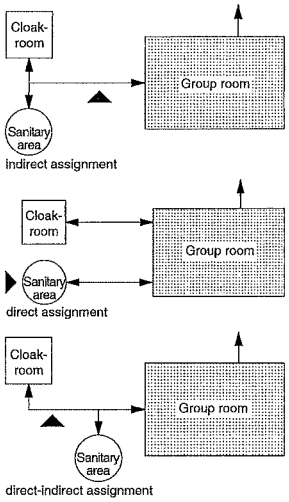
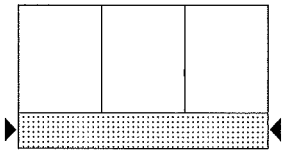
CHILDREN'S DAYCARE

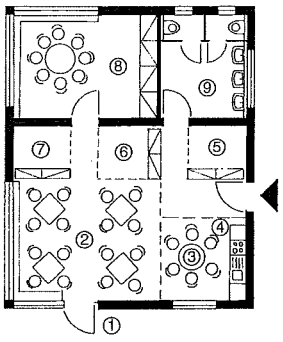
Access and Building Forms



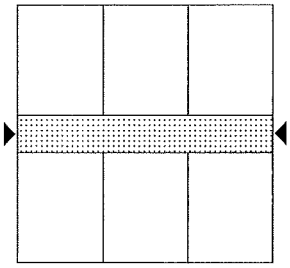
1 Functional arrangement of group room, cloakroom and sanitary facilities



3 Children's daycare centres access types: in a single block



2 Typical plan of a kindergarten group Arch.: Franken/Kreft



4 In two blocks

The design of facilities for children should consider their needs and size. There are no regulations or guidelines for the construction of children's daycare buildings. The regulations of the relevant state and the LBO are used as guidelines. Accessibility building design standards are recommended.

Children's daycare centre

This term includes crèches, kindergartens, after-school care etc. The daycare centre is organised so that a mixture of children with all-day and part-time arrangements can be looked after.

Crèche, nursery

Cares for small children from babies to three years old. The group size is generally approx. 10 children.

Kindergarten

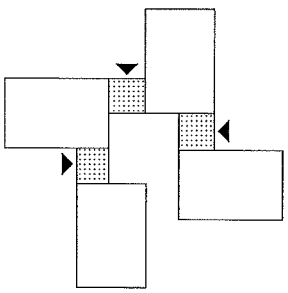
Looks after children from min. three years old until they go to school. It may be possible for them to eat lunch and sleep. The group size is generally 20 children.

Children's after-school care

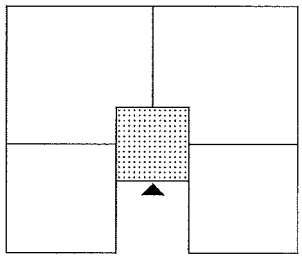
For the care of school-age children until 14 years old. Lunch after school and assistance with homework are offered. These establishments are often combined with kindergartens and the group size is generally 20 children.

Age	1	2	3	4	5	6	7	8	9	10	11	12
Height (cm)	75	85	94	101	108.5	115	121.5	127	131.5	137	143	148
Eye level (cm)	64	74	83	91	96	103	108	113	117	122	127	131
Reach (cm)	30	36	42	48	52	57	61	64	66	69	72	75

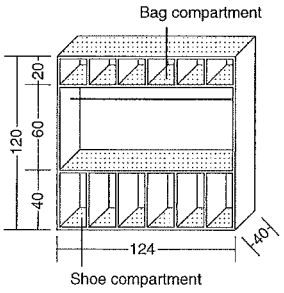
5 Guideline sizes of children (Gralle, Port → refs)



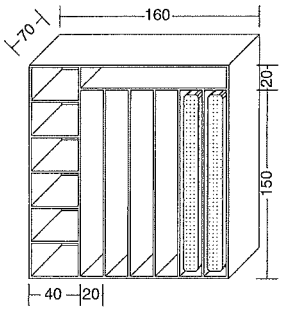
6 Hall access



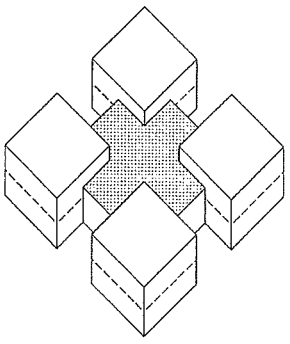
7 Courtyard access



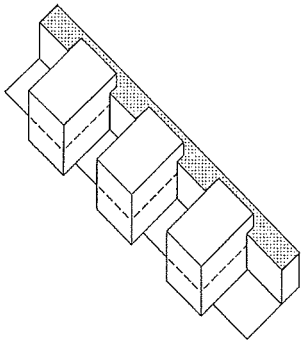
8 Cloakroom cupboard for six children



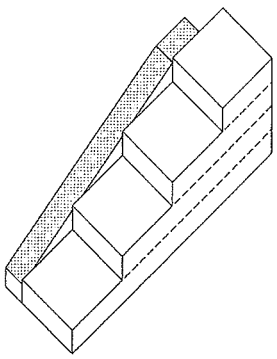
9 Cupboard for storing children's mattresses (size: 140/70 and 120/60 cm)



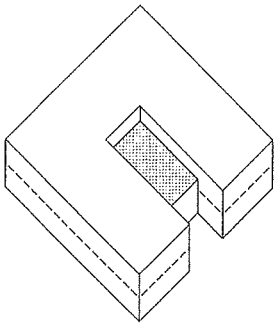
10 Building form: grouped pavilions



11 Building form: rows of pavilions



12 Building form: stepped



13 Building form: compact

Group room
Most time in the children's daycare centre is spent here. Required floor area approx. 2.5 m^2 per child. Create zones as varied as possible and design a second floor level and a stage (play-stage half-open, with a snug cave). Play decks up to a height of 1.50 m must have a handrail at least 70 cm high; play decks more than 1.50 m high must have handrails min. 1.00 m high. The group room should have as short a distance as possible to the WC area. Ideally, provide direct access to the open air and align to the south.

Rest or sleeping rooms
These are not always considered necessary, as mattresses are often laid out in the group room for the midday sleep (cupboard to store the mattresses → p. 188 ❾).

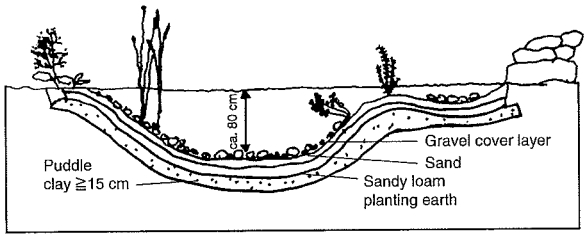
Kitchen
The status of the kitchen in the children's centre can vary according to the paedagogical concept, for example a central kitchen for all groups or as a series of kitchens, one in each group room. Different floor heights are recommended so that adults and children can cook together.

Dining room
The group room is normally used for eating. An extended corridor or the entrance hall are also suitable as communicative places to eat.

Stairs
The risers of stairs in children's centres should not be more than 16 cm, and the treads between 30 and 32 cm.

Height recommendation	Washing facilities	WC, seat height
nursery	for every 10 children	
potty room	1, 45–60 cm	1, 20–25 cm
kindergarten	approx. for every 5 children	
potty room	1, 45–60 cm	1, 25–30 cm
after-school	approx. for every 10 children	
girls boys	1–2. 1–2 65–70 cm	1 1 30–35 cm

❶ Height guidelines for washbasins and WCs



❷ Pond with clay lining for outside area in children's daycare centre

Outdoor areas
Outside playgrounds should be designed to be as varied as possible. The design of external works for children's centres is regulated by several standards. The stipulated minimum area outside per child is variable between the German states.

Hilly landscape Modelling the terrain by heaping and excavating the ground surface. The coarse shape is produced by a hydraulic excavator, and the fine modelling by hand. The hills can incorporate plants, shrubs, hedges, flowers and clover of various heights.

Compost heap as the core of an organic garden. Semi-shaded location for organic waste from the centre.

Trees for climbing, to provide shade, deliver fruit and be educational. Also worth considering are vegetable/herb gardens, sandpits, bird tables, dry stone walls, meadows etc.

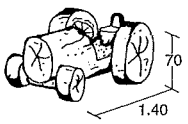
Pond should have min. 6 m^2 water surface and a depth of 80 cm to avoid oxygen deficiency. For safety reasons, either a coarse net should be spread over the water or builder's steel mesh installed 10 cm under the water surface.

BS EN 1176
ASTM F1487
DIN EN 1176
DIN EN 1177
DIN 18034

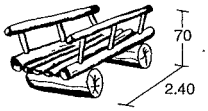
LBO

PLAYGROUNDS

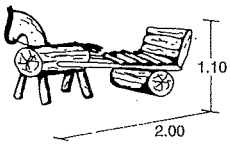
Playground Equipment



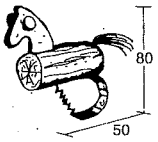
❶ Tractor



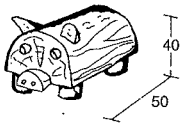
❷ Trailer → ❶



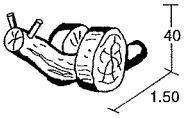
❸ Horse and cart



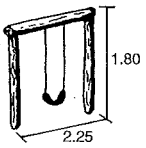
❹ Rocking horse



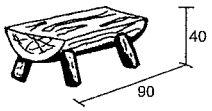
❺ Pig



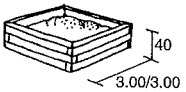
❻ Snail



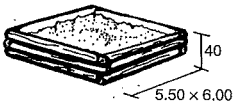
❼ Swing for small child



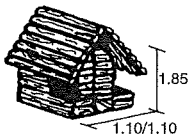
❽ Snack table



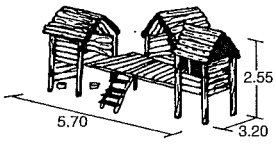
❾ Sandpit (squared timber)



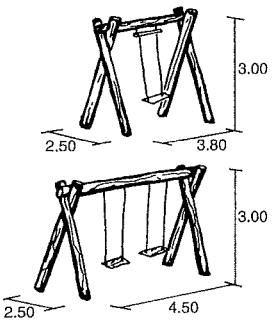
❿ Sandpit (round timber)



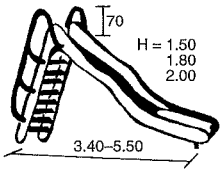
⓫ Playhouse



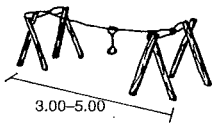
⓬ House group



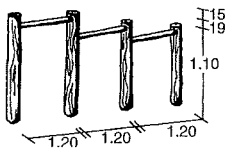
⓭ Swings



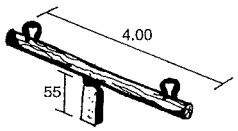
⓮ Slide



⓯ Cable run



⓰ Vertical bars



⓱ Seesaw

⓲ Slide and climbing house

Playgrounds must be varied in design, changing and changeable. They must meet the needs of children. Some of the requirements for children's playgrounds are: traffic safety, no pollution by emissions, sufficient sunshine, groundwater level not too high,

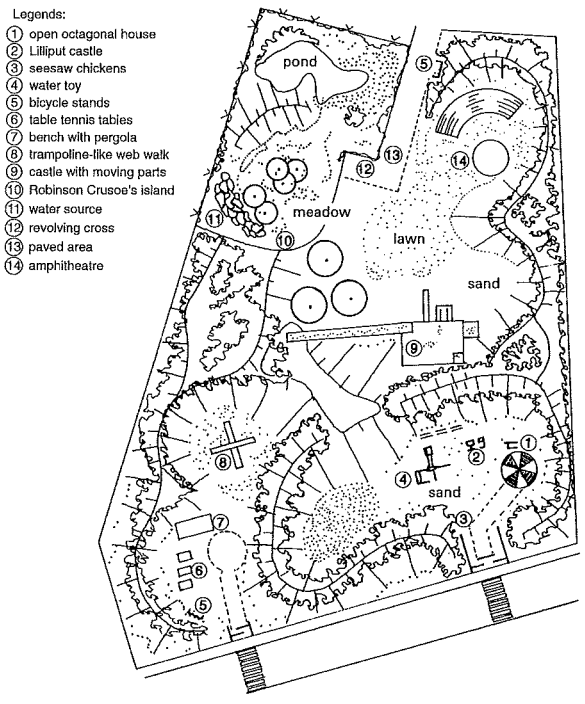
Play equipment in playgrounds is often made of timber (e.g. larch, robinia) and the surface of the wood can be additionally protected with beeswax treatment. Standing water and damp should be avoided on all wooden surfaces, so galvanised steel is often set into the ground at the base of verticals.

Playgrounds should be orientation points within residential districts and connected to housing with simple networks of paths. Do not banish playgrounds to the periphery, but design in combination with other communication systems.

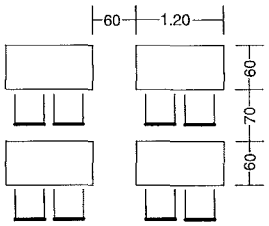
Guideline values for the design of playgrounds are built up from individual data: age group, usable area per resident, play area size, distance from home:

Age (years)	m^2/resident	Accessibility, max. distance from home (m)	(min.)
0–6	0.6	up to 200 and in sight	2
6–12	0.5	up to 400	5
12–18	0.9	up to 1000	15

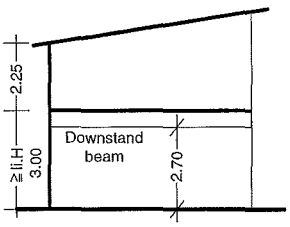
Playgrounds for children are to be provided, as private facilities within the building plot, with the construction of houses or flats: for small children up to 6, for children from 6 to 12, plus leisure areas for adults. This is a requirement for three flats or more. The uniform basis for the provision of all public playgrounds is: 5 m^2 playing area per residential unit, minimum area of playground: 40 m^2. Outdoor play areas must be fenced at least 1 m high (thick hedges, fence or similar) to prevent access to roads, car parking, railway lines, deep watercourses, cliffs and similar dangers.



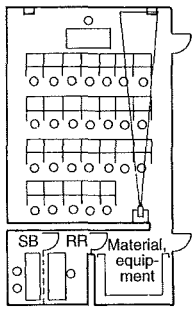
⓳ 'Karnacksweg' playground



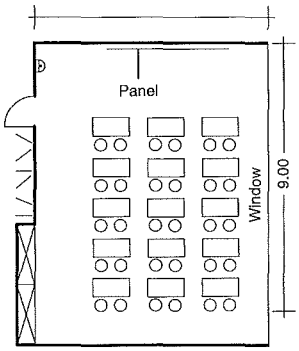
❶ Minimum dimensions for table arrangement in regular classrooms (Saxony → refs)



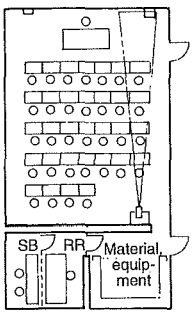
❷ Room heights of classrooms



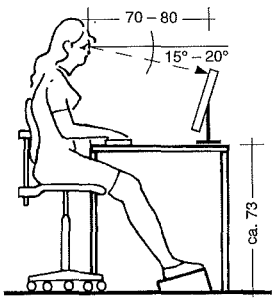
❸ LTR (= listen, talk, record) laboratory, SB = speaker's booth, RR = recording room



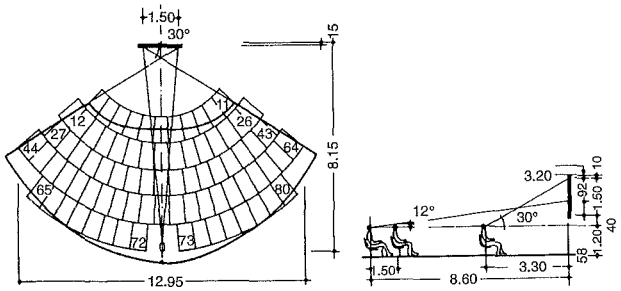
❹ Max. depth of classrooms with one-sided daylight



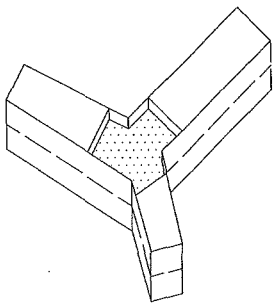
❺ LT (= listen and talk) laboratory



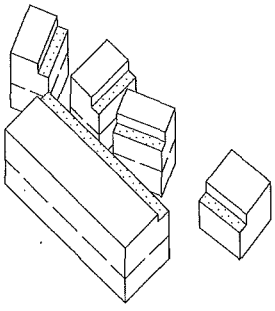
❻ Workplace with monitor



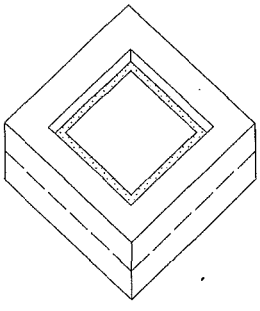
❼ Seating arrangement for 80 pupils ≧10 years old, for film, slides and overhead projection



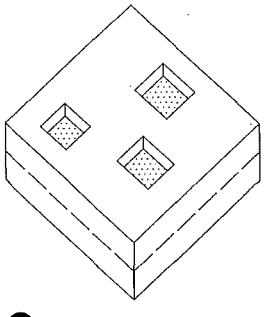
❽ Building form: grouping with central access



❾ Building form: grouped pavilions



❿ Compact building form: with central courtyard access



⓫ Compact building form: with light wells

Design parameters

The basis for the planned development of schools are the school building guidelines of each German state (including model room layouts), in conjunction with relevant national building standards and health and safety regulations.

General classroom area

This includes standard and replacement classrooms, course rooms, rooms for languages and social studies, language laboratories, teaching equipment and map rooms, and other subsidiary rooms. The subjects taught in the general classroom area are: languages, general studies, mathematics, religion, social studies and politics, as well as optional subjects and remedial teaching.

Group rooms

In primary and special schools it should be arranged that these are each accessible from two classrooms. Multi-purpose rooms can be assigned to other areas.

Number of floors

This should lie between three and four. Schools for pupils who are physically disabled or have learning difficulties should have 1–2 storeys.

Room dimensions

The maximum number of pupils in a class is 32.

According to the school building guidelines, the design of classrooms should normally be based on tables with two workplaces → ❶. If the windows are all on one side, the max. room depth is 7.20 m. If possible, have windows on both sides to permit furniture to be freely positioned. The distance between the blackboard and the pupil workplaces at the back should not exceed 9.00 m → ❹. Guideline values: area: ≦1.80–2.00 m²/pupil. Air volume: ≦5.00–6.00 m³/pupil. The ceiling height of classrooms (min. 3 m) may not be reduced by more than 0.30 m by individual construction elements → ❷.

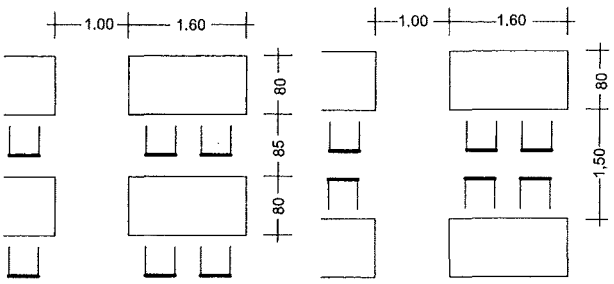
Language laboratory → ❸ – ❺

Located within the general classroom area or near the media centre/library. Guideline: approx. 30 language laboratory places per 1000 pupils. Size: LT (listen and talk) and LTR (listen, talk, record) laboratory size, total approx. 80 m², language laboratory cabins approx. 1 × 2 m, number of places per laboratory 24–30 m², i.e. 40–60 m² plus subsidiary areas. LTR laboratory → ❸: 23 workplaces as cabins, approx. 65 m² (approx. 2.8 m²/place) including subsidiary rooms approx. 95 m².

LT laboratory → ❺: 33 workplaces as desks, approx. 65 m² (approx. 2.0 m²/place) including subsidiary rooms approx. 95 m². Side rooms: studio, recording room, archive for teacher and pupil tapes. Language laboratories are also possible in inner areas of the building with artificial light and air conditioning.

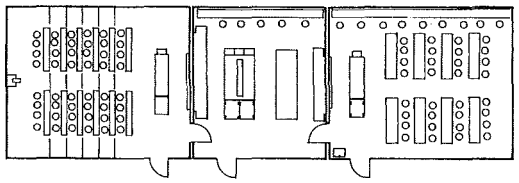
Computer room

Should if possible face north and not be on the ground floor (Saxony → refs). The IT workplaces are designed according to the guidelines for computer workplaces. The upper edge of the monitor should be below eye level so that the pupil's head is tilted at 15–20° → ❻.

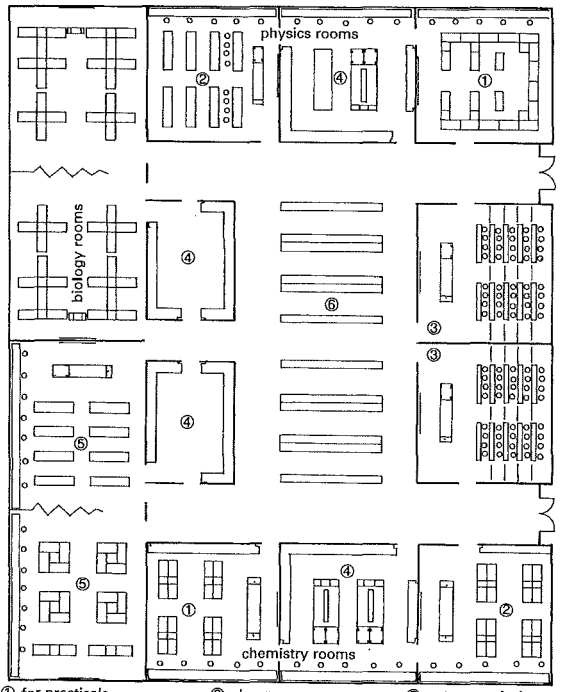


❶ Minimum dimensions for table layouts in practical rooms, in rows

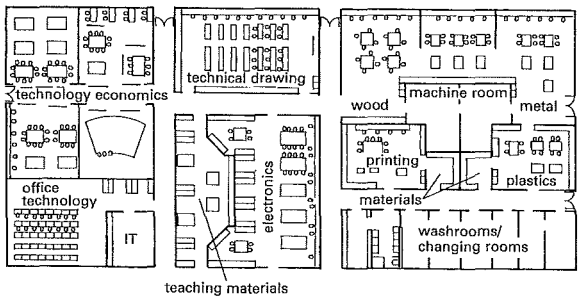
❷ Minimum dimensions for table layouts in practical rooms, back-to-back



❸ Rooms and areas for science teaching



❹ Science area, approx. 400 places, approx. 1400 m²



❺ Areas for technology/business studies, office technology, technical drawing, subjects altogether approx. 350 places, approx. 1600 m²

Science teaching area

This includes teaching, teaching/practical, practical, preparation and meeting rooms, photo work and photo lab rooms. Teaching rooms for biology, physics and chemistry approx. 2.50 m²/place. For lectures and demonstrations approx. 4.50 m²/place.
Demonstration and practical room for natural sciences, chemistry and biology, and physics, chemistry and biology approx. 70–80 m² → ❸. Teaching room for lecturing and demonstrations in the subjects physics, biology and perhaps chemistry approx. 60 m², with permanently installed, ascending auditorium seating. A second entrance and exit may be necessary. This room may be in an internal location with artificial lighting. Practical room for pupils, collaborating groups etc. in biology and physics or also interdisciplinary practical area, space sub-divided by means of partitioning, area per room or section approx. 80 m².
Preparation, meeting and materials room for subject combinations or single subjects: together approx. 30–40 m² or approx. 70 m², according to the size of the science area. This room may be in an internal location with artificial lighting.

Music and art teaching

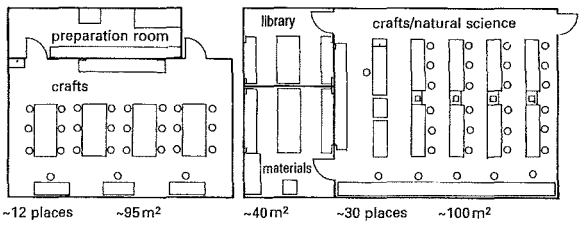
Rooms for drawing should have uniform natural light, if possible from the north. Music rooms should have an appropriate layout and sound insulation to avoid disturbing other facilities.

Technical teaching

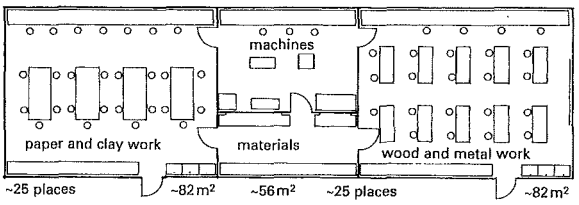
Workrooms should be arranged so that teaching in other rooms is not disturbed by the noise. The working area should be subdivided into the various media (wood, paper, metal, plastic) and ideally be located on the ground floor.

Photo laboratory

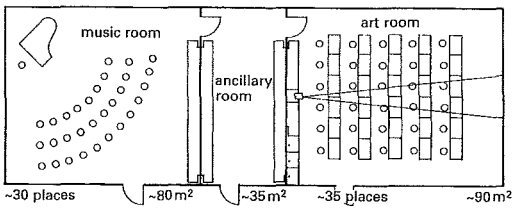
The photo laboratory is a dark room for positive work (one enlargement table for 2–3 pupils, combined with wet working areas), for negative work (film development) and a film storage room. If possible it should be north-facing with constant room temperature. Space requirement: 6–14 pupils per work group, min. 3–4 m² per work place.



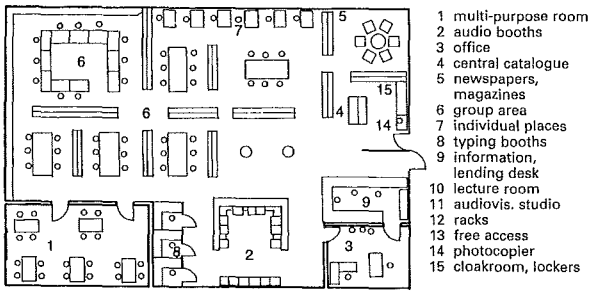
❻ Rooms and areas for technology



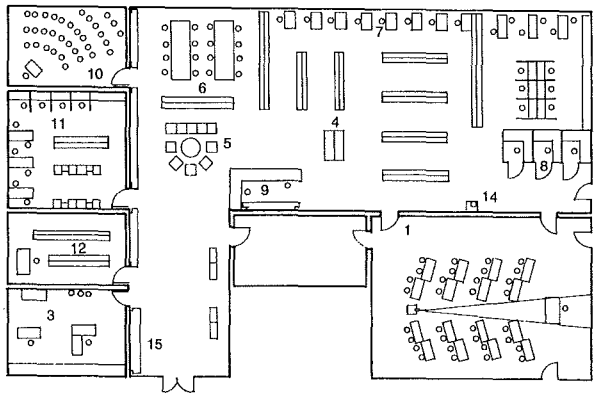
❼ Areas for technology



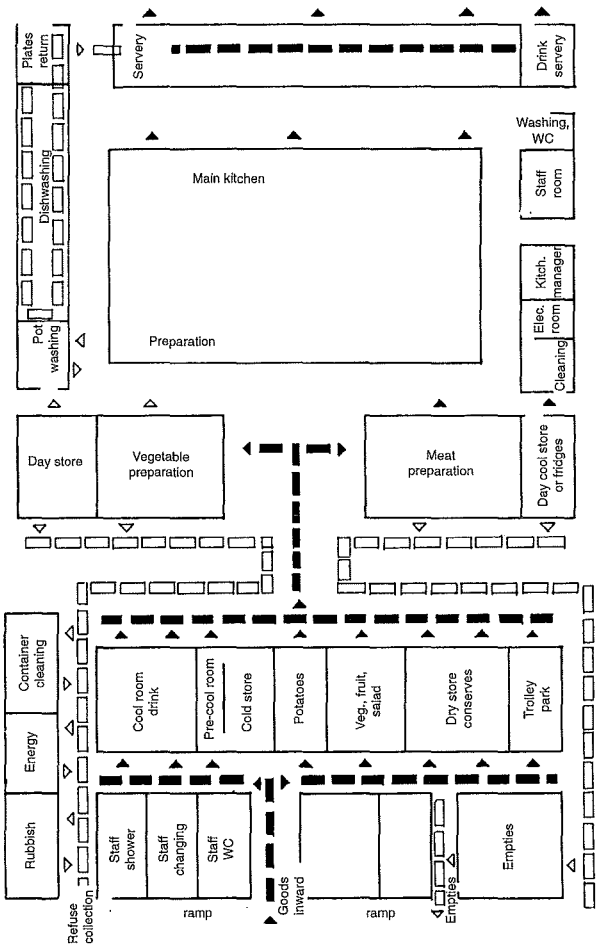
❽ Areas for music and art



❶ Example of school library/media centre



❷ Example of school library/media centre



❸ Organisation of space and functions in a school kitchen

Library, media centre and central facilities

Information centre for teaching, further education and leisure. The users are pupils, teachers and external participants. **Library** denotes a conventional school and lending library including lending, reading and work spaces and the appropriate shelves for books and magazines. **Media centre** describes the extension of the library to cover recording and reproduction technology (hardware) for radio, film, television, cassettes, tapes, CD, DVD, i.e. so-called audio-visual material and a corresponding stock of software.

Guideline space requirement

Total for library and media centre 0.35–0.55 m^2/pupil.

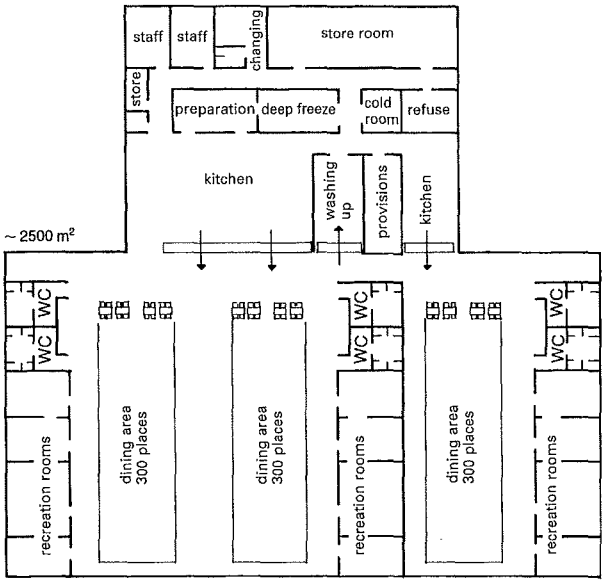
Details: Book issue and return, per work space approx. 5 m^2 including catalogue areas approx. 20–40 m^2.
Advisors (librarian, media teacher, media technician etc.), per employee approx. 10–20 m^2. Compact book storage per 1000 volumes at approx. 20–30 volumes per running m of shelf, approx. 4 m^2 self-service shelves incl. movement areas; reading places and catalogue per 1000 volumes of non-fiction and reference works approx. 20–40 m^2; general working zone per 1000 reference volumes approx. 25 m^2 for approx. 5% of pupils/teachers but min. 30 work spaces each 2 m^2, approx. 60 m^2, per carrel approx. 2.5–3.0 m^2. Group work room, 8–10 people, approx. 20 m^2 → ❶ – ❷.

Kitchen and dining room

For a dining room with more than 400 places, the places of assembly regulations should be complied with.

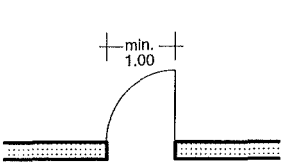
The size and equipment depends on the catering system, food service and return of plates. For young pupils meals may be served at table (portions possibly served by the teacher) otherwise self-service (from conveyor, counter, cafeteria line, free-flow cafeteria, turntable etc.). Serving capacity: from 5–15 meals/minute or 250–1000 meals/hour with varied personnel requirement.

Space required for serving system approx. 40–60 m^2. Dining room size depends on number of pupils and sittings, per seat min. 1.20–1.40 m^2. Larger areas should be partitioned into smaller rooms. At entrance, provide one washbasin per 40 seats → ❸ – ❹.

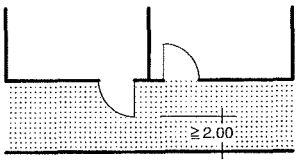


❹ Servery, plates return and eating area

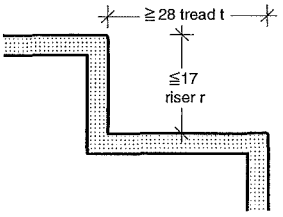
SCHOOLS
General classrooms
Specialist classrooms
Information and communal area
Sanitary facilities
Break and circulation areas
Arrangement of classrooms
Clusters
Model room programme
Examples



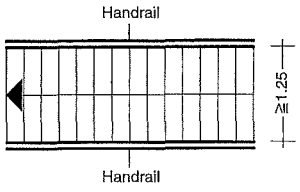
❶ Doors



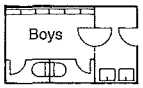
❷ Corridors, min. escape route width



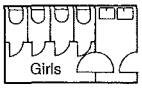
❸ Pitch of stairs



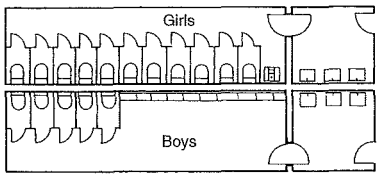
❹ Stairs as escape route (according to school building guidelines)



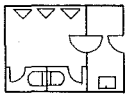
❺ Lesson-time WC facilities, e.g. for approx. 100 boys, approx. 15 m²



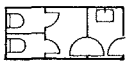
❻ e.g. for approx. 100 girls, approx. 15 m²



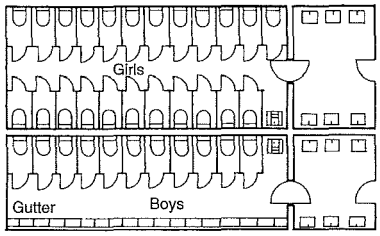
❼ Break-time WC facilities, e.g. single-row facilities for approx. 250 girls, approx. 40 m²; for approx. 250 boys, approx. 40 m²



❽ Teacher WC facilities, e.g. for approx. 30 teachers, approx. 15 m²



❾ e.g. for approx. 20 women teachers, approx. 10 m²



❿ Break-time WC facilities e.g. two-row facilities for approx. 500 girls, approx. 65 m²; for approx. 500 boys, approx. 40 m²

No. users	WC	Urinals
40 boys	1	2
20 girls	1	–
15 teachers	1	1
10 women teachers	1	–

⓫ Guideline for number of sanitary facilities (Saxony → refs)

Circulation and escape routes

Horizontal and vertical access routes are normally also emergency escape routes. Escape routes must have a clear width of min. 1.00 m/150 people but min. width of corridors in classroom areas is 2.00 m, or 1.25 m with up to 180 people. Stairs in classroom areas must be 1.25 m wide, other escape routes 1.00 m wide. Max. length of escape routes: 25 m measured in a straight line from the stairwell door to the farthest work place, or 30 m in an indirect line to the centre of the room. Capacity of stairs dependent on number of users and average occupancy, e.g. stair width: 0.80 m for each 100 people (min. 1.25 m, but not wider than 2.50 m).

Doors → ❶

These may open inward or outward. Outward opening doors should not endanger pupils and project max. 20 cm into the escape route. → ❷.

Doors from rooms with more than 40 pupils or increased fire risk (chemistry, work rooms) must open in the direction of the escape route.

Stairs, ramps → ❸ – ❹

The pitch of stairs is to be based on length of pace: 2 riser + tread = 59–65 cm. Ramps ≦6% gradient.

Cloakrooms

Cloakrooms are to be provided outside classrooms.

Break areas

The space guideline for enclosed break areas is 0.4–0.5 m²/pupil. They are to be designed so that they can be used for school events. Dining and multi-purpose rooms may be used as break areas. If the connection between school building and sports hall is roofed over, this can be designed as a break area or covered sports area (Saxony → refs).

Communal area

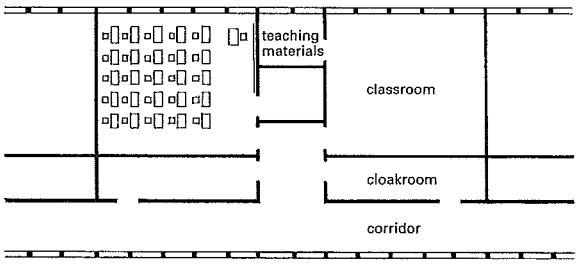
A communal area should be provided in each larger school for events and celebrations. This can be achieved through the temporary connection of several rooms and circulation areas. Whether the building of a school hall is necessary is regulated by the relevant state school building guidelines.

Sanitary facilities → ❺ – ⓬

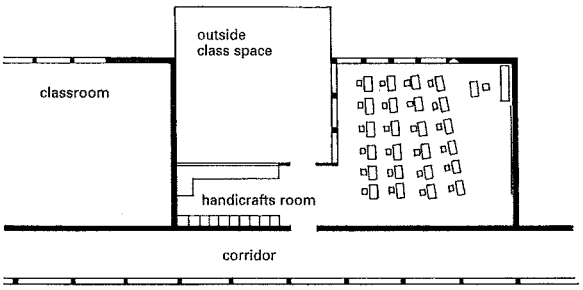
The necessary WCs, urinals and washbasins are provided according to the total number of pupils (divided between boys and girls) according to the school building guidelines → ⓫. One washbasin is provided for every boys' WC or for every two girls' WCs. Toilets should be as directly lit and ventilated as possible. The accesses for girls and boys are to be separate.

Context	Form	Separation boys/girls	Location	Use	Notes
class WC	toilets with lobby	no	near a classroom	during lesson	possibly for preschool and school kindergarten, poss. 2 WCs and lobby
lesson WC	toilets	yes	accessible from corridor or hall	several classes during lesson	each classroom without WC should be max. 40 m distance (incl. stairs) from lesson WC
break WC	toilets	yes	accessible from schoolyard or hall	for classes during the break	WCs at ground level, not in centre of building, accessible from break areas
teacher WC	toilets	ladies/gents	for teachers or administration	during the break	possibly linked to staff cloakroom

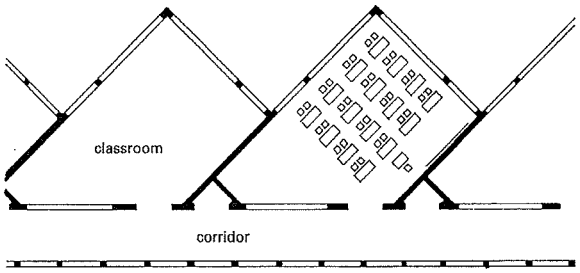
⓬ Recommended WC facilities



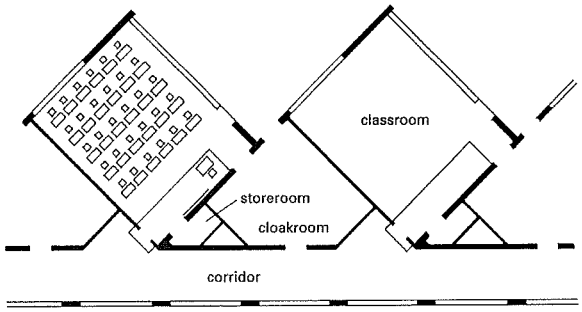
1 Classroom lit and ventilated on both sides through cloakroom and corridor, corridor opening up every two classrooms into teaching equipment room
Arch.: Yorke, Rosenberg, Mardall



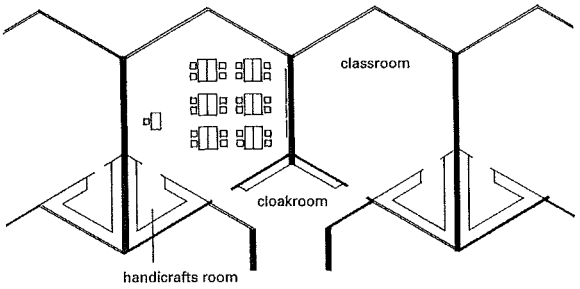
2 Design proposal: combination of classroom, open-air classroom and hobby room
Arch.: Neutra



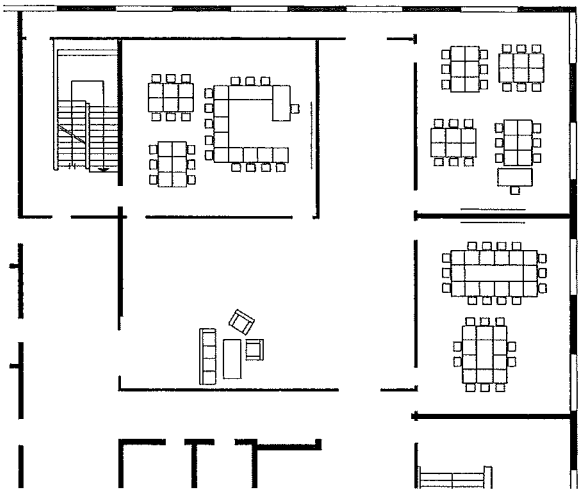
3 Saw-tooth plan
Arch.: Carbonara



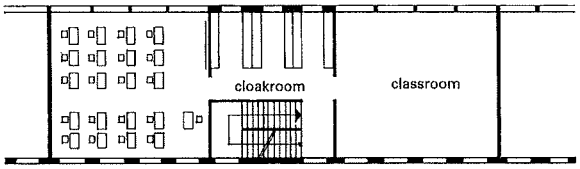
4 Classrooms with additional daylight through high-level window, without view in from the back. Corridor opens up at each classroom into cloakroom and storeroom
Arch.: Carbonara



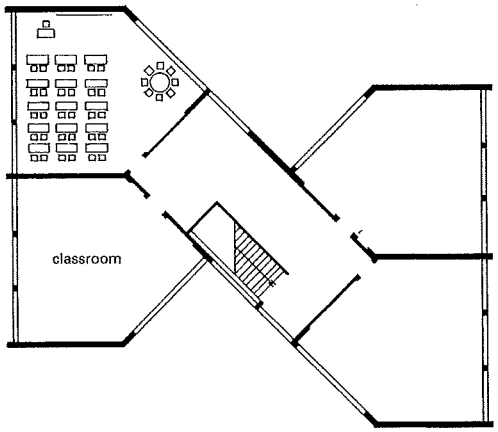
5 Hexagonal classrooms with enclosed triangular hobby rooms
Arch.: Brechbühlen



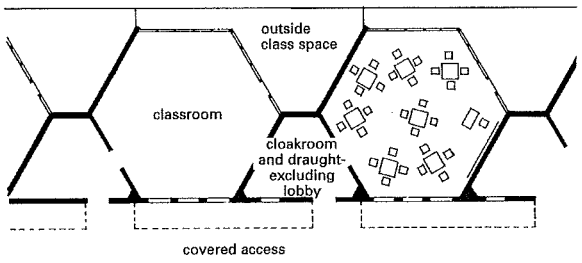
6 Cluster, bundling of several classrooms, single-sided daylighting of individual rooms



7 Multi-storey building: two classrooms to each staircase, daylight from two sides
Arch.: Schuster



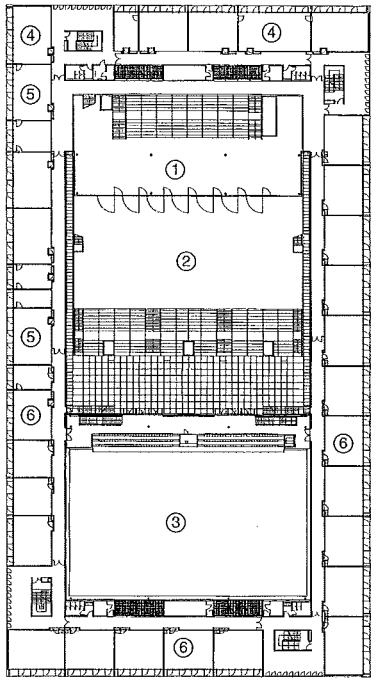
8 Four classrooms per storey with daylight from both sides, side extension for group teaching
Arch.: Haefeli, Moser, Steiger



9 Hexagonal classroom without corridor, accessed through cloakroom and lobby
Arch.: Gottwald, Weber

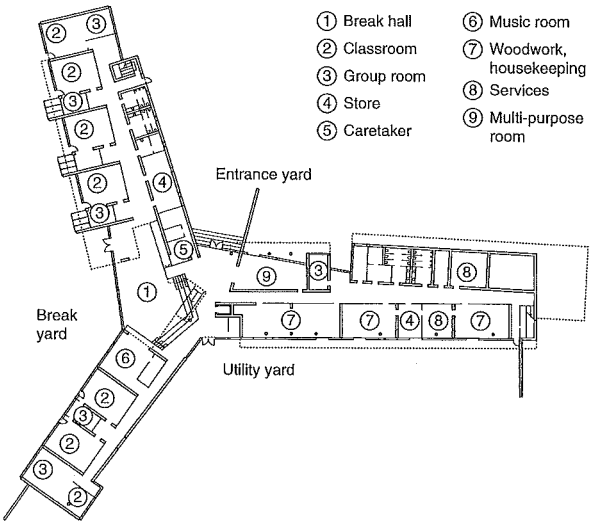
			1 cohort 4 classes 120 pupils		2 cohorts 8 classes 240 pupils	
	Places	**m²/room**	**No.**	**m²**	**No.**	**m²**
General teaching rooms				**326–490**		**592–748**
classrooms	24 – 32	50–66	4	200–264	8	400–528
group rooms	12–18	36–50			2	72–100
multi-purpose rooms	32	72	1	90	1	72
side rooms		18–36	1	18	1	24
teaching equipment room		18–36	1	18	1	24
Specialist classrooms						**96**
work room	16	72			1	72
side room		24			1	24
music room	32	72				
School library/media centre				**60**		**72**
Administration				**36**		**102**
head teacher's room		12–18				60
secretariat		18–24		36		
teachers' room		24–50		12		
sick room		18			1	18
parents' meeting room		12			1	1
caretaker's room		12			1	12
Communal areas				**92**		**92**
kitchen servery		24	1	24	1	24
dining/multi-purpose room			1	50	1	50
side room		18–24	1	18	1	18
Utility areas				**24**		**66**
caretaker's workshop		18			1	18
room for cleaning materials		12			1	12
storeroom			1	24	1	36
Caretaker's flat					**1**	**80**
Sports hall					**1**	**600**
Open-air sports facilities						
break areas with gymnastic and play equipment				600		1200
school garden				150		300
playing field			1 pitch		1 pitch	
100 m track	4 tracks					
long jump facility	3 tracks					
gymnastics lawn				400		400
Subtotals						
general classrooms				326–390		592–748
specialist classrooms						96
school library/media centre				60		72
administration				36		102
utility areas				24		66
Total				**446–510**		**928–1084**
m²/pupil				**4.0**		**4.2**

❶ Model room programme, primary school, school building regulations (Saxony → refs)

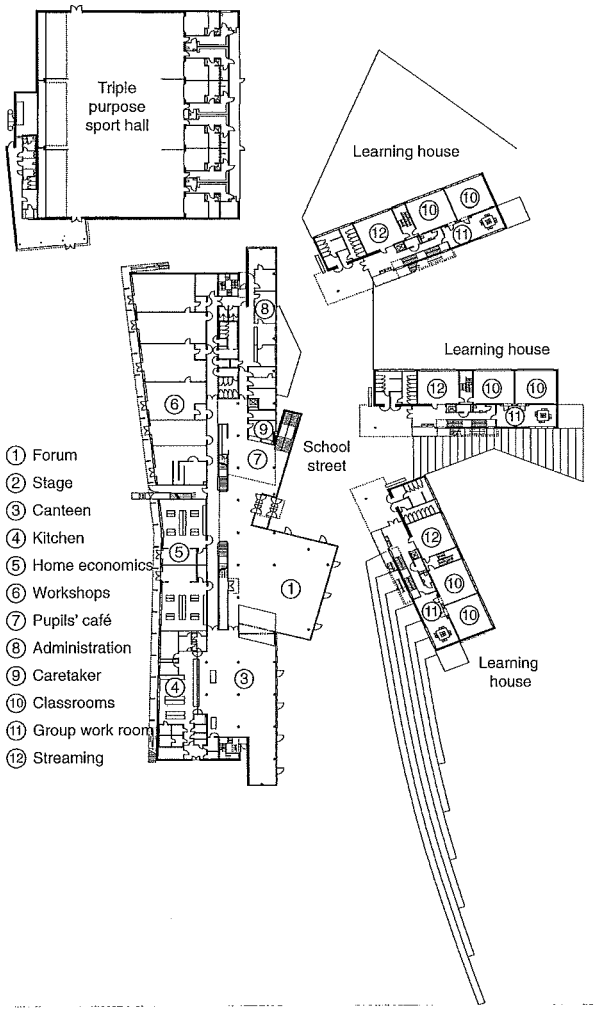


① Break hall
② Break yard
③ Sports hall
④ Physics classroom
⑤ Drawing/crafts
⑥ Class/course rooms

❶ Markt Indersdorf grammar school, first floor
Arch.: Allmann Sattler Wappner Architekten

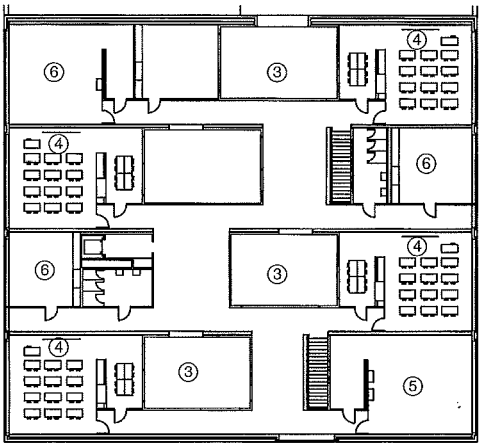


❸ School for individual promotion of learning, Alzenau, primary and secondary school, ground floor Arch.: (se) arch Stefanie Eberding und Stephan Eberding



① Forum
② Stage
③ Canteen
④ Kitchen
⑤ Home economics
⑥ Workshops
⑦ Pupils' café
⑧ Administration
⑨ Caretaker
⑩ Classrooms
⑪ Group work room
⑫ Streaming

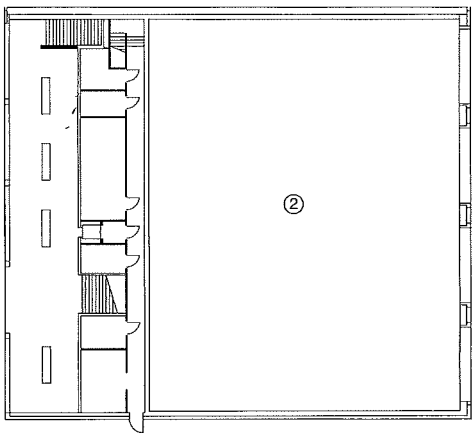
❷ Montessori school, Aachen, one-stage school, ground floor
Arch.: Prof. Ernst Kasper, Prof. Klaus Klever



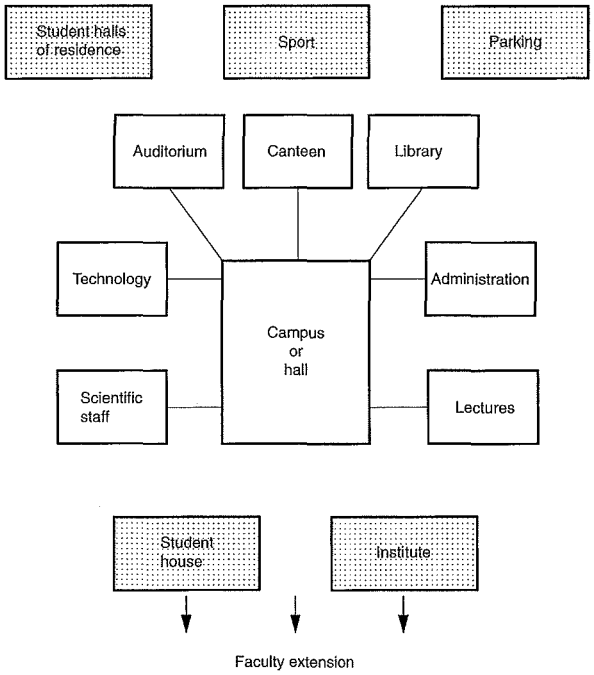
❹ Volta school house, Basel, fourth floor → ❺

→ ❹ – ❺

① Entrance hall
② Sport hall
③ Yard light well
④ Classroom with group
⑤ Crafts
⑥ Religion/remedial teaching/ languages



❺ Volta school house, Basel, ground floor Arch.: Miller & Maranta

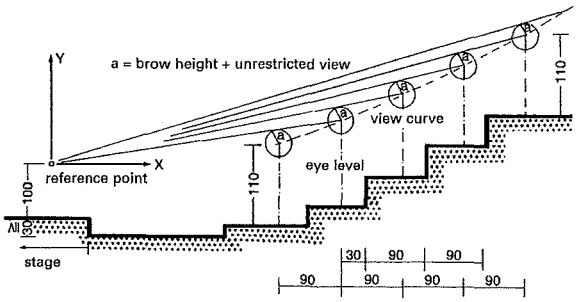


❶ Scheme of university facilities

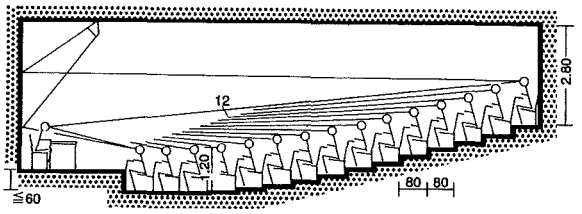
Central university facilities include: great hall, event hall, administration, deanery and student union. Also prominent are libraries, canteens, sports facilities, car parks and student residences (→ p. 167).

Basic space requirements for all subjects
Lecture theatre for basic and special lectures, seminar and tutorial rooms (partially with PC workplaces) for detailed instruction of the course material, specialised libraries, rooms for scientific assistants, conference and examination rooms.

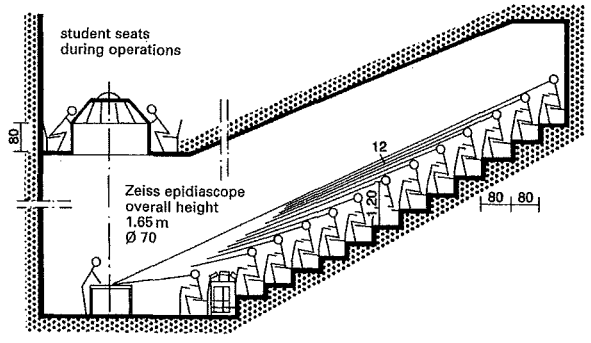
Space requirements for specific subjects:
Humanities: lecture theatre with seating raked (rising) at a low pitch → ❸. No particular requirements for blackboards or projection.
Technical and artistic subjects: e.g. architecture, art, music: drawing, studio, workshop, practice and meeting rooms of all types.
Technical and natural science subjects: e.g. physics, mechanical engineering, electrical engineering: drawing rooms, laboratories, workshops.
Natural science and medical theory subjects: e.g. chemistry, biology, anatomy, physiology, health care, pathology: laboratories with associated practical rooms, scientific workshops, animal keeping and experiment rooms. Medical demonstration ('anatomy') theatres with steeply raked seating → ❹. Natural science lecture theatres with experiment benches and steeply raked seating → ❻.



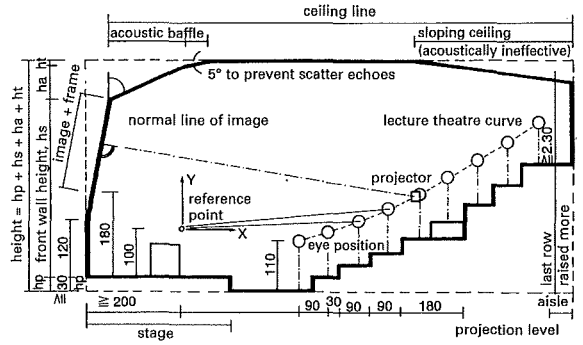
❷ Geometrical determination of the listener curve



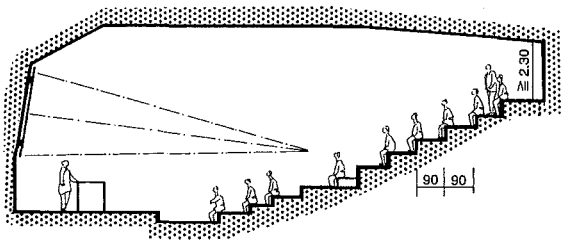
❸ Normal lecture theatre design (humanities)



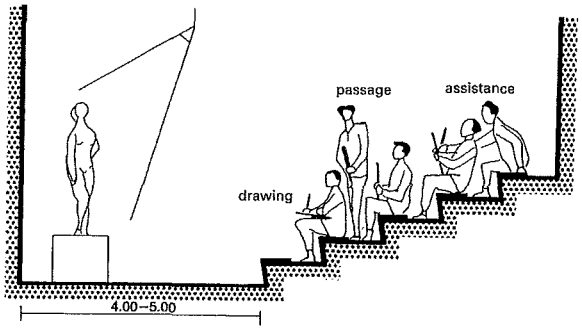
❹ Lecture theatre for demonstrations on a bench (medicine)



❺ Longitudinal section through a lecture theatre



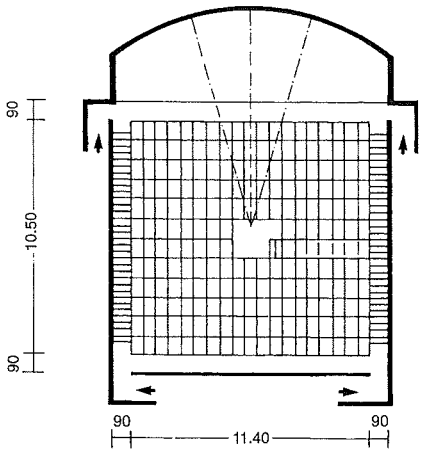
❻ Steeply raked lecture theatre (natural sciences)



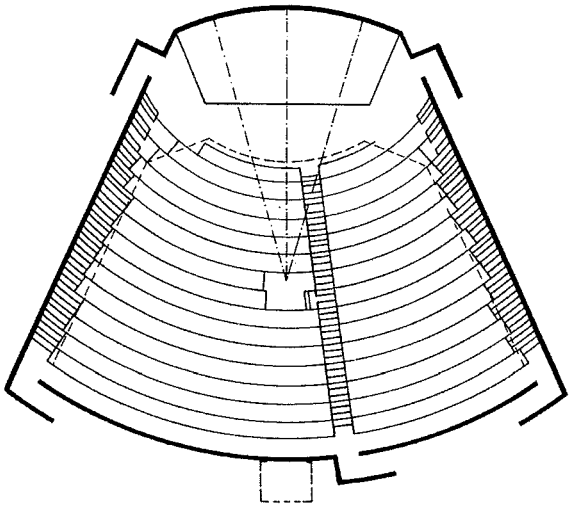
❼ Steps in life drawing class with seated area of 0.65 m² per student (technical artistic subjects)

Larger lecture theatres for central lectures are preferably accommodated in auditorium buildings, and smaller lecture theatres for specialist lectures in institute or seminar buildings. Access to the lecture theatre is best separated from the research facilities, with the shortest possible route from outside to the back of the lecture theatre (in the case of raked seating, entrances behind the uppermost row, or in larger lecture theatres also at the side at middle height → ❸). Lecturers enter the lecture theatre at the front, from the preparation room, and experimental apparatus can be rolled into the theatre. Common lecture theatre sizes are 100, 150, 200, 300, 400, 600, 800 seats. Lecture theatres with up to 200 seats, ceiling height approx. 3.5 m can be integrated into an institute building; larger theatres should ideally have their own building.

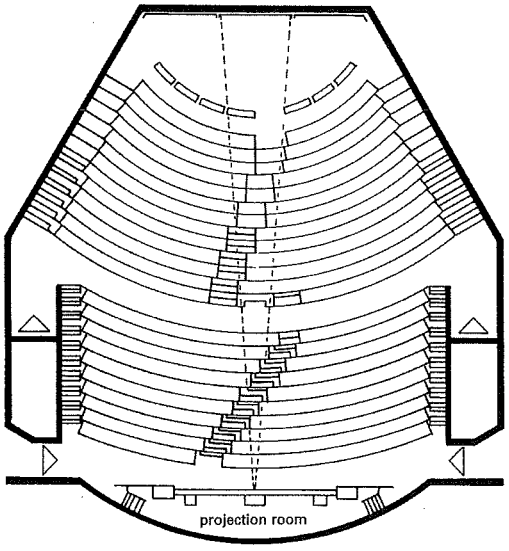
Experiment benches should be easily changeable, on wheels and suitable for laboratory work. Media connections are required.



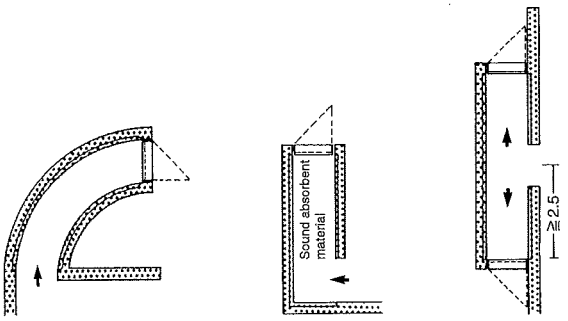
❶ Rectangular lecture theatre with 200 seats



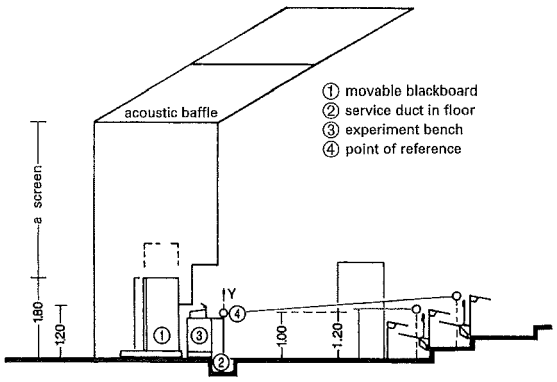
❷ Trapezoidal lecture theatre with 400 seats



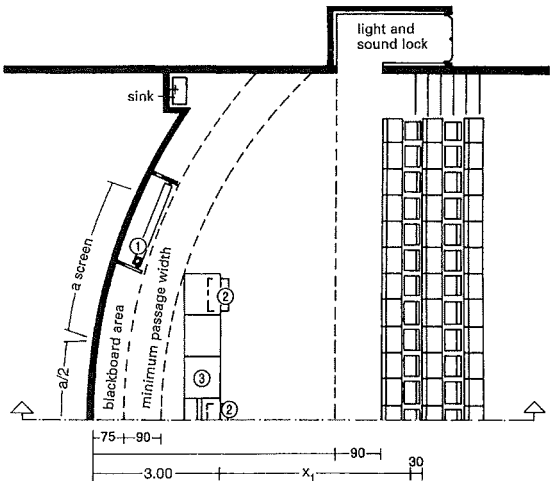
❸ Lecture theatre with 800 seats



❹ Floor plans for light and sound booths



❺ Longitudinal section → ❻



❻ Plan of podium area

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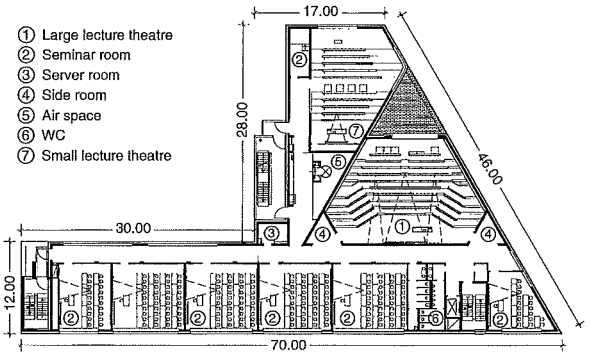
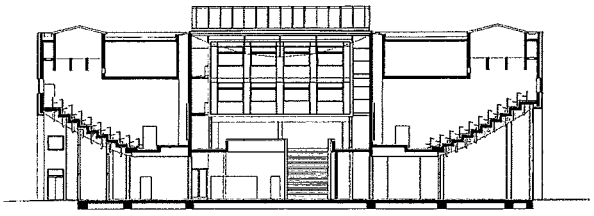
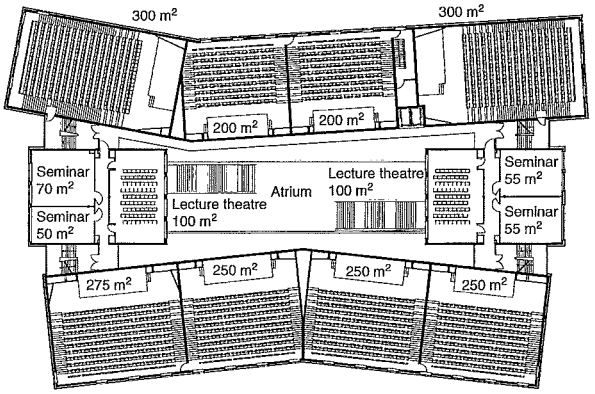
Examples of Lecture Theatres



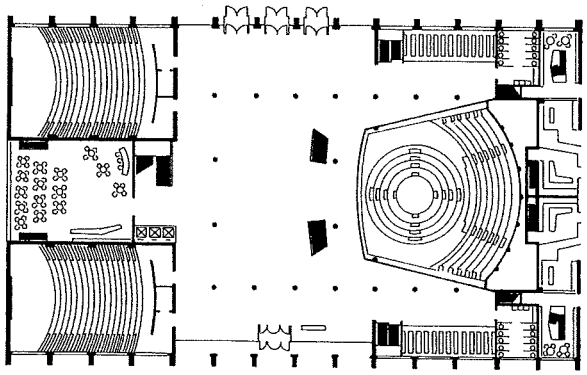
1 Bremerhaven University, third floor Arch.: Kister Scheithauer Gross



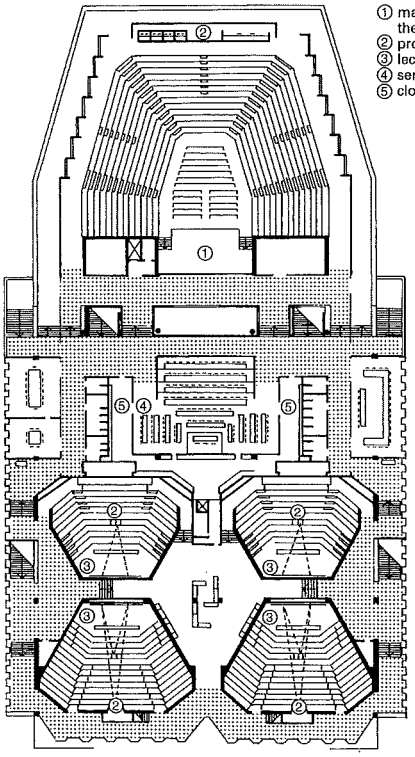
4 Section → **5**



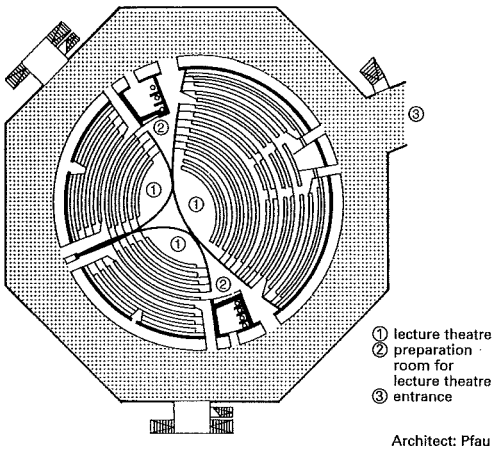
5 Lecture theatres, Gräfin Dönhoff Building, first floor, Frankfurt an der Oder University Arch.: Yamaguchi und Essig Architekten BDA



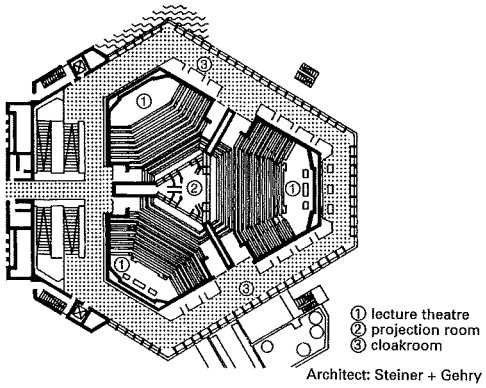
2 Council building, Freiburg University, ground floor entrance hall and two-storey Auditorium Maximum Arch.: O.E. Schweizer



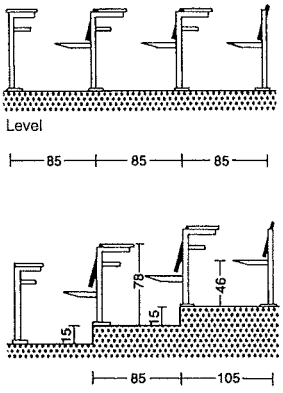
3 Auditorium of the Technical University of Delft Arch.: Broek + Bakema



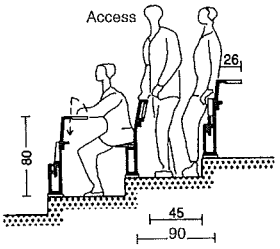
6 Student building in Düsseldorf



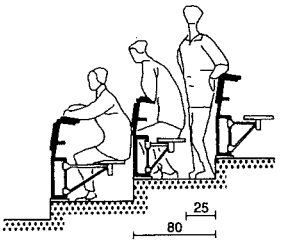
7 Lecture theatre of the ETH Hönggerberg, Zurich



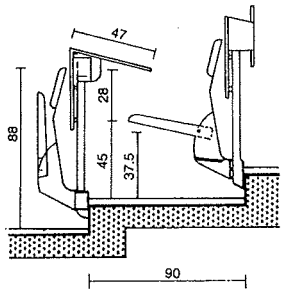
❶ Lecture theatre seating



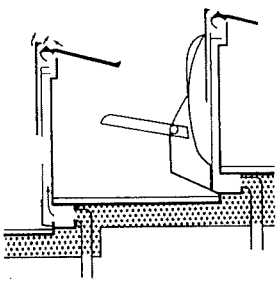
❷ Seating arrangement with tip-up seats and desks



❸ Arrangement with fixed desks and rotating seats (required space)



❹ Lecture theatre seating /desk ventilation



❺ Desk ventilation / air flow

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Seating and Projection

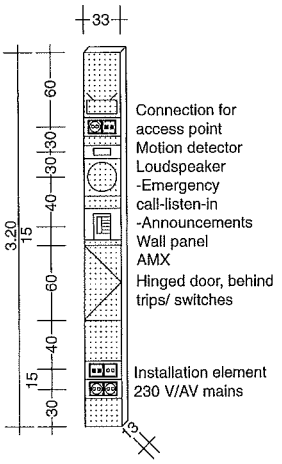
Lecture theatre seating

Combined units with tip-up or slewing seat, backrest and desk (with shelf or hook for case or bag), mostly fixed mounting → ❶ – ❸. Arrangement is according to subject, number of students and type of tuition: from light (slide shows, electro-acoustic facilities) to heavy. Some lecture theatres (surgery, internal medicine, physics) have raked (rising) rows of seating → ❶. The space requirement per student depends on type of seating, desk depth and floor pitch. Per student (including all walking areas in larger lecture theatres in a cramped situation), the space requirement is 1.10 m², in smaller lecture theatres and in a normal situation 0.80–0.95 m².

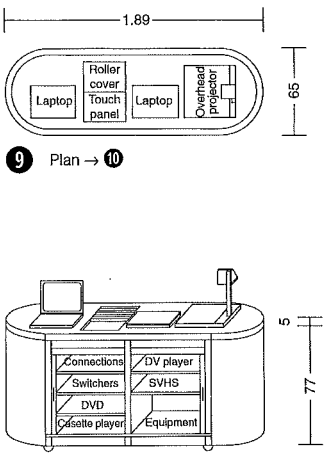
Projection, boards, acoustics, lighting:

Projection screens and black-/whiteboards can be designed as segmented surfaces, or fixed to a straight back wall. Wall boards in many sections, mostly vertically sliding, manual or mechanical, can be dropped down below the projection area. Wheeled boards or screens are also possible.

Speech should reach the listener as uniformly as possible, with no disturbing echo. Suspended ceilings will aid reflection and absorption. Rear walls should be clad with sound-absorbing material, other walls flat. Light intensity in windowless lecture theatres: 600 lx.

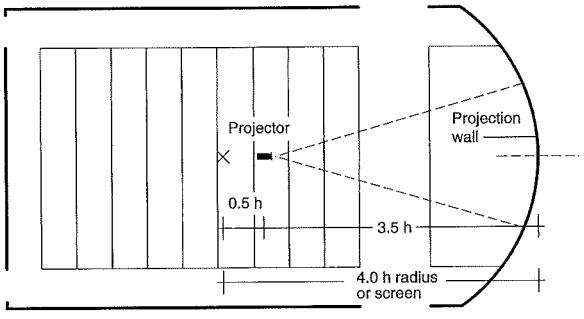


❽ Media column integrated into lecture theatre, exact height according to room height

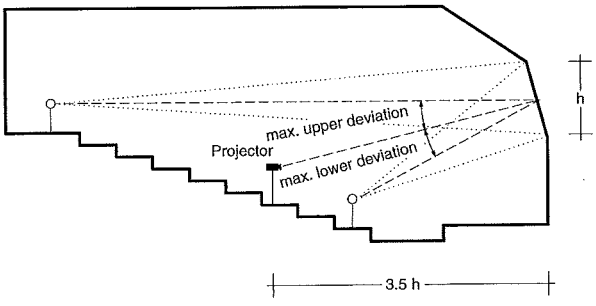


❾ Plan → ❿

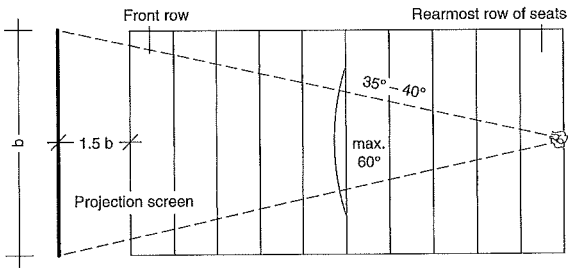
❿ Front view, mobile (wheeled) media table



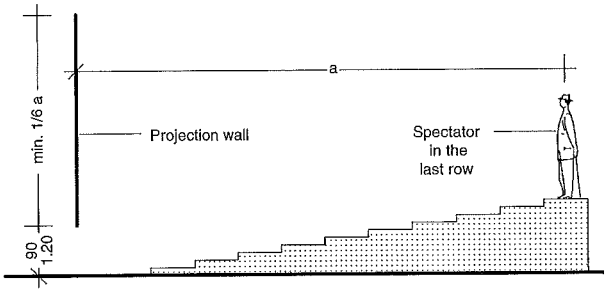
❻ Layout of projectors, plan



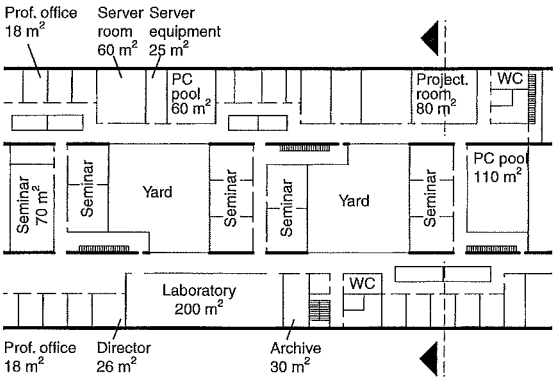
❼ Layout of projectors, section, showing distribution of the angle of inclined view to places above and below the projectors



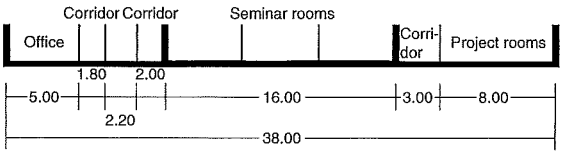
⓫ Projection wall width dependent on length of lecture theatre, plan



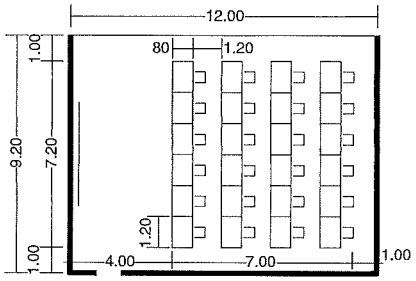
⓬ Projection wall width dependent on length of lecture theatre, section



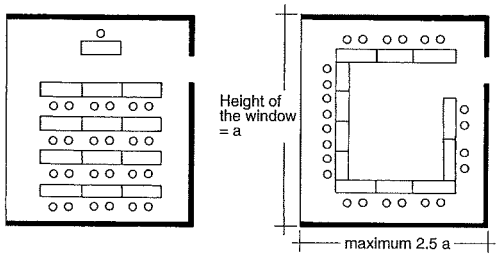
1 Plan of a university building; seminar rooms are used by many departments



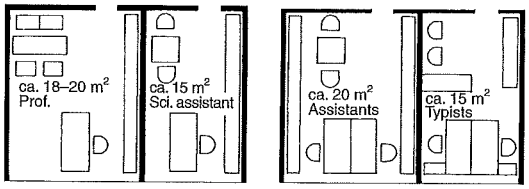
2 Section → 1: column-free pre-stressed concrete floor boards supported on the external walls



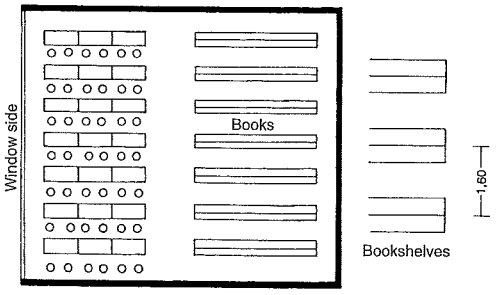
3 Dimensions of a computer room



4 Dimensions of seminar rooms with natural ventilation



5 Basic equipment for service rooms



6 Arrangement of reading places and bookshelves

The design of lecture theatres and seminar rooms has to comply with the places of assembly regulations. It should also be ensured that wheelchair users have sufficient space in lecture theatres in line with standards.

Service rooms for lecture theatres
Every lecture theatre should have a directly accessible side room. This has no fixed function and can be used as a storage room. Sufficient preparation area should be provided next to all lecture theatres featuring experiments, positioned at the same level and with a short route to the podium. Guideline for the min. size: for rectangular plan lecture theatre, approx. 0.2–0.25 m²/seat; trapezoidal plan 0.15–0.18 m²/seat; natural science and pre-clinical subjects 0.2–0.3 m²/seat.
Areas for storage and staff rooms are necessary for the proper operation of a lecture theatre building: a room for technical staff to maintain the facilities; for cleaning staff; storeroom for replacement parts, light bulbs, fluorescent tubes, black-/whiteboard, clothing etc. Min. size per room 15 m²; space required for all side rooms min. 50–60 m².

Computer room
The size of the computer room is related to the number and size of the computer desks, which depends on the size of the displays.

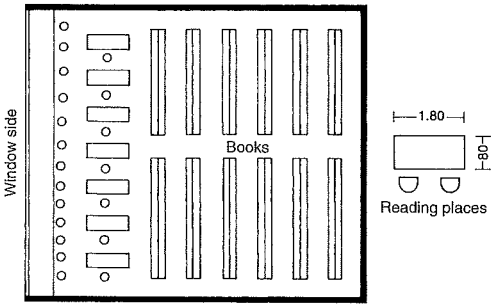
General tuition rooms
Seminar rooms, usual sizes: 20, 40, 50, 60 seats; mobile double tables, width 1.20 m, depth 0.60 m, space required per student 1.90–2.00 m.
Variable arrangement of the tables for tutorial and group work. If there is free ventilation from only one external wall, the depth of the room should not exceed 2.5 × clear ceiling height.

Offices for scientific personnel → 5
professor 20–24 m²
scientific assistant 15 m²
assistant 20 m²
secretary 15 m² (double occupation 20 m²)

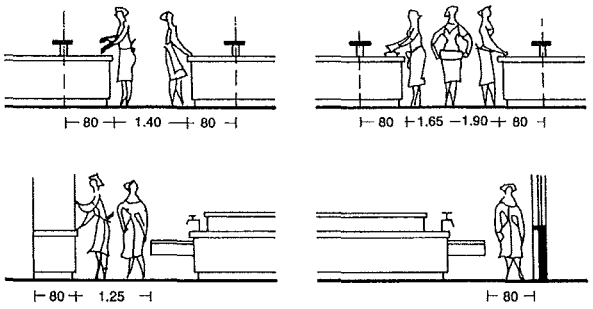
Cloakroom and WC facilities
Rough estimate for both together: 0.15–0.16 m²/seat
Faculty and open-access libraries (→ Libraries pp. 247 ff.)
Storage for 30 000–200 000 vols on open-access shelves.

Book storage space → 6
Bookcases with 6–7 shelves, 2 m high (reaching height)
Distance between bookcases 1.50–1.60 m
Space required 1.0–1.2 m²/200 vols

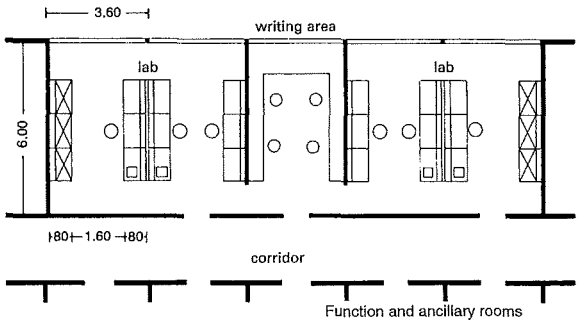
Reading places → 7
Width 0.9–1.0 m/depth 0.8 m
Space required 2.4–2.5 m² per place
Entrance control, with storage for cases/bags; catalogue, copier room



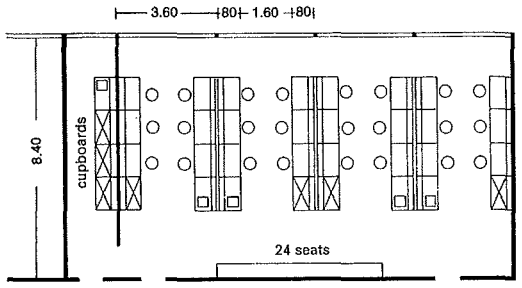
7 Arrangement of reading places and bookshelves



❶ Minimum passage width at workstations



❷ Research laboratory

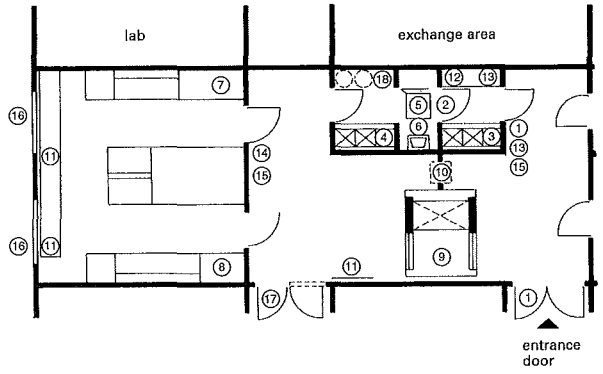


❸ Teaching and practical laboratory

Lab safety level 3
① warning sign
② double-door safety lobby, self-closing doors
③ outdoor clothing
④ protective clothing
⑤ floor trough (pos. disinfectant mat) in front of shower
⑥ hand wash basin with disinfectant dispenser
⑦ workbench (clean bench) with separate special filter
⑧ extractor
⑨ autoclave (in lab or building)
⑪ flat panel radiator (7.5 cm from wall)
⑫ control and monitoring cupboard: electricity box, emergency mains off-switch, error board
⑬ pressure difference display readable from inside and out with acoustic alarm
⑭ emergency telephone, telephone
⑮ two-way intercom, electric door-opener
⑯ windows: gas-tight, non-combustible, leaded
⑰ pass-door: fireproof

Lab safety level 4
② three-chamber safety lobby. Doors self-closing and gas-tight
⑤ personal shower (L-3 system can be upgraded*). Collect and disinfect waste water
⑦ gas-tight, enclosed workbench, separate air supply and extraction, additional special filter
⑨ autoclave with lockable doors on both sides, disinfect condensation
⑩ flood lock
⑱ autoclavable container for used protective clothing

*) Only required if upgrading to L-4 lab.



❹ Clean room laboratory, example

Laboratories differ according to use and subject. According to use:

Tuition-related practical laboratories with a large number of workstations collected together and mostly with simple basic equipment → ❸.

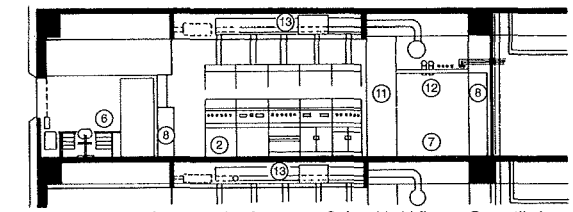
Research-related laboratories, mostly in smaller rooms with special equipment and additional practical spaces like weighing and measurement rooms, centrifuge and autoclave rooms, rinsing kitchens, air-conditioned and cold storage rooms with constant temperature, photographic/dark rooms etc. → ❷.

According to subject:

Chemistry and biology laboratories have permanently installed laboratory benches. Rooms have a high rate of air exchange and frequently additional fume cupboards with air extraction → p. 204 → ❼ for work producing gas and smoke. Fume cupboards are often installed in their own rooms ('stink rooms').

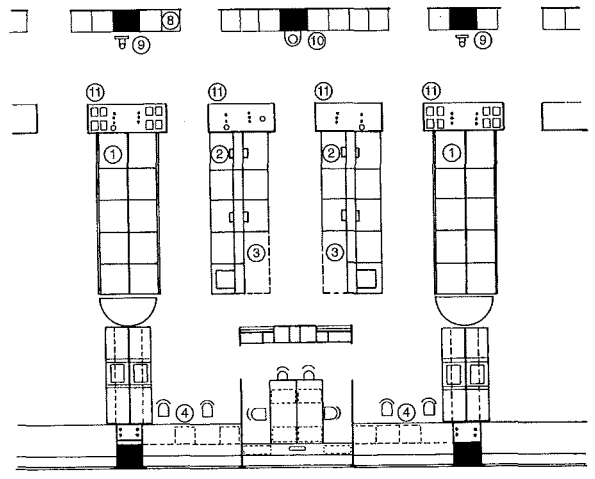
Physics laboratories mostly have mobile benches and sophisticated electrical equipment in cable ducts in the wall or suspended from the ceiling. Low rate of air exchange → p. 204. There are special laboratories for specific requirements, e.g. isotope laboratories for work on radioactive substances in various safety classes.

Clean room laboratories are used for work requiring especially dust-free filtered air, e.g. in microelectronics or for particularly dangerous substances, whose release into the surrounding rooms should be prevented by special air circulation and filtering (microbiology, gene technology) → ❹.

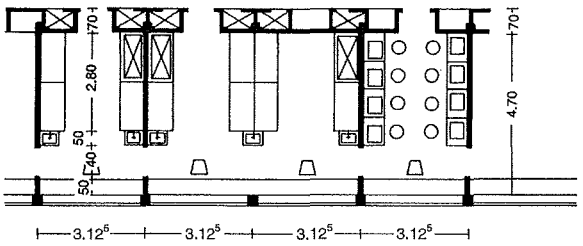


① fume cupboards
② workbenches
③ reserves
④ dry work places
⑤ weighing tables
⑥ workstation for chemist
⑦ corridor
⑧ materials cupboards
⑨ eye douche
⑩ hand-held fire extinguisher
⑪ vertical energy supply
⑫ overhead pipes
⑬ ventilation and environmental control system

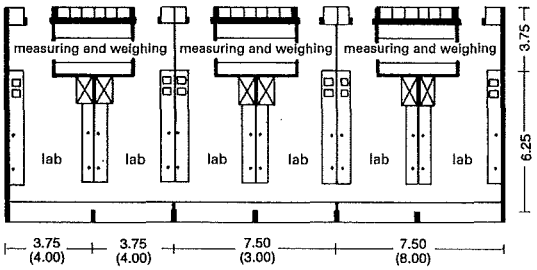
❺ Section, BASF plastics laboratory — Arch.: Suter u. Suter



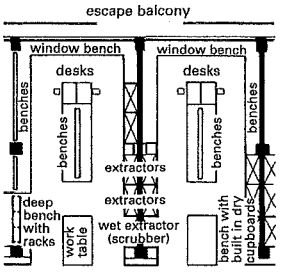
❻ Plan → ❺



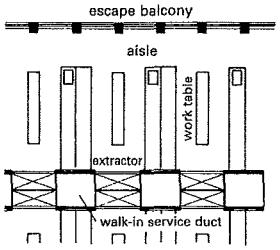
❶ Room dimensions derive from size of bench (workstation). Services and cupboards are in the corridor wall. Weighing room is separate.



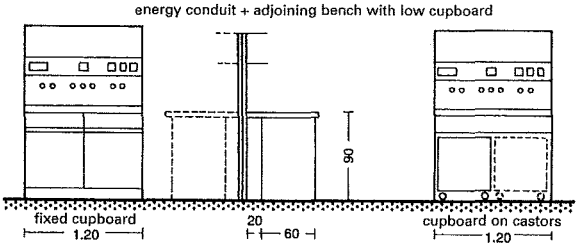
❷ Uniform laboratories with measurement and weighing rooms in front, University Clinic, Frankfurt am Main Arch.: Schlempp + Schwethelm



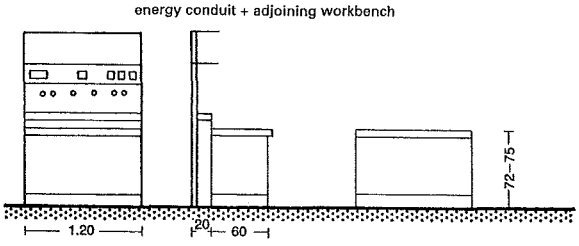
❸ Laboratory equipment in main scientific laboratory (Bayer AG dye plant)



❹ Arrangement of equipment in accessible service ducts (BASF)



❺ Chemistry laboratory bench



❻ Physics laboratory bench

Cold laboratories are used for tasks requiring extreme temperature conditions, photographic work and as darkrooms. Workrooms without equipment installed also belong in the close laboratory area:
Study cubicles; social/rest rooms for laboratory staff; central rooms for general storage, chemical stores and issue, with particular safety measures; isotope stores with decay containers etc. Animal laboratories are a special case, with rooms for keeping the animals, which have special equipment appropriate to the species and require their own air circulation.

Laboratory workstations

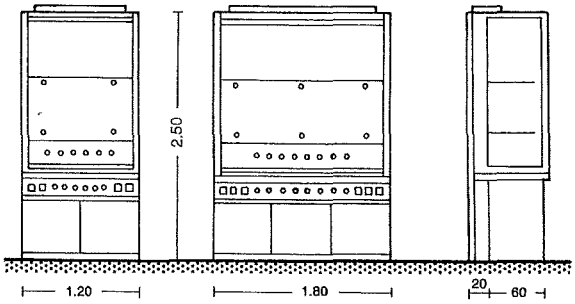
The determining design unit for the laboratory workstation is the laboratory bench, permanently installed or mobile, whose dimensions together with the associated work and passage areas define the laboratory axis, which forms the basic spatial unit → ❶ – ❸.
Standard dimensions for the normal working bench:
120 cm width in practical laboratories, several times that in research laboratories, 80 cm depth work surface including socket strip → ❺ – ❻.
Benches and fume cupboards are mostly in the form of a building block system: element widths 120 cm, fume cupboards 120 and 180 cm → ❼.
The socket strip is an independent element with all electricity supply systems. Benches and low-level cupboards are placed in front of it → ❺ – ❼.
Steel tubing supports the construction of laboratory benches, whose work surfaces are of artificial stone panels without joints, seldom tiled, and chemically resistant plastic panels. Low-level cupboards are of wood or plastic-coated chipboard. Supply services are fed from above out of the ceiling cavity or from below through the floor structure.

Ventilation

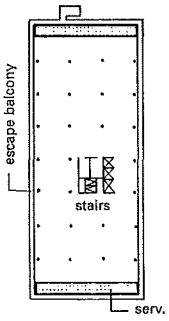
Of low- or high-pressure systems, the latter are particularly recommended for multi-storied institute buildings with large-scale air requirements, in order to reduce the ducts' cross-section. Cooling and humidification as required. Ventilation equipment has the highest demand for space of all services installations.
All laboratories in which work with chemicals takes place must have artificial ventilation and extraction.
Air changes per hour: chemistry laboratories 8 times
biology laboratories 4 times
physics laboratories 3–4 times
(in the extraction area)

Electrical installation

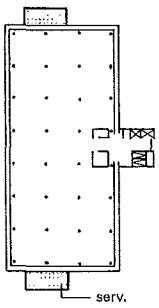
Each building will need its own transformer station if the numbers of connections are high or if special electricity supplies are specified. Electrical service rooms must be enclosed in fire-resistant walls and may not be crossed by other pipework or cables.



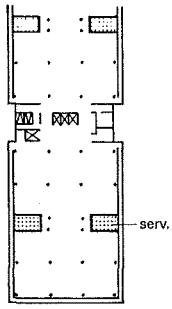
❼ Fume cupboards



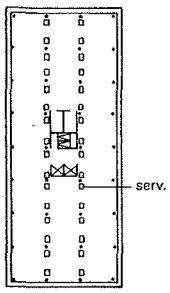
❶ Services shafts on the face side, internal VCC



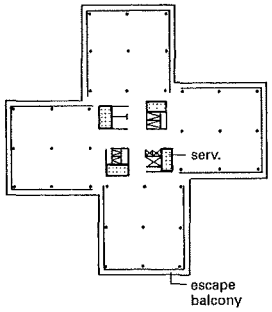
❷ Services shafts on the face side, external VCC



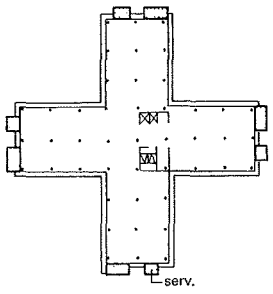
❸ Services shafts central, VCC as leading element



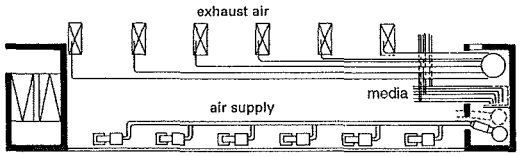
❹ Single-shaft services, internal VCC



❺ Internal installation, coupled with VCC

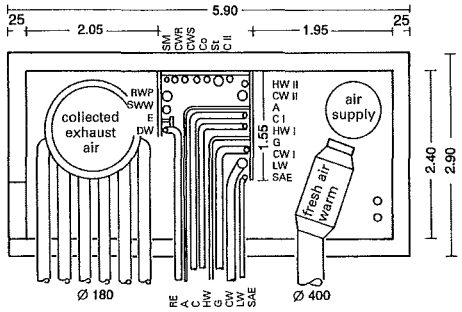


❻ External services shafts, central VCC



❼ Horizontal conduits and ducts: laboratory floor. Plan → ❽

CW	cold water	St	steam	E	emptying
HW	hot water	Co	condensate	RE	reserve
C	circulation	A	air	LW	lab water
DW	distilled water	G	gas	SAE	secondary air extraction
CWS	cooling water supply	SM	special medium	SWW	sanitary waste water
CWR	cooling water return			RWP	rainwater pipe
I	1st pressure level				
II	2nd pressure level				



❽ Plan of joint shaft → ❼

Possible arrangements of service shafts, columns and vertical circulation core (VCC)

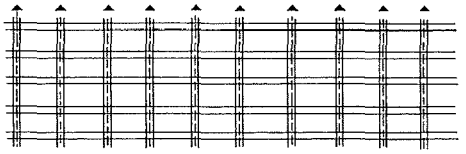
Services concentrated in:
- joint shafts on face side of building, internal VCC → ❶
- external joint shafts, external VCC → ❷ – central joint shafts, VCC as leading element → ❸
- services distributed among single-shaft installations, internal VCC → ❹
- internal installation, coupled with VCC → ❺
- external shafts, central VCC, cruciform plan → ❻

Vertical services system → ❾

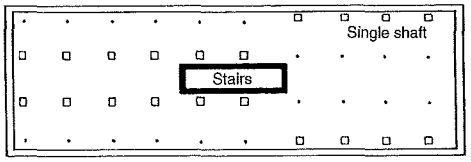
Many vertical supply lines, internally or on the façade, run the media in individual shafts to the laboratories. Decentrally routed air supply and extraction ducts to the fume cupboards, separate ventilators on the roof.
Advantage: maximum individual supply; short horizontal connections to laboratory bench.
Disadvantage: limited floor layout flexibility; greater space requirement on working and services floors.

Horizontal services system → ❿:

Vertical main services for all media concentrated in joint shafts and distributed horizontally from there into the services floors with upper or lower connection to laboratory benches.
Advantages: less space required in the services shafts, greater flexibility of floor layout, simpler maintenance, central ventilation equipment, better adaptability. High density of installation requires large amount of space. Vertical joint shafts are simpler, more accessible and allow revisions.
Conduits should be insulated against condensation, heat, cold and noise transmission → ❼ – ❽.

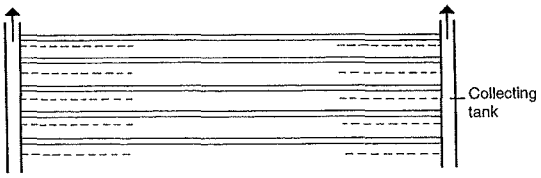


Average

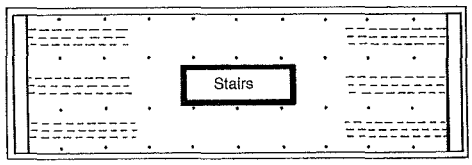


Ground plan

❾ Vertical services system: single shafts for installation of building, horizontal direct connection to laboratory benches, fume cupboards etc.; limited flexibility of floor layout

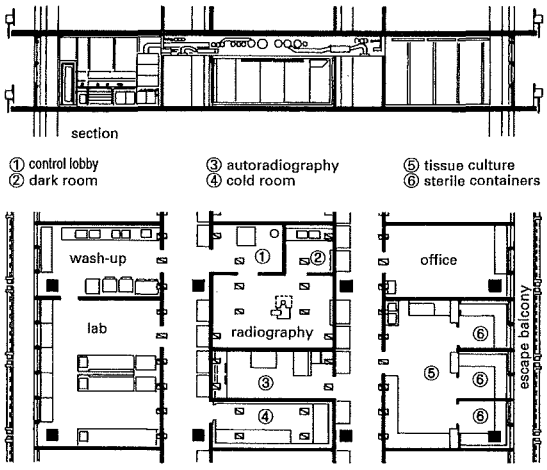


Average

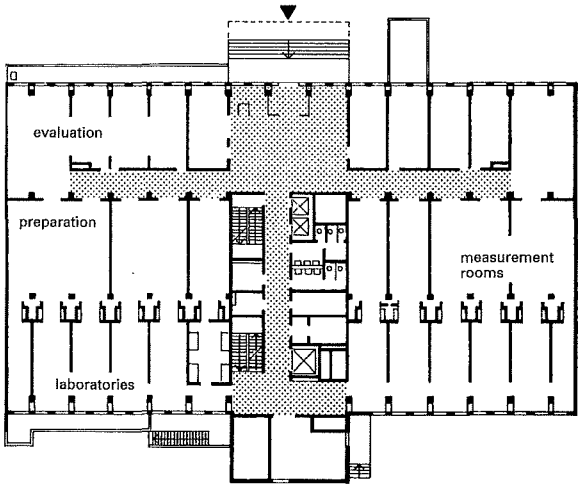


Ground plan

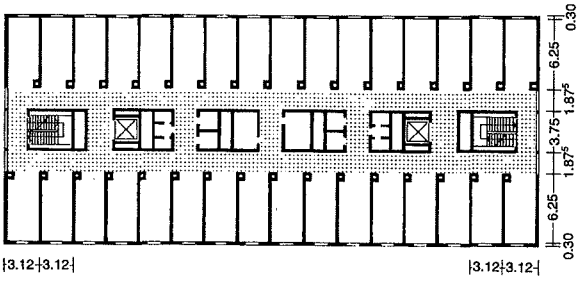
❿ Horizontal services system: horizontal conduits and ducts in ceiling space, good flexibility of floor layout



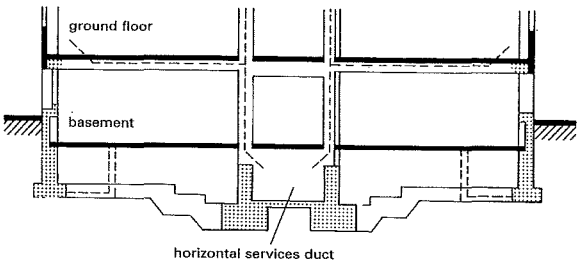
❶ Part of the floor plan of cancer research centre, Heidelberg
Arch.: Heinle, Wischer u. Partner



❷ Analytical physics laboratory building (BASF Ludwigshafen)



❸ Typical floor plan of an adaptable multi-purpose institute Arch.: W. Haake



❹ Cross-section of laboratory with well-placed central corridor

Structure and fittings grid

Good structural grids to achieve mostly column-free rooms have the following dimensions:

7.20 × 7.20 m, 7.20 × 8.40 m, 8.40 × 8.40 m, normal storey height 4.0 m, clear room height ≧3.0 m.

The structural grid is a multiple of the typical planning grid of 120 × 120 cm (decimetric system). Reinforced concrete frame construction, as pre-cast elements or cast in situ, is preferred on account of the flexibility of plan.

Following programme and layout requirements, with installation at high and low level, plus natural and artificial lighting and ventilation rooms, results in areas with different potential uses and technical qualities. Laboratories therefore have large internal zones and are arranged as three-block facilities → ❶ – ❸. The length of the building is influenced by the maximum reasonable length of the horizontal runs of wet services.

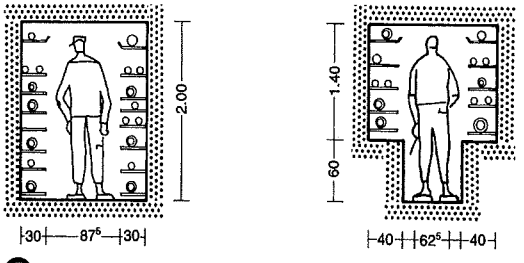
Columns are placed on a grid offset from the structural grid to increase the flexibility of servicing. Separation of areas is via a room-enclosing system consisting of partitions and suspended ceilings. Movable partitions should be easily operated and have chemical-resistant surfaces. Ceilings should permit disassembly and have sound insulation. Floor coverings should be resistant to water and chemicals, without joints and with low electrical conductivity. Normally, plastic roll flooring material or tiles with welded joints should be used.

Windows in the doors or next to them are important to provide a view into laboratories.

Isotope laboratories should have flat, non-porous ceiling and wall surfaces, rounded corners, be surrounded by lead and concrete, monitored waste water, and shower cubicles between laboratory and exit. Concrete containers for active residues or waste and concrete safes with lead doors etc. must be provided.

Weighing tables are part of every laboratory, and are normally installed in their own weighing room. The tables should be at the wall side of vibration-free walls.

Services floors for plant are normally placed in the basement or on the top storey.



❺ Main pipe duct (accessible): cross-section varies according to number of pipes