accordance with workplace regulations and for operational reasons. Reduce excessive noise from machinery with rubber-bonded metal bearings.

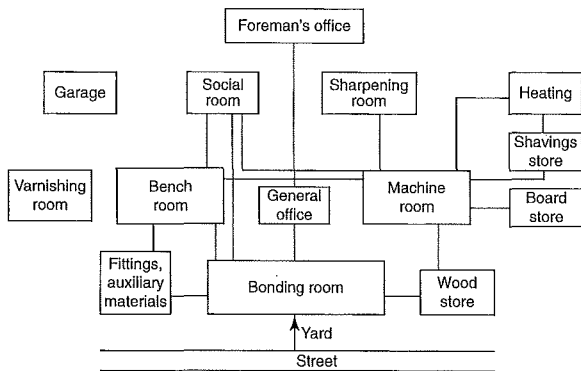
Industry and trade

WORKSHOPS

Joinery
Carpenter's shop
Metalwork
Vehicle repairs
Bakery
Meat processing plant
Other trades
Laundry
Fire station

WORKSHOPS

Carpenter's Shop



1 Functional scheme of a carpentry and woodworking business

The layout of the carpenter's shop can be planned on the basis of the following operational data:

Equipment, utilisation, cost-effectiveness, power requirements, floor loadings, space requirement, cost, production process, production times, number of employees, technical organisation of the business, operating procedures and working sequence

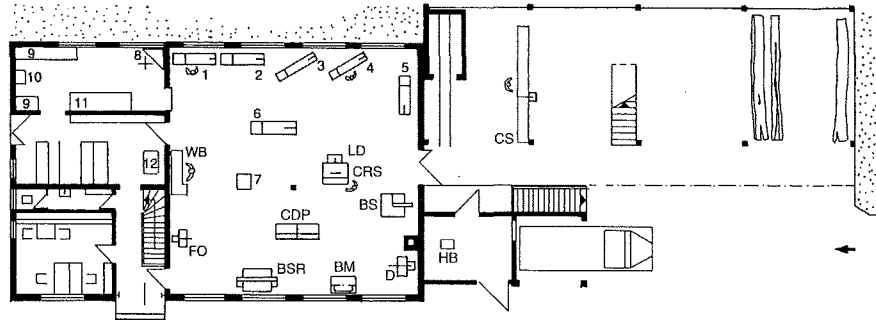
Materials: types, quantities, weights, space requirement

Stores: size, space requirement

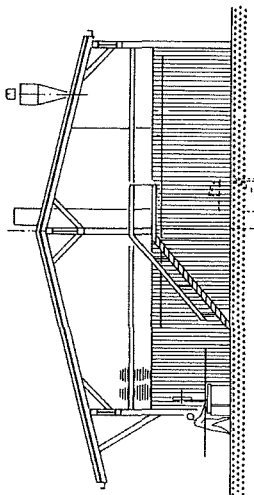
Energy supply: heat, electricity, compressed air.

Waste products: types, space requirement, waste disposal.

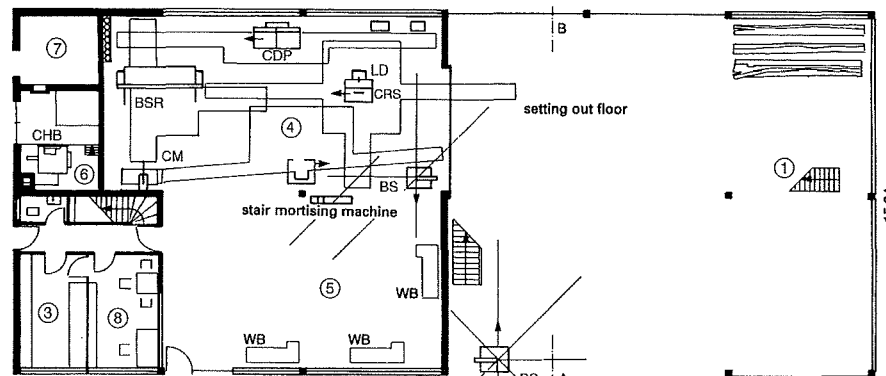
- 1-4 Lathes
- 5 Stave lathe
- 6 Autolathe
- 7 Round bar machine
- 8 Spraying stand
- 9 Storage bench
- 10 Varnish dipping apparatus
- 11 Varnish drying cupboard
- 12 Polishing drum
- LD Drill
- LD Long-reach drill
- CDP Combined dressing and planing machine
- BM Bench milling machine
- CS Cut-off saw
- BSR Band sander
- BS Band saw
- CRS Circular saw
- WB Work bench
- HB Heating boiler for waste wood



2 Example of a turnery

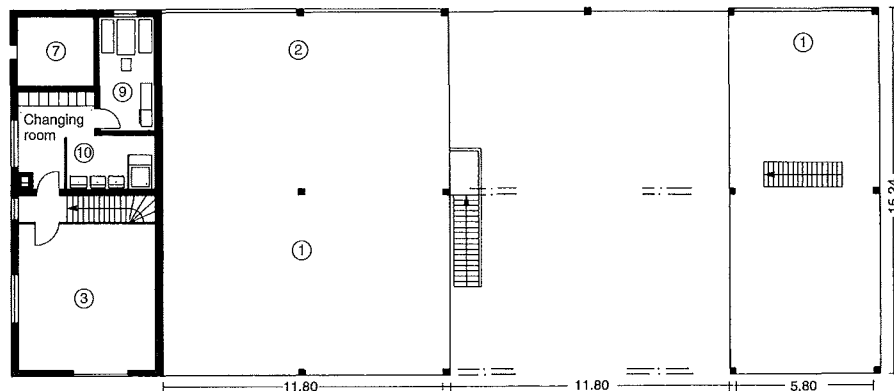


3 Section A-B → 4 + 5



4 Example of woodworking business, ground floor → 3 + 5

- D Drill
- LD Long-reach drill
- CDP Combined dressing and planing machine
- BM Bench milling machine
- CM Cut-off saw
- BSR Band sander
- BS Band saw
- CRS Circular saw
- WB Work bench
- HB Heating boiler for waste wood
- CHB Combined heating boiler for oil and waste wood
- 1 Solid wood store
- 2 Board store
- 3 Small machine store
- 4 Machine production
- 5 Bench production
- 6 Heating room
- 7 Sawdust silo
- 8 Foreman's office
- 9 Break room
- 10 Washroom



5 First floor → 3 - 4

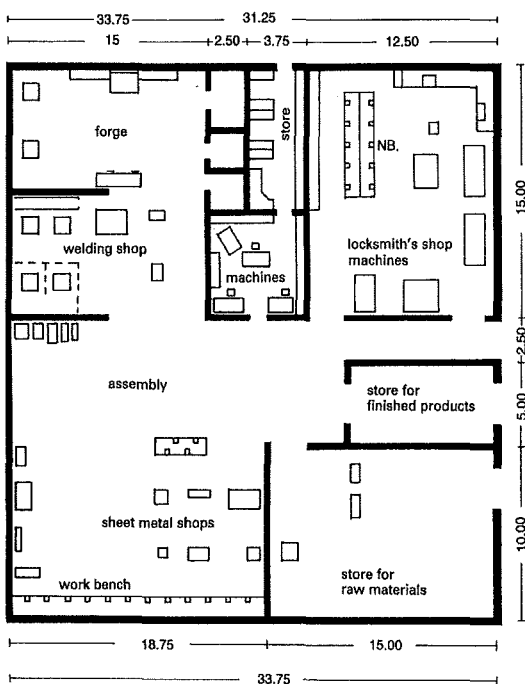
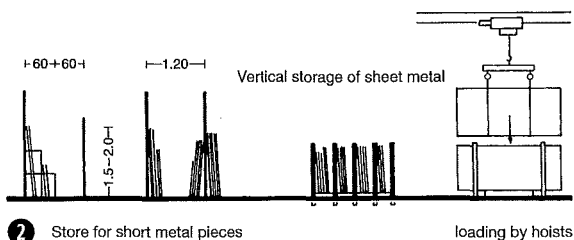
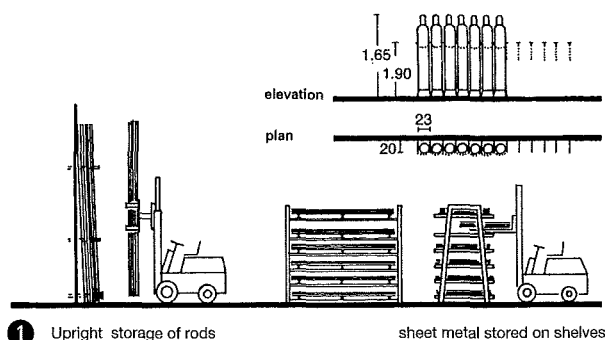
Industry and trade

WORKSHOPS

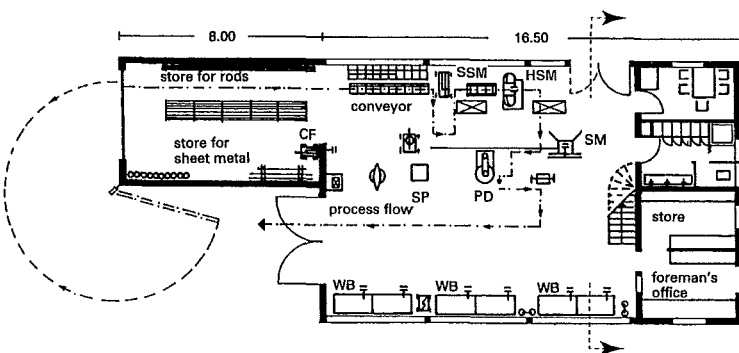
- Joinery
- Carpenter's shop
- Metalwork
- Vehicle repairs
- Bakery
- Meat processing plant
- Other trades
- Laundry
- Fire station

WORKSHOPS

Metalwork



3 Metalwork shop with machine location and arrangement of stores



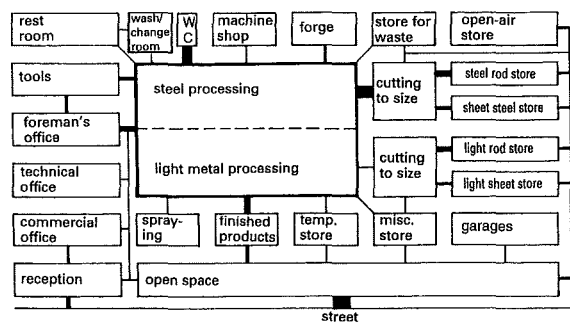
4 Architectural ironmongery and precision metalwork construction businesses

A large business is divided into workshops for gas welding, fitting, construction and repair, a smithy for ornamental ironmongery, plus construction and mechanical metalwork areas. The room relationships correspond to the functional scheme → 5.

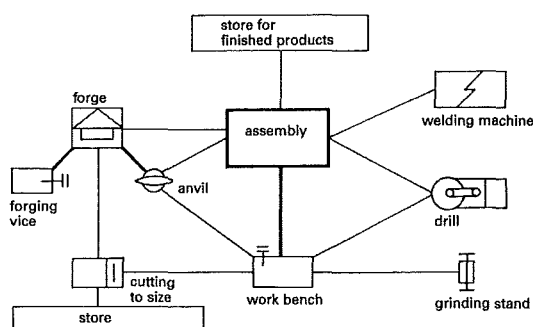
The company office and foreman's office should if possible be located in the centre, with a view of all workshops if possible.

Welding and forging should take place in rooms enclosed by steel doors, even in medium-sized workshops. The workshops should be lit from above, and additional lighting is required for individual machines (provide socket boxes in the floor).

The floor should be of concrete, preferably on a concrete base slab. The welding bench is fitted with fire bricks. A charcoal pit is required for pre-warming before welding of metal and cast iron, with a small chimney above it; it is also suitable for brazing, forging and annealing. There should be water and oil containers next to this for annealing.

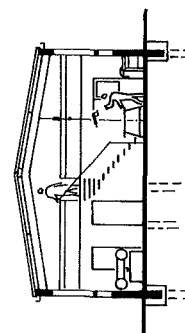


5 Room relationship plan for large business in steel treatment and metal construction



6 Example of working sequence for architectural ironmonger's

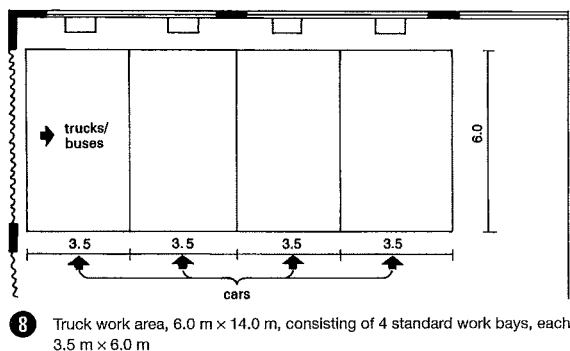
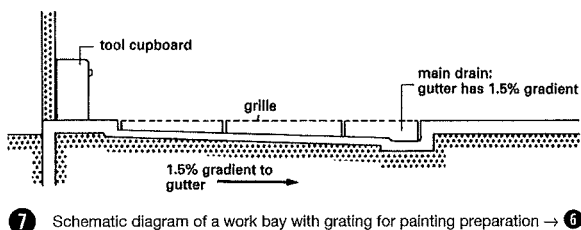
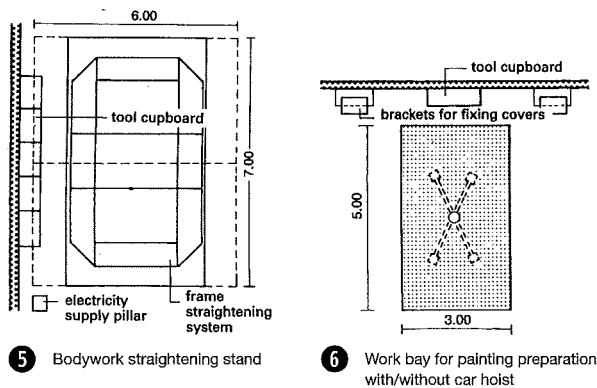
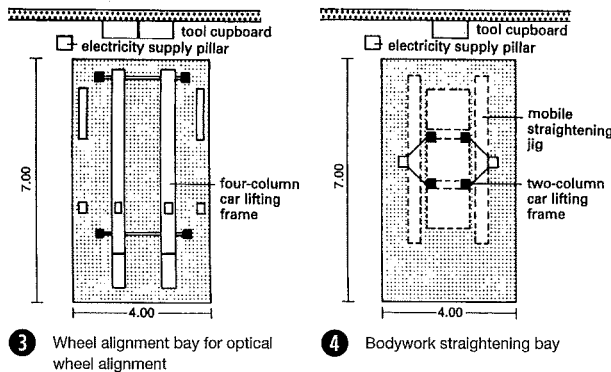
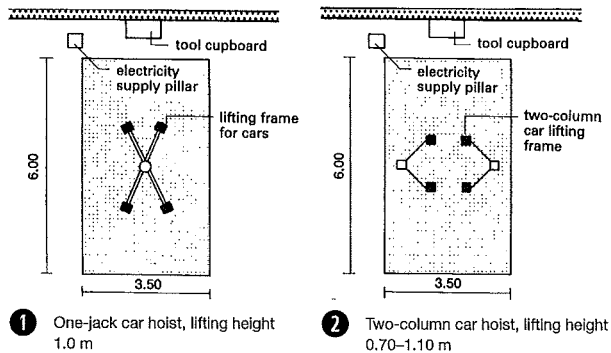
Equipment:
PD: Pillar drill
SM: Straightening machine
SP: Surface plate
SSM: Section shearing machine
HSM: Hack sawing machine
WB: Work bench
CF: Crimping/flanging machine



7 Section → 4

WORKSHOPS

Vehicle Repairs



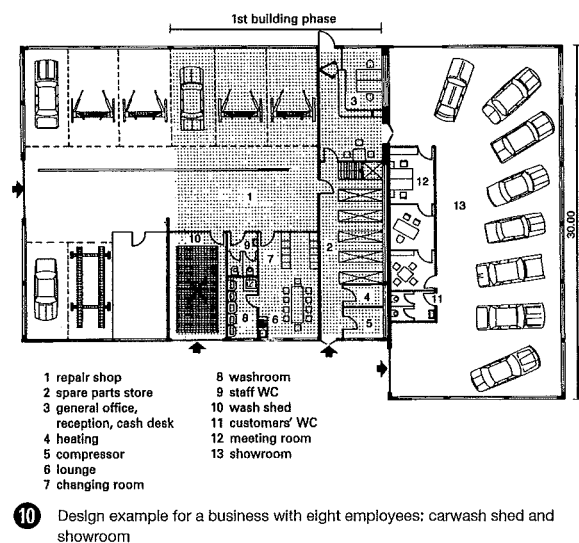
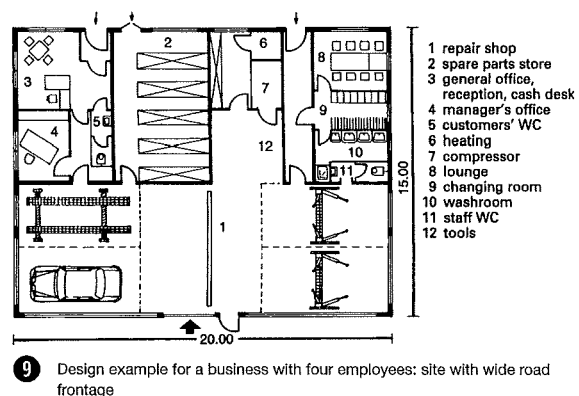
A customer-service business should be located with a good road connection (even if this results in higher access and building costs). In a location on the edge of town, advertising and customer loyalty require particular attention.

Basic rule: site $\frac{1}{3}$ built, $\frac{2}{3}$ unbuilt. Take possible later extension into account. For larger businesses, the average is 200 m² per employee for workshop operation. In addition to this, rooms are required for sales, office, customer waiting room and social rooms etc.

The building will be mostly steel construction, single-storey. Free-spanning shed construction without obstructive columns is preferred. Possible future extension should be taken into account in the spacing of the bays.

The workshop floor should be sealed against penetration of oil and grease, and grease separators installed in the drainage system. Provide extract duct for exhaust gases. Design automatically opening doors with air curtain. Installation ducts for electricity, compressed air, waste oil and water are recommended. Check utility supply connections. Carwash equipment has high water consumption.

Examples of vehicle repair workshops of various sizes → 9 – 10.



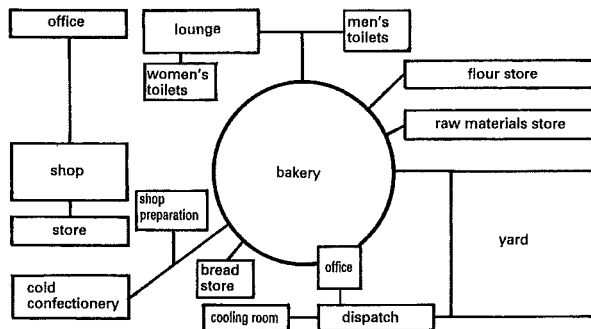
Industry and trade

WORKSHOPS

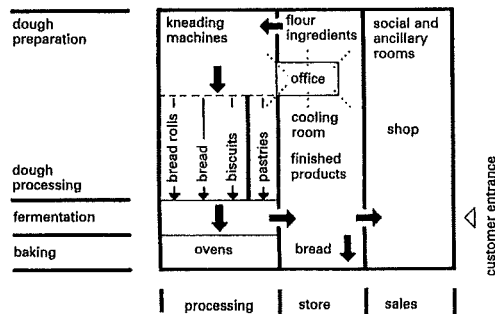
Joinery
Carpenter's shop
Metalwork
Vehicle repairs
Bakery
Meat processing plant
Other trades
Laundry
Fire station

WORKSHOPS

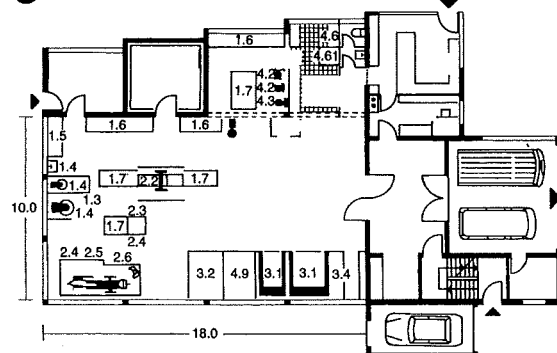
Bakery



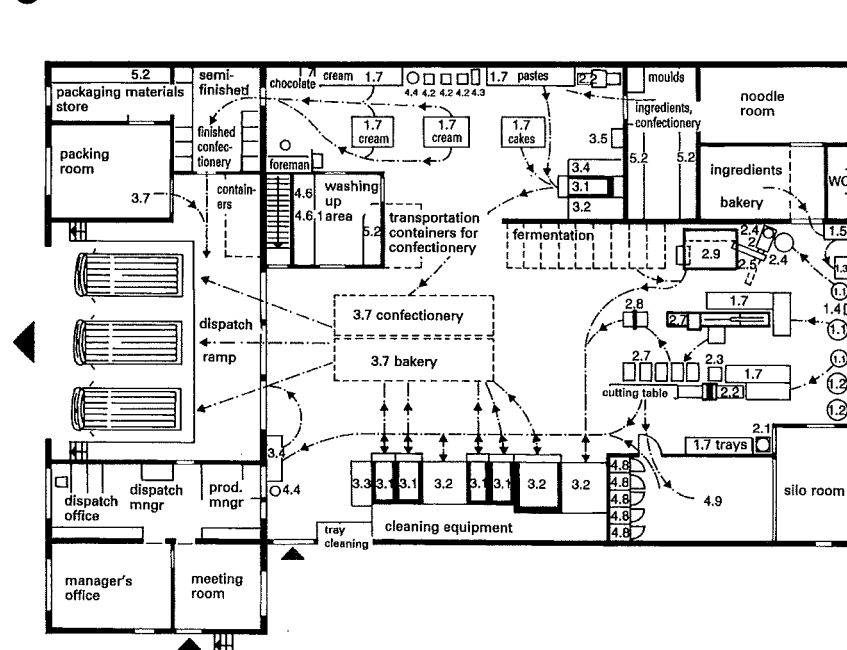
1 Functional scheme



2 Room connection plan



3 Example: floor plan of a bakery



4 Example: floor plan of a large bakery

Systematic design includes the anticipation and recording of all future technical and operational processes to which the building will have to adapt. An investigation of the location should always be part of the design work.

Room allocation plan

Basic division: storerooms, production rooms, sales rooms, building services rooms, administration and business rooms, social and subsidiary rooms → 1. Work processes in or between the individual rooms → 2. Storerooms for raw materials, ingredients and packaging. Daily supplies are stored in work areas.

Basic types of storage

Raw material store: grains, sugar, salt, baking agents, dry goods in sacks, flour in silos or sacks.

Ingredients room: fruit, toppings, dry fruit, fats, eggs.

Packaging store: space requirement for containers (shelving, racks, cupboards), stacking, counters. Space for traffic (passages).

Minimum area for stores 15 m²; approx. 8–10 m² per employee for all stores.

Short routes between stores and work areas.

Separation of workrooms for bakery and pastries

Bakery requires warm and humid room climate; pastry room should be cooler. Bakery has following areas: dough preparation, dough processing, baking, storage of finished products. Pastry room: cold area – cream, creme, chocolate, fruit; warm area – ready mixes, kitchen, fine pastries.

Workroom area is sum of:

Space required for equipment, handling and processing, intermediate storage (trolleys) and side counters. Space for traffic (passages); lost space.

Working from the internal operational plan (layout), the necessary space requirements can be determined.

3 – 4 key

- 1 dough preparation
 - 1.1 kneading machine
 - 1.2 kneading bowl
 - 1.3 suspended or floor scales (flour)
 - 1.4 basin – for mixing and measuring water
 - 1.5 ingredients table
 - 1.6 work table with flour trolley
 - 1.7 work table
 - 1.8 mixer
- 2 dough processing
 - 2.1 dough portioning and kneading machine
 - 2.2 rolling machine
 - 2.3 croissant machine
 - 2.4 dough portioner (by weight)
 - 2.5 rotary kneading machine
 - 2.6 rolling machine
 - 2.7 bread roll machine
 - 2.8 dipping machine
 - 2.9 hydraulic portion cutter
- 3 baking area
 - 3.1 oven
 - 3.2 fermentation room
 - 3.3 soaking machine
 - 3.4 metal covered finishing table (icing etc.)
 - 3.5 hand basin
 - 3.6 baking tray washing machine
 - 3.7 finished goods store
- 4 confectionery
 - 4.1 confectionery cooling table
 - 4.2 mixing and whipping machine
 - 4.3 orbital paddle mixer
 - 4.4 gas cooker
 - 4.5 deep fat cooking
 - 4.6 sink with floor drain
 - 4.6.1 dishwasher
 - 4.7 cream cooler
 - 4.8 froster
 - 4.9 fermentation interrupter
- 5 miscellaneous
 - 5.1 floor drainage
 - 5.2 shelving

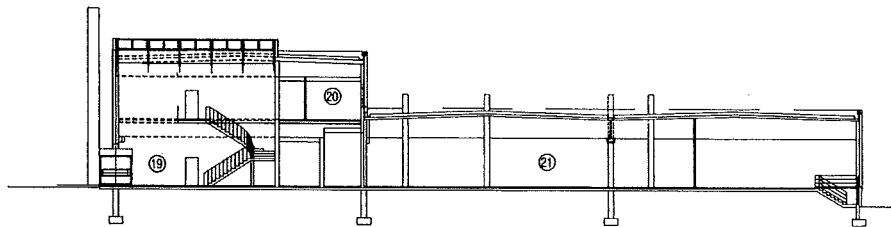
WORKSHOPS

Meat Processing Plant

On the ground floor → ③, sausages, cold meat, ham and delicatessen goods are produced in an area of 4500 m². Offices, laboratories, canteen, kitchen, washing and changing rooms are located on the first floor → ②. Daily production is about 25 t. The building requires various groups of rooms with different room temperatures: social rooms, offices, WC, 20°C; production rooms,

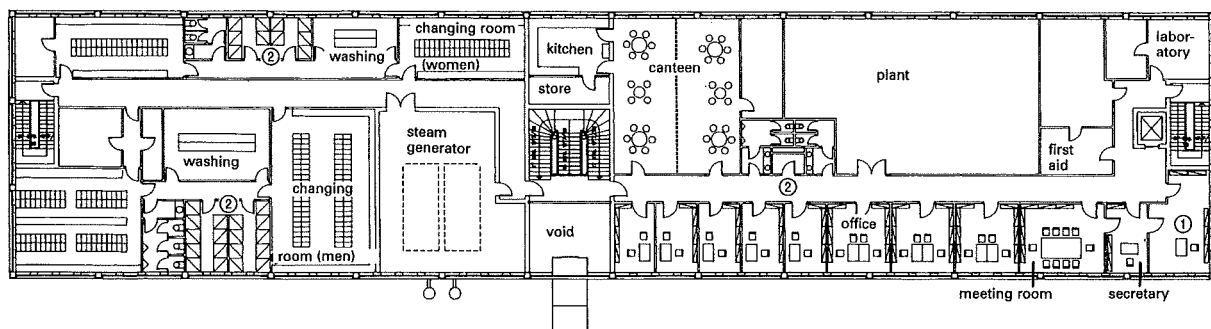
18°C; air-conditioned rooms, 14–18°C; cool rooms, 10–12°C; cold rooms, 0–8°C; deep-freeze, –20°C. High physical requirements for construction and materials.

Production building: raw material is delivered in form of halves of pork, quarters of beef and coarsely dismembered, wrapped pieces.

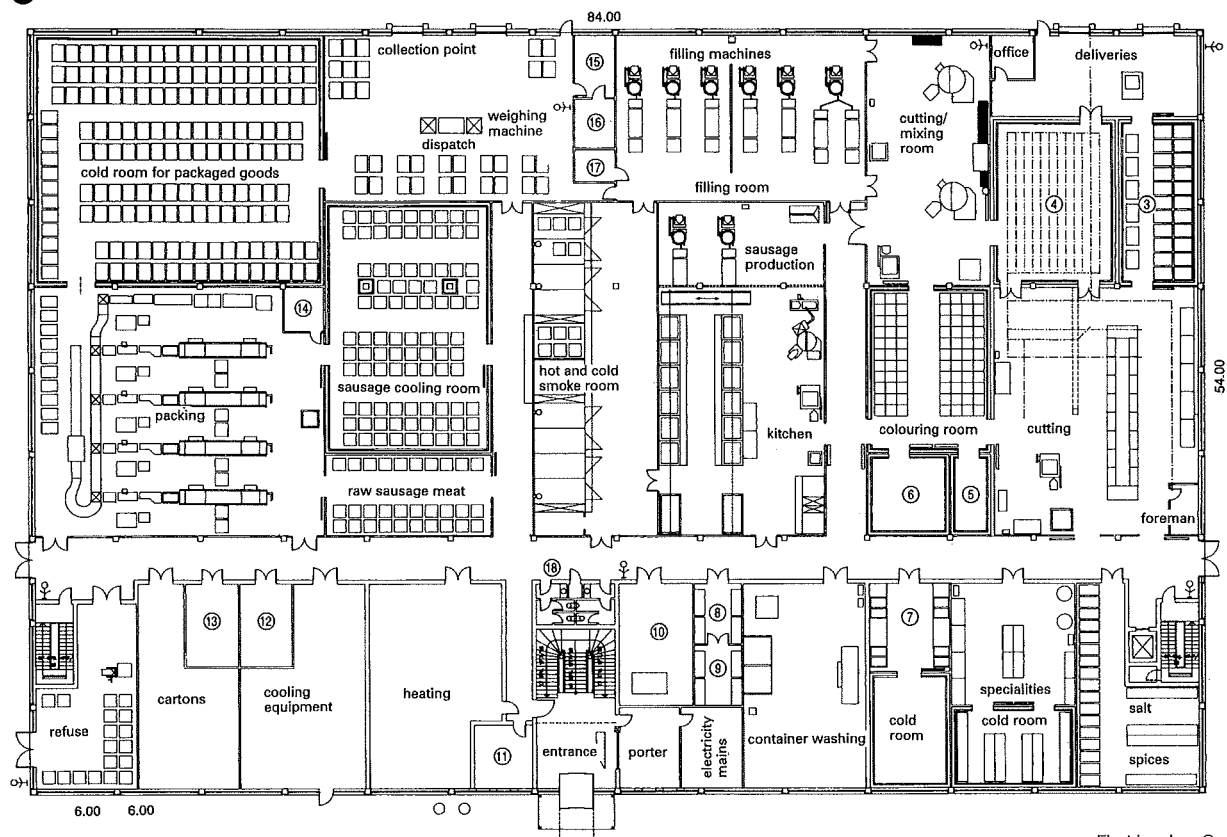


- | | |
|----------------------|--------------|
| ① managing director | ⑫ workshop |
| ② WC/showers | ⑬ boot room |
| ③ freezer store | ⑭ foreman |
| ④ delivery cold room | ⑮ office |
| ⑤ freezer room | ⑯ computing |
| ⑥ meat cold room | ⑰ foreman |
| ⑦ offal processing | ⑱ WCs |
| ⑧ alkaline solvents | ⑲ entrance |
| ⑨ acid solvents | ⑳ kitchen |
| ⑩ cleaning room | ㉑ production |
| ⑪ first aid room | |

① Section → ② – ③



② First floor



③ Ground floor, Thüringer Fleischzentrum

Industry and trade

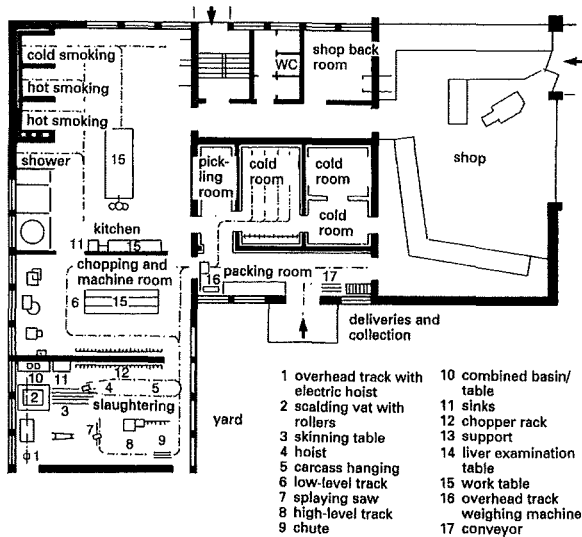
WORKSHOPS

Joinery
Carpenter's shop
Metalwork
Vehicle repairs
Bakery
Meat processing plant
Other trades
Laundry
Fire station

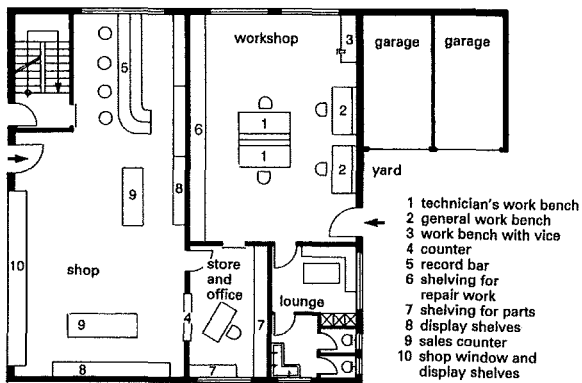
Electrics: Jena GmbH
ZPN Rhinstr. 149 Berlin
Planning: AG Neufert, Mittmann, Gref.

WORKSHOPS

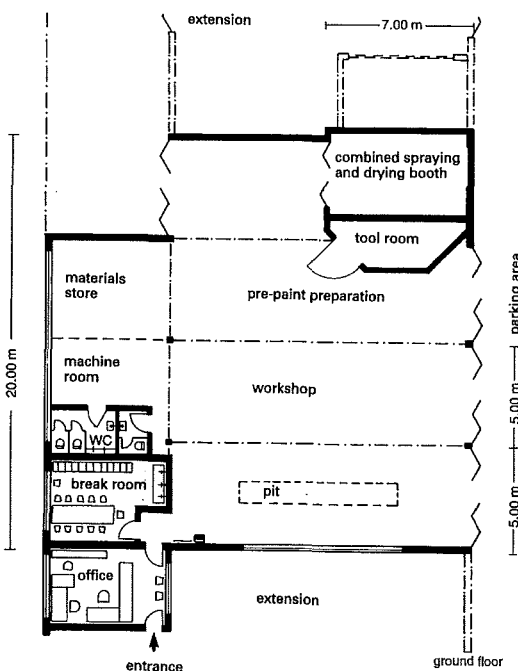
Other Trades



1 Example of a butcher



2 Example of a radio and television shop with workshop



3 Example of a paint spraying workshop

Butcher → 1: example ground plan for 6–7 employees

Functional scheme for in-house sausage and cold meat production: meat arrives in sausage machine room (cutting/mincing), into smoke house, then boiler (sausage kitchen) and from there to the cool store or the shop.

Height of workrooms (according to size of business) ≥ 4.0 m, width of passages for goods transport ≥ 2.0 m. Work space at sausage machine, in front and every 1.0 m at side = 3.0 m^2 each. Machine spacing from walls (for repairs) 40–50 cm.

Sound insulation is required for cooling plant, which works day and night. Provide water taps with hose fittings in the sausage kitchen, machine room and salting room. Floor rough and waterproof, ideally of rough or ribbed tiles with gully. Walls tiled completely. Good general lighting of 300 lx at the work spaces. Provide social room, clothes cupboards, WC and showers for employees.

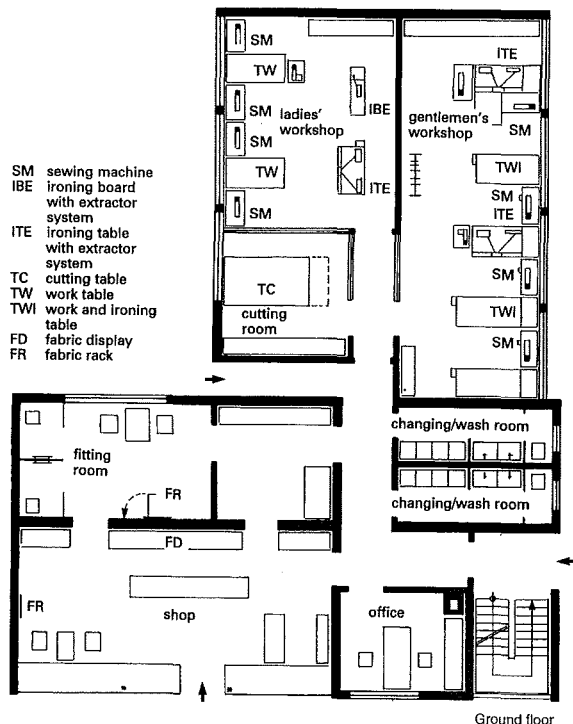
Radio and television shop with workshop → 2

Workrooms: clear height ≥ 3 m and 15 m^3 minimum air volume per employee. On account of the great danger of electrocution, the workshop should have well-insulated flooring, or at least the workbenches of the employees should be insulated. Recommended light intensity: 500 lx. For the assembly of very fine electronic components, 1500 lx is required.

Workbench must have a spacious worktop, ideally 1.00×2.00 m. 2 shelves under desk for storage of circuit plans, appliance descriptions etc. and tools in easily accessible drawers.

Paint spraying workshop → 3

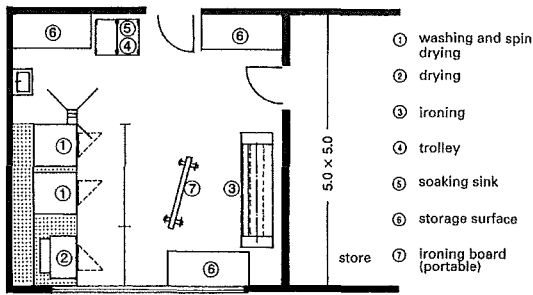
Tailor → 4 example plan for 10 employees



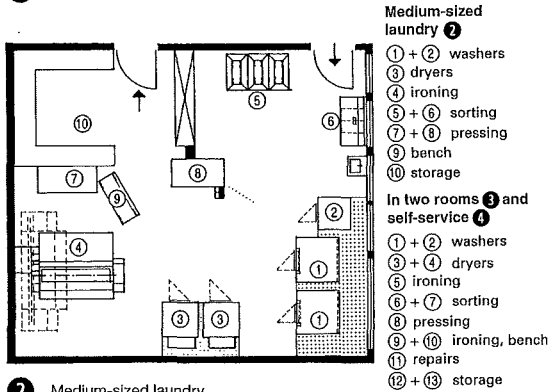
4 Example of a tailor

WORKSHOPS

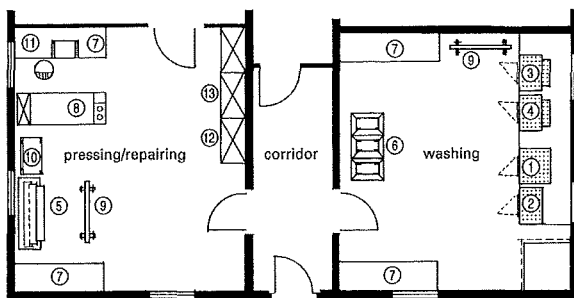
Laundry



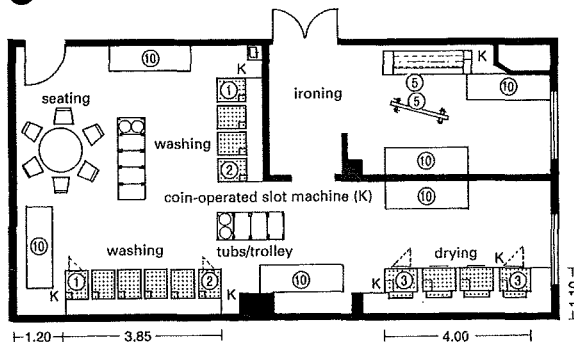
1 Small laundry for hotel



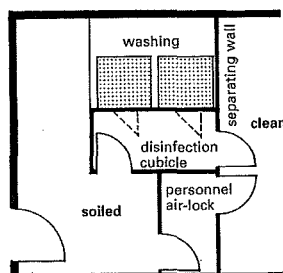
2 Medium-sized laundry



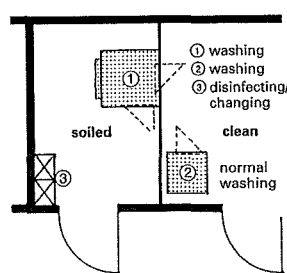
3 In two separate rooms



4 Self-service launderette



5 Single-door washing machines in the disinfection cubicle



6 Washing with room separation into clean and soiled

Laundries for hospital washing are to be separated into two areas for soiled and clean, each with their own entrance → 5 – 6, 8. In the soiled area, it must be possible to damp-clean and disinfect the floor, walls and external surfaces of built-in equipment and machines.

Passages between the dirty and clean sides of the laundry are to be equipped with personnel control lobbies plus hand disinfection and a place for protective clothing. The doors of the staff control lobby must be fitted with devices making it impossible to open both doors at once → 5.

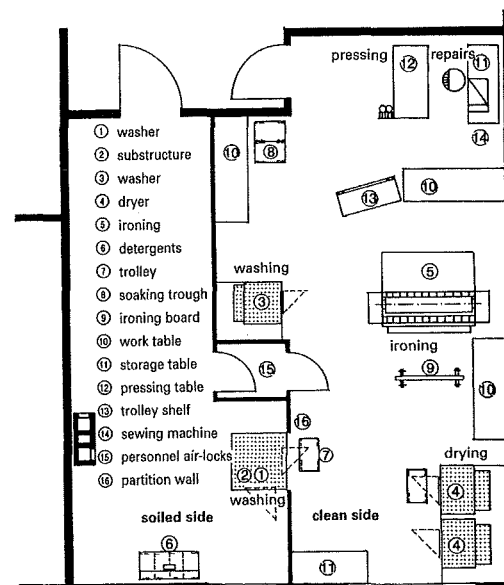
gents	Weight (g)
shirt	170
light vest	100
heavy vest	150
short underpants	75
long underpants	180
pyjamas	450
handkerchief	20
pair of socks	70
ladies	
blouse	140
underclothes	140
petticoat	75
night dress	350
night shirt	170
handkerchief	10
apron	170
blouse	130
children	
small dress	110
underclothes	80
jacket, pullover	75
dungarees	25
handkerchief	15
pair of socks	70
pair of tights	100

7 Average weights of clothes for washing

bathing	Weight (g)
bathrobe	900
towel	800
beach towel	400
hand towel	200
bathing trunks	100
bathing costume 1-pce	260
2-pce	200
bed linen	
bed cover	850
under-sheet	670
top sheet	600
pillow cover	200
table linen	
table cloth	370
long table cloth	1000
serviette	80
hand towel	100
tea towel	100
working clothes	
protective suit	1200
dungarees	800
apron	200
man's overalls	500
lady's overall	400

Industry and trade

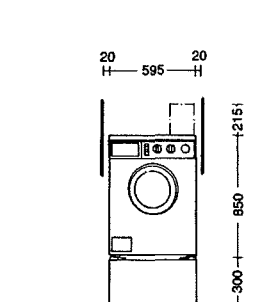
WORKSHOPS
 Joinery
 Carpenter's shop
 Metalwork
 Vehicle repairs
 Bakery
 Meat processing plant
 Other trades
 Laundry
 Fire station



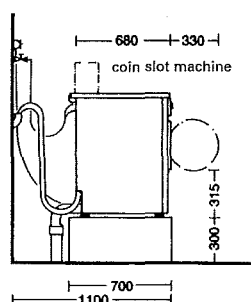
8 Laundry in centre for the elderly

WORKSHOPS

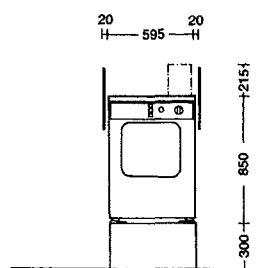
Laundry



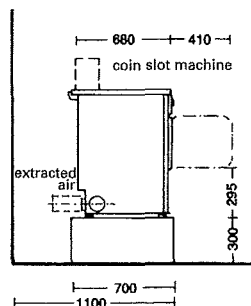
1 Automatic washer/spin dryer



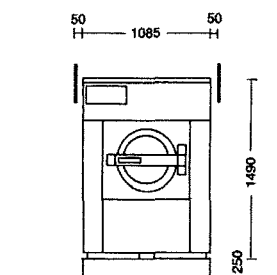
2 Side view → 1



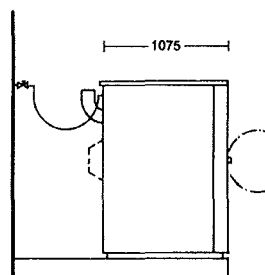
3 Automatic dryer



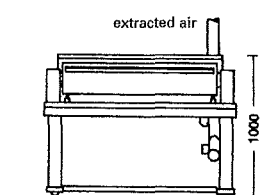
4 Side view → 3



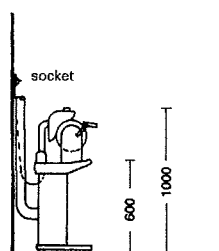
5 Automatic washer/dryer



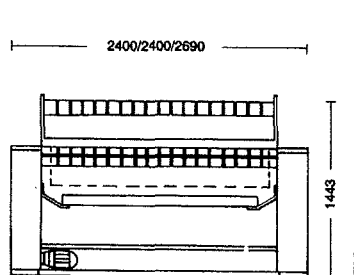
6 Side view → 5



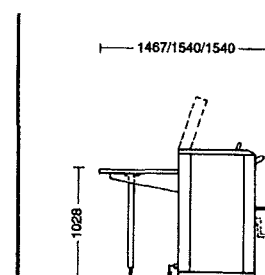
7 Rotary iron



8 Side view → 7



9 Flatbed iron



10 Side view → 9

Industry and trade

WORKSHOPS

Joinery
Carpenter's shop
Metalwork
Vehicle repairs
Bakery
Meat processing plant
Other trades
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Fire station

Dry laundry produced per week:

Household: approx. 3 kg/person (ironing share approx. 40%)

Hotel: approx. 20 kg/bed (daily sheet and towel changing)

approx. 12–15 kg/bed (4 changes/week)

approx. 8–10 kg/bed (2–3 changes/week)

approx. 5 kg/bed (1 change/week)

(above values include hotel restaurant)

Guesthouse: approx. 3 kg/bed

Restaurant: approx. 1.5–3 kg/place

(for hotels, guesthouses and restaurants, ironing share approx. 75%)

Home for elderly: approx. 3 kg/bed (residential)

approx. 8 kg/bed (care home)

approx. 25 kg/bed (incontinent)

Children's home: approx. 4 kg/bed,

Baby home: approx. 10 kg/bed

Nursing and care establishments: approx. 4 kg/bed

approx. 25 kg/bed

(incontinent)

(for the above homes, ironing share approx. 60%)

Hospitals, clinics (up to approx. 200 beds):

general hospital: 12–15 kg/bed

maternity clinic with births: approx. 16 kg/bed

children's clinic: approx. 18 kg/bed

(for hospitals and clinics, ironing share approx. 70%)

care staff: approx. 3.5 kg/person

$$\text{Required washing capacity} = \frac{\text{washing quantity/week}}{\text{washing days/week} \times \text{washes/day}}$$

Example calculations:

1. Hotel with 80 beds (utilisation 60% = 48 beds)

4 bedding changes/week

daily towel changes (approx. 12 kg/bed)

576 kg/wash

table and kitchen washing

approx. 74 kg/week

650 kg/week

$$\text{required washing capacity} = \frac{650 \text{ kg}}{3 \times 7} = 18.6 \text{ kg/wash}$$

2. Hotel with 150 beds (utilisation 60% = 90 beds)

daily bed and towel changes (20 kg/bed)

1800 kg/week

90 beds @ 20 kg washing

table and kitchen washing

approx. 200 kg/week

2000 kg/week

$$\text{required washing capacity} = \frac{2000 \text{ kg}}{3 \times 7} = 57.1 \text{ kg/wash}$$

3. Home for elderly (50 residents, 70 care patients)

70 care places @ 12 kg washing

840 kg/week

$$\text{required washing capacity} = \frac{840 \text{ kg}}{5 \times 5} = 33.6 \text{ kg/wash}$$

50 residential places @ 3 kg washing

150 kg/week

table and kitchen washing

approx. 100 kg/week

250 kg/week

$$\text{required washing capacity} = \frac{250 \text{ kg}}{3 \times 6} = 8.3 \text{ kg/wash}$$

4. Block of flats with 90 residents

approx. 3 kg dry washing per person and week

90 people × 3 kg = 270 kg

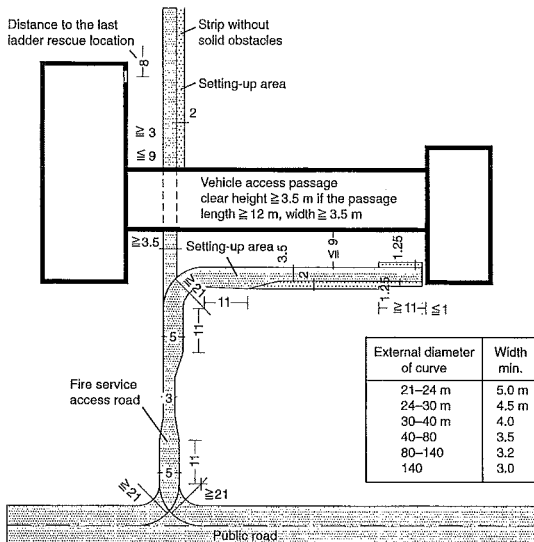
(6 days × 5 washes) = 9.0 kg/wash

5 kg/washing machine = 1.8 machines

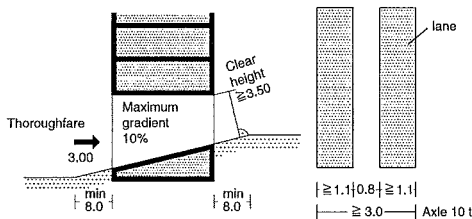
1.8 machines will be needed = 2 machines

WORKSHOPS

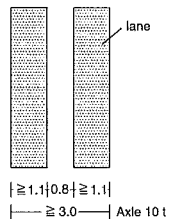
Fire Station



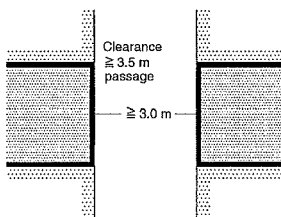
1 Examples: areas for a fire station on a site



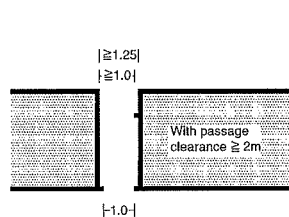
2 Through passage: changes in slope



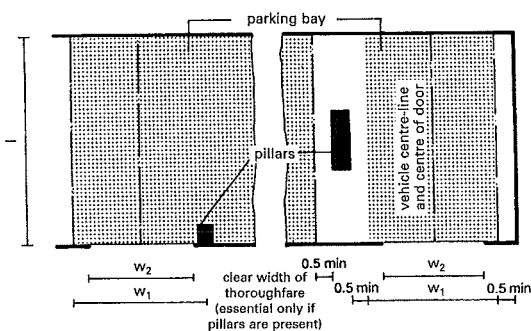
3 Fire service access



4 Fire service access



5 Pedestrian access



6 Parking places and gates → 7

Size ¹⁾	Parking place		Gate (drive-through width b ² × drive-through height)	Unit (U) Calculated acc. to → 8 ²⁾ m ²
	Width b ₁ min.	Length L min.		
1 (avoid if possible)	4.5	8	3.5 × 3.5	9
2	4.5	10	3.5 × 3.5	11.25
3	4.5	12.5	3.5 × 3.5	14
4	4.5	12.5	3.5 × 4	14

¹⁾ see also → 9 notes; ²⁾ corresponds to 1/4 of parking place

7 Dimensions of parking places → 6

a) **Fire sub-station for local call-outs** can consist of: fire engine parking, equipment room, store for special equipment, training room (multi-purpose room for administration and control centre), social rooms, building services.

b) **Fire station for local and regional call-outs**, for example for preventative fire protection and technical assistance, with central workshop, repair, training and exercise rooms, can consist of: fire engine parking (with additional places if ambulances are also stationed), equipment room, store for special equipment, training room, staff rooms like washroom, showers, WC, changing room, drying room, social rooms (like on-call lounge, kitchenette), administration, chief's office, vehicle and equipment workshop, building services, room for ABC (disaster) service, central workshop (if required). Unless there are centralised hose maintenance and breathing equipment maintenance workshops, these will also be required. If the workshops are centralised, then appropriate stores will still be needed at each station.

	units ¹⁾
equipment room	1 U
store room for special equipment	1 U
training room	4 U
associated side room	1 U
staff rooms:	
washroom, showers, WC, changing room, drying room	3 U
on-call lounge, kitchenette	3 U
administration	
room for fire service chief	1 U
control room	1 U
workshops: hose maintenance workshop, hose washing and testing room (min. 26 m long and 3 m wide)	8 U
hose store	1 U
hose drying tower with exercise wall (clear height of tower 23 m)	1 U
(If a horizontal hose drying installation is intended instead of a hose drying room, then this should be accommodated in the hose washing and testing room, whose min. area must then be 9 U and clear height min. 3 m)	
breathing equipment workshop	4 U
maintenance, repair, storage incl. radiation protection, diving ²⁾	4 U
room for ABC (disaster) service	4 U
vehicle and equipment workshop including:	
battery charging station, next door to existing parking place	2 U
washing hall	4 U
building services:	
heating, fuel room	1 U

¹⁾ units (U) according to → 7 determine the floor area of rooms. For fire stations with parking places of various sizes, the unit is based on the largest. The floor areas determined through the units give the minimum size of the rooms.

²⁾ this does not include breathing equipment exercise facility.

8 Floor areas of rooms → 7

Fire service vehicles	Actual total weight (kg) (permissible)	Wheelbase (mm)	Turning circle B (mm)	Length (mm)	Width (mm)	Greatest height (mm) for 4WD vehicles with rooflights
fire engine with pump and crew LF 8	5450 (5800)	2600	11,700 (2WD)	5650	2170	2800
fire engine with pump and crew LF 8	7490 (7490)	3200	15,050 (4WD)	6400	2410	2950
fire engine with pump and crew LF 8	11,300 (11,500)	3750	16,100 (4WD)	8000 with hose reel trailer	2470	3090
fire engine with pump and crew LF 16	10,200 (11,000)	3750	16,100 (4WD)	7600	2470	3100
fire engine with pump and crew LF 16-TS	7490 (7490)	3200	14,800 (4WD)	6250	2410	2850
water tender with tank and pump TLF 8/18	10,700 (11,500)	3200	14,400 (4WD)	6450	2470	2890
water tender with tank and pump TLF 16/25	15,900 (16,000)	3500	15,400 (4WD)	6700	2500	3270
water tender with tank and pump TLF 24/50	11,500 (12,000)	3750	16,100 (4WD)	7000	2470	2990
foam tender with tank and pump TLF 16	7300 (7490)	3200	14,800 (4WD)	6100	2410	3250
foam tender with tank and pump 1000	10,100 (11,600)	3200	14,400 (4WD)	6450	2410	3300
foam tender with tank and pump 2000	12,550 (13,000)	4400	18,600 (2WD)	9800 with hose reel trailer	2430	3250
turntable ladder DL 30	20,200 (21,000)	3800 × 1320	19,900 (4WD)	9800	2480	3300
turntable ladder LB30/5 with cradle	7200 (7490)	3200	14,800 (4WD)	6400	2420	2850
equipment truck RW1	10,850 (11,000)	3750	16100 (4WD)	7600	2480	3070
equipment truck RW2	10,200 (11,000)	3200	14,400 (4WD)	6500	2500	2980

9 Usual dimensions of current fire service vehicles from one of the largest German manufacturers

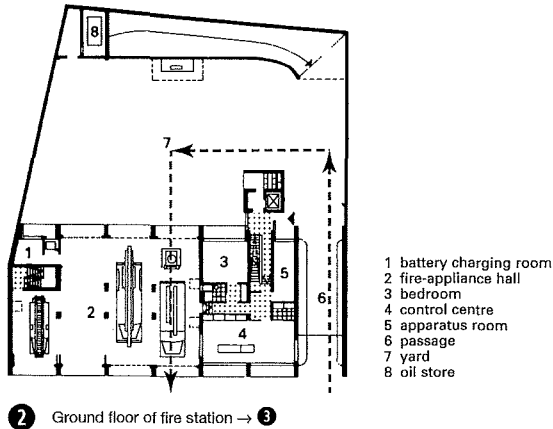
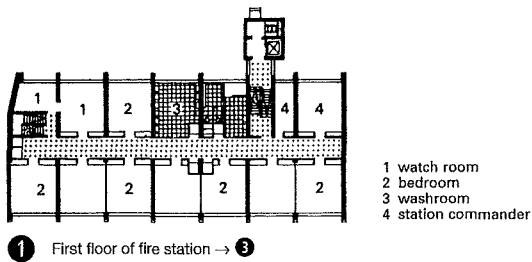
Industry and trade

WORKSHOPS

Joinery
Carpenter's shop
Metalwork
Vehicle repairs
Bakery
Meat processing plant
Other trades
Laundry
Fire station

WORKSHOPS

Fire Station



Fire station: is used for the accommodation of vehicles and other equipment.

Staffed fire station: is used for the accommodation of personnel, vehicles and other equipment in readiness for emergency services and also in some cases the constantly staffed control centre for the centralised receipt of reports, alarming, coordination and control of emergency personnel. A flat should ideally be provided. The crews are either in readiness or on call for call-outs by telephone or fire alarm, either entirely or as reinforcement. Emergency call, warning and fire alarm equipment.

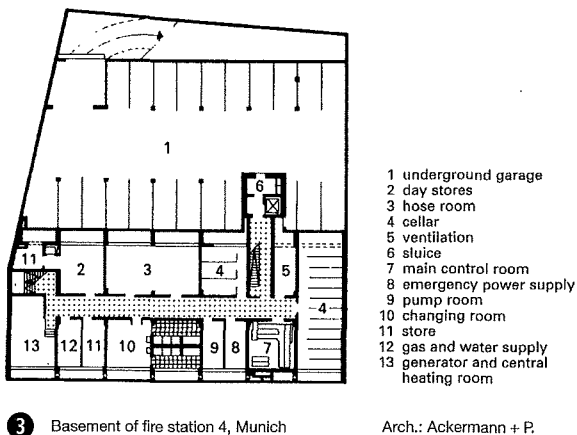
Functions before the call-out: Parking of private cars. Changing near the vehicle and fitting of equipment. Getting into vehicle.

After the call-out: Vehicles returning from a call-out are parked forwards into the vehicle hall via the yard. The vehicles are then re-equipped and fire-fighting water and fuel filled up. The crew change and wash. The plot should be in a position central to all parts of town or suitable for risk hotspots. Provide clear and unobstructed access and exit routes and sufficient open areas, e.g. consider the turning circles for vehicles. Vehicle washing area with sand trap and petrol separator, tanks for diesel and petrol. The yard should be suitable for heavy vehicles (about 16 t). Underground and overground hydrants. Space is required for additional vehicles, perhaps also a helipad (50 x 50 m) with an additional 15 m of free space. Sport facilities and green areas.

Industry and trade

WORKSHOPS

Joinery
Carpenter's shop
Metalwork
Car repair workshop
Bakery
Meat processing plant
Other trades
Laundry
Fire station



Arch.: Ackermann + P.

- | | | |
|-----------------------|------------------------|-------------------------|
| 1 landing | 12 parts store | 23 recreation room |
| 2 flat | 13 workshop | 24 practice room |
| 3 training room | 14 breathing apparatus | 25 breathing apparatus |
| 4 training material | 15 courtyard | 26 training room |
| 5 meeting room | 16 station commander | 27 heating plant |
| 6 garage | 17 duty room | 28 store |
| 7 oil store | 18 changing room | 29 battery room |
| 8 vehicle wash | 19 washroom | 30 telephone/radio room |
| 9 fire-appliance hall | 20 locker room | |
| 10 hose wash | 21 porch | |
| 11 hose store | 22 lobby | |

