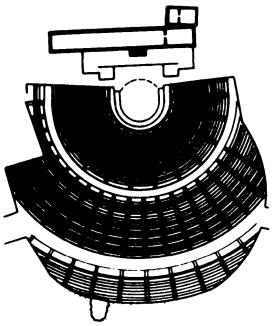
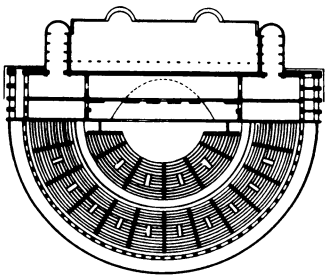
THEATRES: HISTORICAL SUMMARY

Theatre planning requires an understanding of complex functional relationships which can, in part, be gained by examining the 2500-year-old history of theatre development. The examples shown here and on the following page give an insight into the tradition of theatre building, the principles of which are still in use today, although contemporary architects are increasingly injecting modern thinking into theatre design.

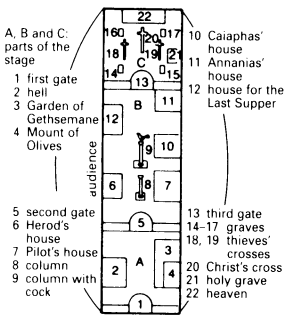
Dionysos Theatre, the start of European theatre building → ①. Marcellus Theatre, the first theatre in Rome built entirely of stone → ②. Medieval stage theatre, temporary platform and fittings → ③. Inner room of the Swan Theatre from a drawing by Van de Wit in 1596 → ④. Italian theatre from the start of the 16th century → ⑤. Early Renaissance theatres were temporary wooden structures in existing halls, e.g. Vasari developed a wooden reusable system for a theatre in the Salone dei Cinquencento Palazzo Vecchio in Florence. The Teatro Olimpico in Vicenza → ⑥. The first permanent theatre building of the Renaissance was the Comédie Française in Paris → ⑦. Boxes were first built in the mid-17th century. Teatro Farnese in Parma → ⑧ was the first building with a moving scenery system. Teatro 'San Carlo' in Naples → ⑨. Teatro alla Scala Milan → ⑩, the model for opera houses in the 18th and 19th centuries, but also the new Metropolitan Opera in New York, 1966. Grand Opéra House in Bordeaux → ⑪. The great foyer was the model for the Grand Opéra House in Paris, Garnier 1875.



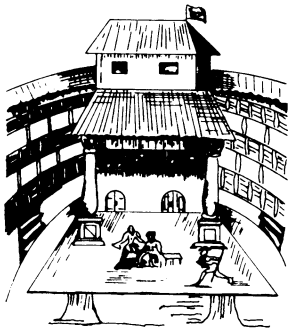
① **Dionysos Theatre, Athens, 452/330 BC**



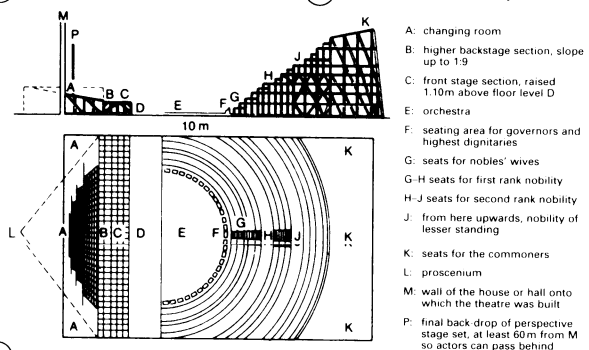
② **Marcellus Theatre, Rome: 11 500 seats, 11 BC**



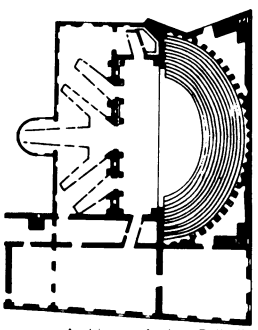
③ **Medieval theatre stage**



④ **The Swan Theatre, London**

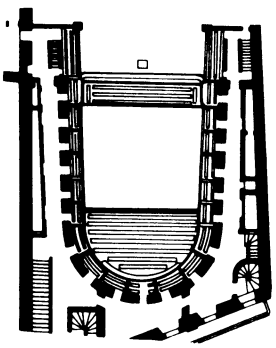


⑤ **Theatre layout by Sebastiano Serlio, 1545**

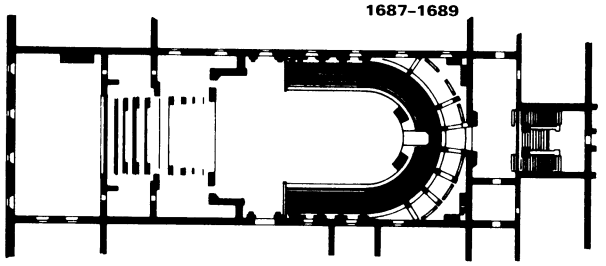


Architects: Andrea Palladio & Vicenzo Scamozzi

⑥ **Teatro Olimpico, Vicenza, 1585**

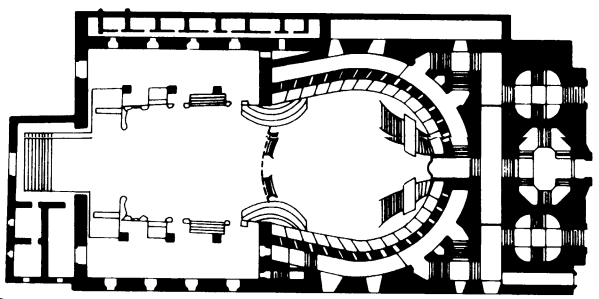


⑦ **The old theatre of the Comédie Française, Paris 1687–1689**



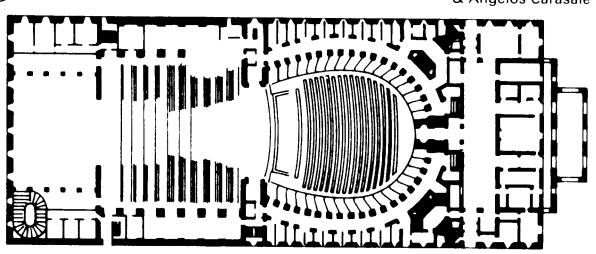
Architect: Giovanni Battista Aleotti

⑧ **Teatro Farnese, Parma, 1618–1628**



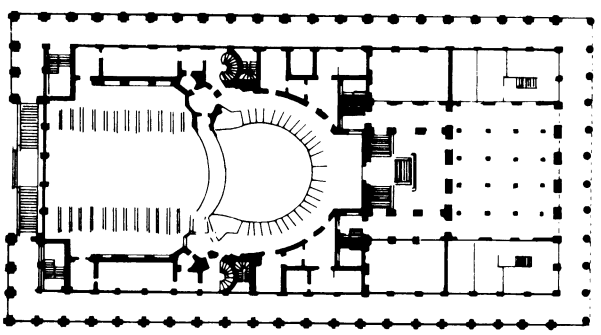
⑨ **Teatro 'San Carlo', Naples, 1737**

Architects: Antonio Medrano & Angelos Carasale



Architect: Piermarini

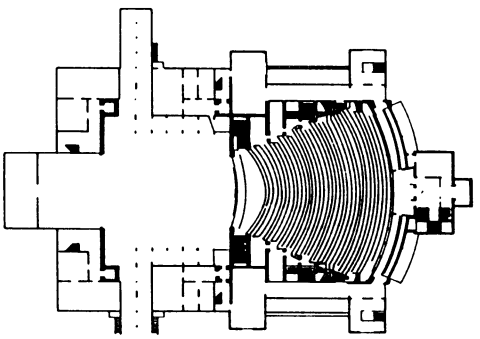
⑩ **Teatro alla Scala, Milan, 1779**



Architect: Victor Louis

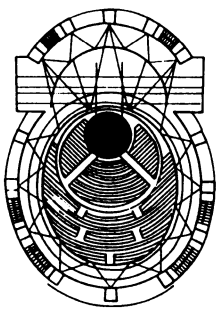
⑪ **Grand Opéra House, Bordeaux, 1778**

THEATRES: HISTORICAL SUMMARY

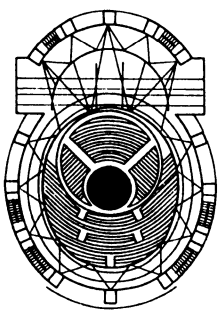


Architects: R. Wagner and O. Bruckwald

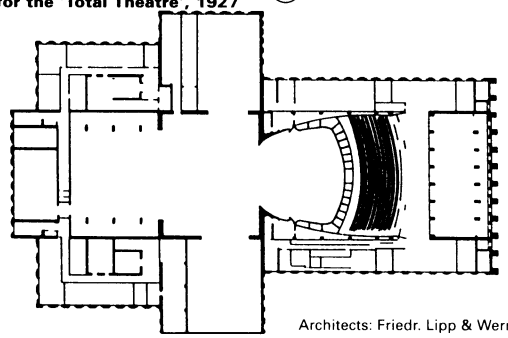
(1) **The Festival Theatre, Bayreuth 1876**



(2) **Walter Gropius: Draft design for the 'Total Theatre', 1927**

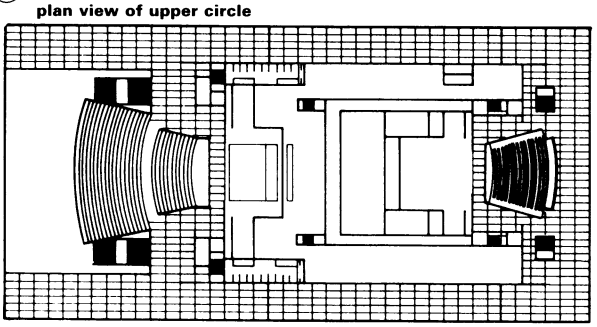


(3) → (2) **Rotated playing area**



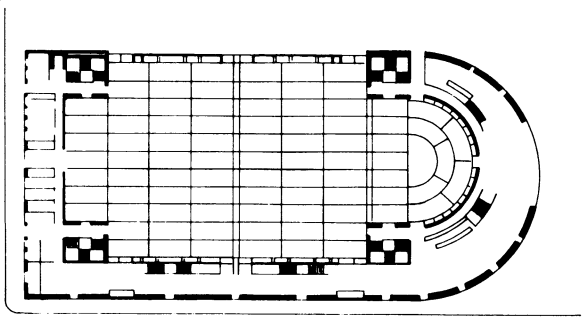
Architects: Friedr. Lipp & Werry Roth

(4) **Dessau Regional Theatre, 1938 (regional theatre), plan view of upper circle**



Architect: Mies van der Rohe, 1953

(5) **Competition entry for the National Theatre, Mannheim**



Architect: J. Savade

(6) **Theatre on Lehniner Platz, Berlin 1982**

The Bayreuth Festival Theatre → (1) With his theatre form, R. Wagner erected a counterpoint to the Grand Opéra House in Paris. Total theatre project by W. Gropius/E. Piscator. To note: rotating audience space, stage with paternoster system – projection options on walls and ceiling → (2)–(3). Dessau Regional Theatre → (4). Early example of a modern stage system with sufficient secondary stages. Draft for the National Theatre in Mannheim → (5). Theatre on Lehniner Platz, Berlin, the first large new building with a flexible theatre space (conversion of the Mendelsohn building 'Universum' from 1928) → (6). Opéra Bastille, Paris → (7), the previous largest stage system with ten secondary stages on two levels.

Trends in current theatre building

There are two trends today.

1 Preservation, restoration and modernisation of the previous theatres of the 19th and up to the middle of the 20th century.
2 New buildings with 'experimental' open space features, e.g. Theatre on Lehniner Platz, Berlin → (6). In a similar direction are the many conversions from previous rooms to theatre workshops with seats for about 80–160 onlookers.

Opera and theatre: There are two different expressions of theatre building: the opera and the theatre.

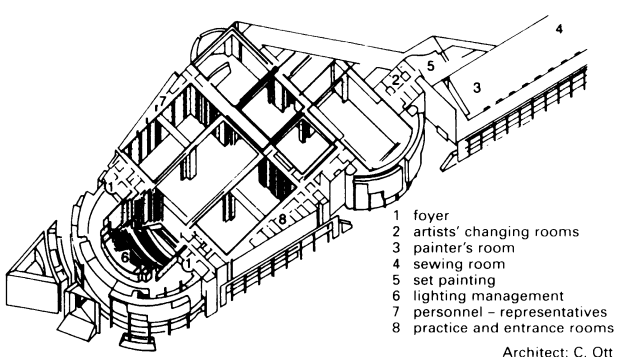
The *opera* is in the tradition of the Italian opera buildings of the 18th and 19th centuries → p. 476 (6) + (10). It is characterised by a clear spatial-architectural separation between the audience area and the stage by the orchestra pit, and through large seat numbers (1000 to almost 4000 seats), as well as the corresponding box system and the circles necessary for large numbers of spectators, e.g. Teatro allo Scala (Milan) with 3600 seats, Deutsche Oper (Berlin) with 1986 seats, Metropolitan Opera (New York) with 3788 seats, Opéra Bastille (Paris), 2700 seats → p. 476. As a counterpoint to the opera form as circle/box theatre is the The Festival Theatre, Bayreuth. This is conceived as a stalls theatre on the Greek/Roman principle and has only 1645 seats.

The *theatre* is structurally in the tradition of the German reform theatres of the 19th century. It is characterised by the stalls arrangement (i.e. the audience sit in a large ascending curved area) and by a distinctive, front acting stage (an acting area in front of the proscenium in the auditorium). Theatres, however, particularly seek the tradition of the English theatre → p. 476 (4), i.e. an acting area in the auditorium.

A modern example from the English speaking area is the Chichester Festival Theatre, England, by Powell & Moya, 1962. One example in Germany is the Mannheim National Theatre, small theatre, Weber, Hämer, Fischer 1957.

The variable open room form was intensified by the room experiments of the theatres in the 1970s, e.g., Concordia Theatre, Bremen, (conversion of a one-time cinema). Room variation options are shown in the Theatre on Lehniner Platz, Berlin → p. 476 (6).

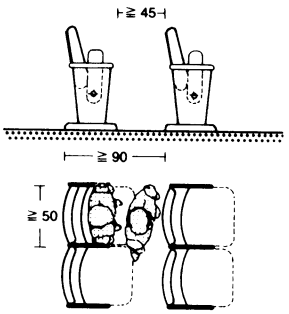
A speciality in the German-speaking area is the multipurpose theatre (mixed form of opera house and theatre) which is characterised by the dominating requirements of the opera, e.g., Stadttheater Heilbronn, Biste & Gerling, 1982.



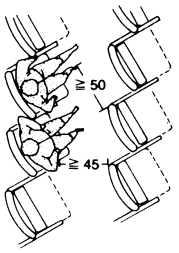
Architect: C. Ott

(7) **Opéra Bastille, Paris 1989**

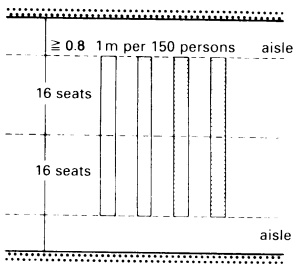
THEATRES: AUDITORIUMS



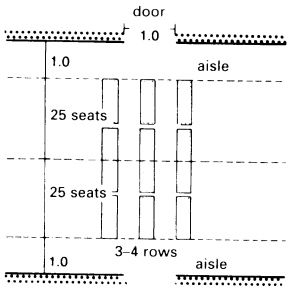
① **All seats apart from boxes must have fixed, self-operating folding seats with the above minimum dimensions**



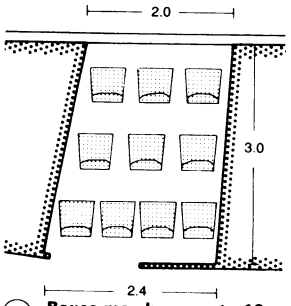
② **Offset folding seats provide elbow space**



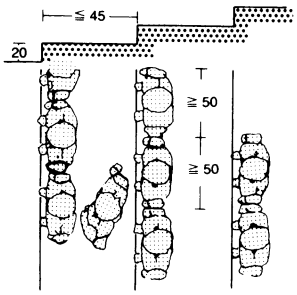
③ **Row width: 16 seats**



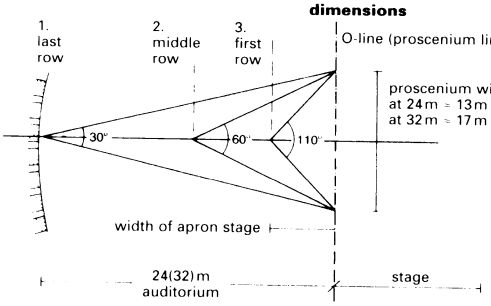
④ **Row width: 25 seats + necessary door**



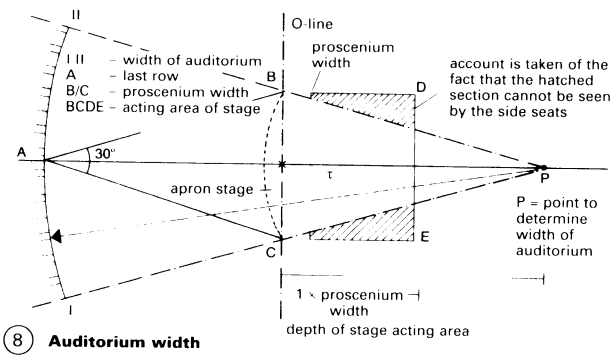
⑤ **Boxes may have up to 10 loose chairs, else fixed chairs are necessary – area: minimum 0.65 m² per person**



⑥ **Standing places should be arranged in rows, separated by fixed barriers according to the above minimum dimensions**



⑦ **Proportions of the traditional auditorium (view)**



⑧ **Auditorium width**

Audiences: assessing demand

An important element of a feasibility study is the assessment of demand for performing arts within the community that the facility is proposed to serve. The aim is to establish whether there are audiences for the proposed programme of use, and to define a catchment area from which audiences are to be drawn. Assessment of the area under consideration includes studies of:

- population characteristics
- transportation characteristics
- potential audiences
- local cultural traditions
- existing provision
- actual audiences
- pilot scheme.

Auditorium and stage/playing area

Seating capacity: In general, the maximum capacity of an auditorium depends on the format selected, and on aural and visual limitations set by the type of production. Other factors include levels, sightlines, acoustics, circulation and seating density, as well as size and shape of platform/stage.

Size of auditorium: An area of at least 0.5 m² per spectator is to be used for sitting spectators. This number is derived from a seat width × row spacing of at least 0.45 m² per seat, plus an additional minimum of 0.5 m × 0.9 m i.e. approximately 0.05 m² per seat → ①.

Length of rows: A maximum of 16 seats per aisle → ③. 25 seats per aisle is permissible if one side exit door of 1 m width is provided per 3–4 rows → ④.

Exits, escape routes: 1 m wide per 150 people (min. width 0.8 m) → ③ – ④.

Volume of room: This is obtained on the basis of acoustic requirements (reverberation) as follows: playhouses approx. 4–5 m³/spectator; opera approx. 6–8 m³/spectator of air volume. For technical ventilation reasons, the volumes should be no less than these figures so as to avoid air changes which are too pronounced (draughts).

Proportions of auditorium: These are obtained from the spectator's psychological perception and viewing angle, as well as the requirement for a good view from all seats.

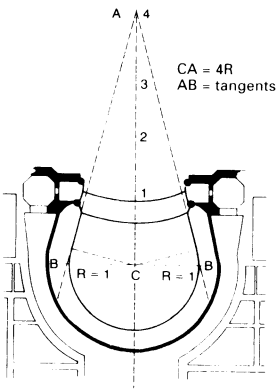
- Good view without head movement, but slight eye movement of about 30°.
- Good view with slight head movement and slight eye movement approx. 60° → ⑦.
- Maximum perception angle without head movement is about 110°, i.e. in this field everything which takes place 'between the corners of the eyes' is perceived. There is uncertainty beyond this field because something may be missed from the field of vision.
- With full head and shoulder movement, a perception field of 360° is possible.

Proportions of the classical auditorium

(Opera, multipurpose theatre, traditional playhouse) → ⑦: Maximum distance of last row from the proscenium line ('start of stage'):

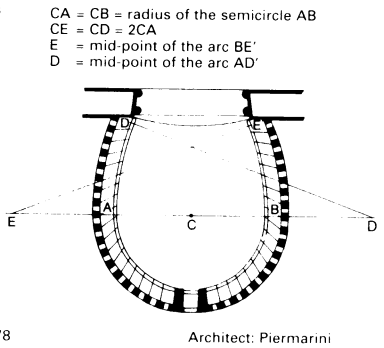
- for playhouse – 24 m (maximum distance from which it is still possible to recognise facial expressions)
- for opera – 32 m (important movements still recognisable).

Width of auditorium: This is derived from the fact that spectators sitting to one side should still be able to see the stage clearly → ⑦. Variants are possible. The comfortable proportions and often good acoustics of the classical theatres of the 18th and 19th century are based on special rules of proportion → ⑨ – ⑩.



Architect: Victor Louis, 1778

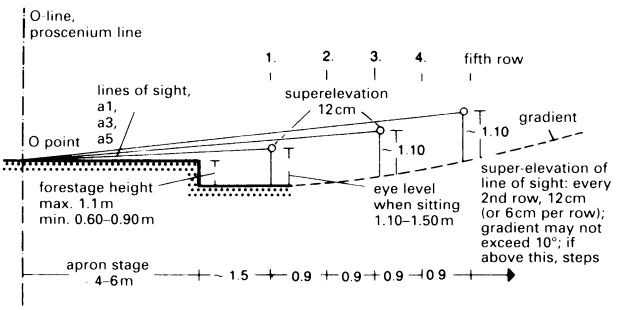
⑨ **Design of the contours of the auditorium in the Grand Theatre in Bordeaux**



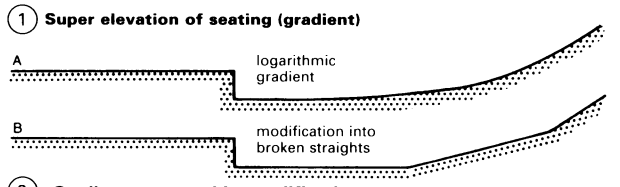
Architect: Piermarini

⑩ **Design of the curve of the auditorium in the Teatro alla Scala in Milan**

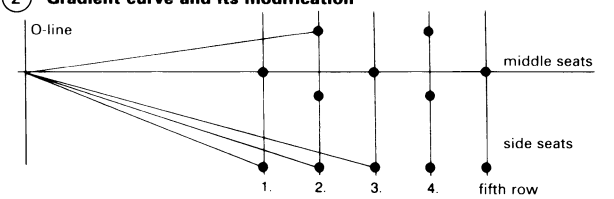
THEATRES: AUDITORIUMS



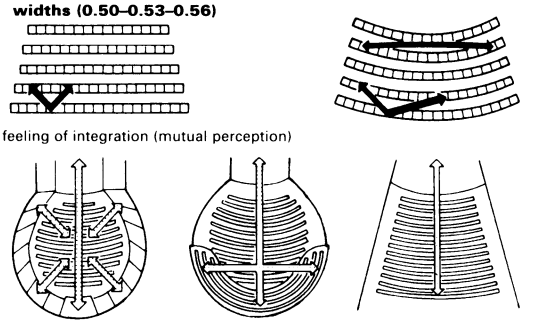
① **Super elevation of seating (gradient)**



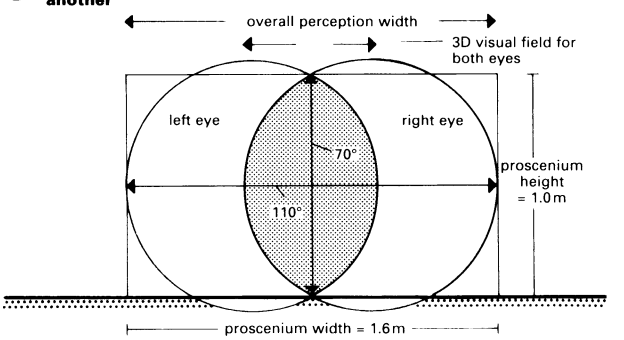
② **Gradient curve and its modification**



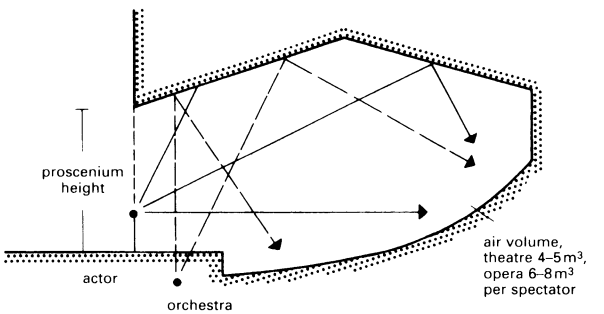
③ **The offsetting of seats in a row is achieved by different seat widths (0.50–0.53–0.56)**



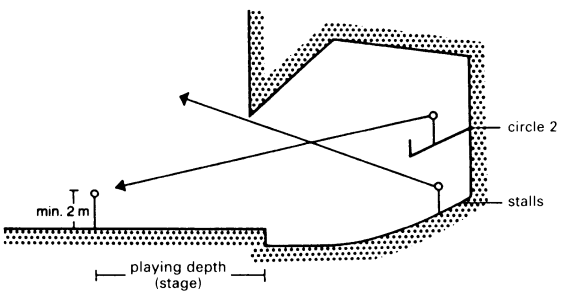
④ **Contact relationships between public and stage and among one another**



⑤ **Perceptive field and proportions of proscenium arch**



⑥ **Ceiling shape and sound reflection**



⑦ **Circle theatre and view of stage**

Elevation of seating

Elevation of seating (gradient) in the auditorium is obtained from the lines of vision. Such lines are valid for all seats in the auditorium (stalls as well as circles) → ①. Since the spectators sit in 'gaps', only every second row requires full sight elevation (12cm). Special mathematical literature addresses the subject of sight problems in theatres in which the randomness of the distribution of different sizes of spectators is also taken into account. The rows of spectators should be formed in a circular segment with respect to the stage, not just for better alignment but also to achieve better mutual perception (feeling of integration) → ④.

Complete vertical section through auditorium

The proscenium height should first be determined. The ratio in a stalls theatre of proscenium height to width should be 1:6. The golden section, or the physiological perception field, is included in this → ⑤. After the proscenium height, the apron height, the banking of the stalls and the volume of the auditorium are determined; the lines of the ceiling are obtained from the acoustic requirements. The aim should be for the reflected sound from the stage or apron to be equally distributed throughout the auditorium. In the case of circles, it should be ensured that the full depth of the stage can be seen, even from the upper seats. This might require an increase in proscenium height.

The proportions of an experimental auditorium are shown on the following page.

Neutral or open theatre auditoriums permit different arrangements of spectator seating and stage areas. This variable arrangement is achieved in two ways:

(A) mobile staging and mobile spectator stands with a fixed auditorium floor

(B) movable floor consisting of lifting platforms.

Method A is technically more complicated and more expensive, and is therefore used only in larger auditoriums for at least 150–450+ people. Type B is especially suitable for smaller theatres and unused rooms which normally have insufficient subspace.

99 seats × 0.6m² needs a stage area of 60m² (²/₃) + 30m² (¹/₃) i.e. 90–100m².

A room proportion of 1:1.6 is the best option for multiple use (see ① – ③ on the following page).

Vertical room section

In simple auditoriums, the lighting rig is unnecessary → ② – ③. Instead, manual hoists can be provided (bars which are pulled up to the ceiling with hand winches). Two examples are shown on the next page: a small theatre in Münster (Architect: v. Hansen, Rane, Ruhnau,1971), 170–380 seats, mid-section of floor is variable with lifting stage sections, acting stages ① – ④ and Ulm podium (Architect: Schäfer, 1996), 150–2000 seats ④ – ⑦.

Larger type B has 450+ seats. It is designed like small type A, but with a mobile floor to simplify change in the floor topography. One problem is the size and lifting accuracy of the stage sections. Often, the rough topography of the stage sections has to be modified by manually arranging platforms to give fine topography → p. 480 ③. See Theatre on Lehniner Platz, Berlin → p. 477 ⑥.

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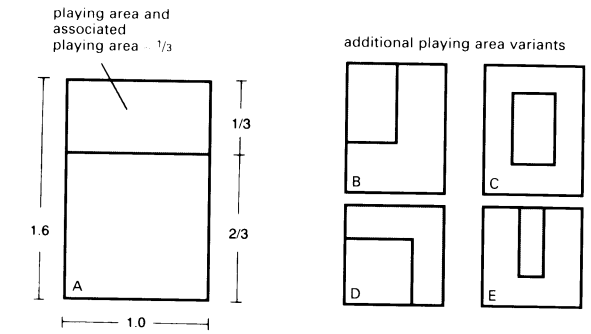
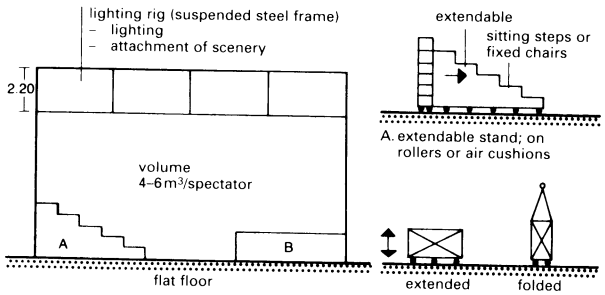
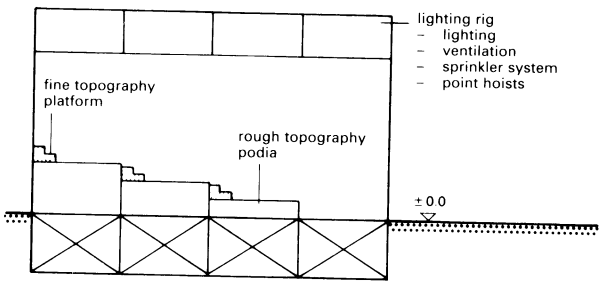


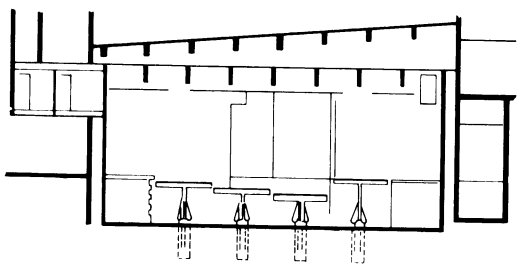
① **Playing area variants; smaller type A**



② **Experimental theatre auditorium**

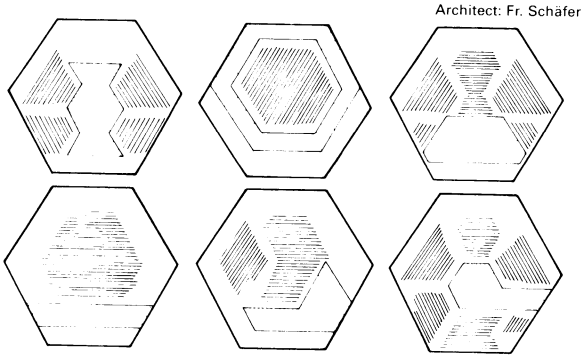


③ **Lifting stages – sketch showing principles**

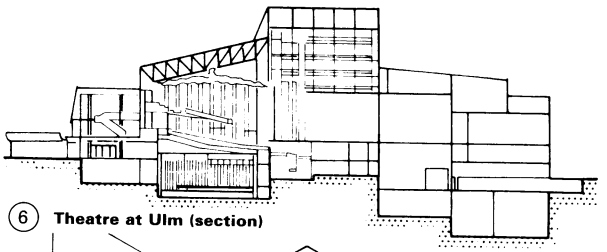


④ **Podium in the theatre at Ulm (longitudinal section)**

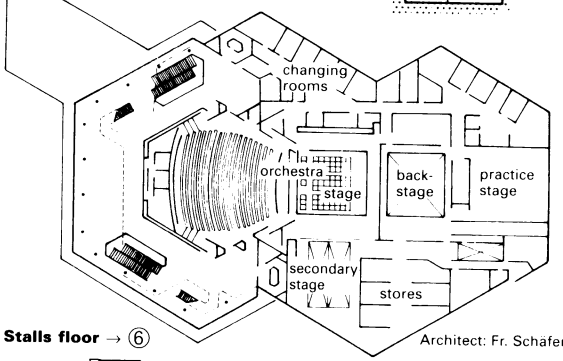
Architect: Fr. Schäfer



⑤ **Ulm podium: six variants for arranging the action surfaces** → ④

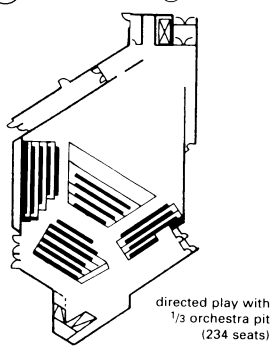


⑥ **Theatre at Ulm (section)**



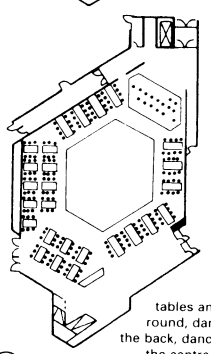
⑦ **Stalls floor** → ⑥

Architect: Fr. Schäfer



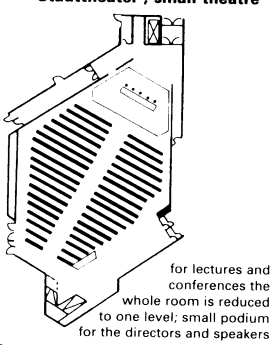
directed play with 1/3 orchestra pit (234 seats)

⑧ **Room variants in the Münster 'Stadttheater'; small theatre**



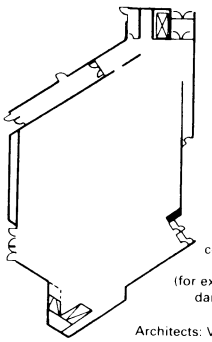
tables and chairs all round, dance band at the back, dancing floor in the centre (178 seats)

⑨ → ⑧



for lectures and conferences the whole room is reduced to one level; small podium for the directors and speakers

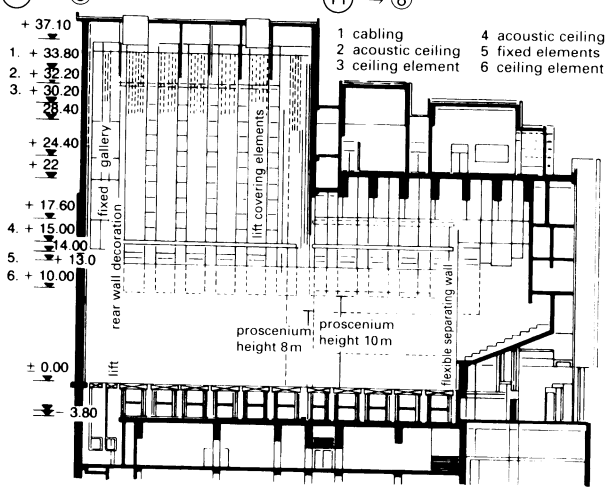
⑩ → ⑧



completely free room (for exhibitions, dances, etc.)

Architects: V. Hausen, Rawe, Ruhnau

⑪ → ⑧



⑫ **Salle Modulable, Opéra Bastille, Paris (longitudinal section)**

STAGES AND SECONDARY AREAS

Proportions of Stages, Secondary Stages and Stores

Stage forms

There are three stage forms: full stage, small stage and set areas.

Full stage: More than 100 m² of stage area. Stage ceiling more than 1 m above top of proscenium arch. An essential feature of a full stage is an iron safety curtain which separates the stage from the auditorium in the event of an emergency.

Small stage: Area no more than 100 m², no stage extension (secondary stages), stage ceiling not more than 1 m above top of proscenium. Small stages do not require an iron safety curtain.

Set areas: Raised acting areas in rooms without ceiling projection. The peculiarity with set areas is in the regulations with respect to curtains and scenery. They affect the operation, not the planning, of set areas. Experimental auditoria fall within the set area definitions.

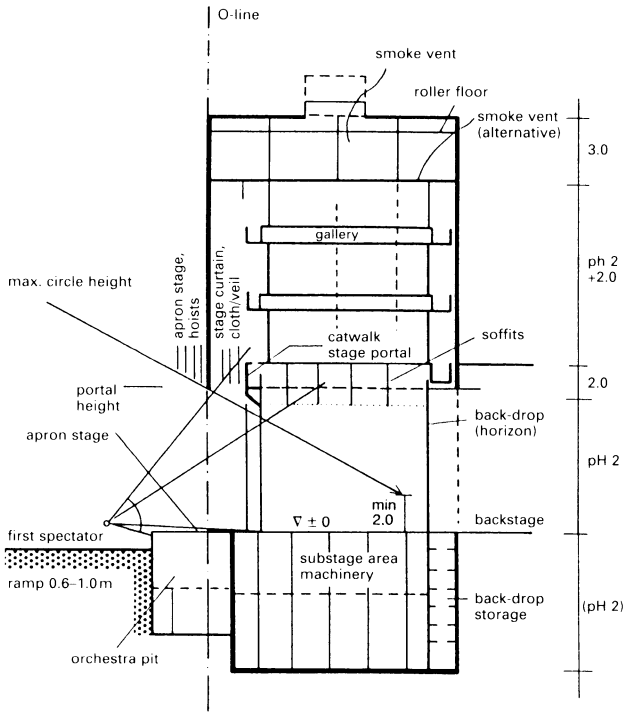
Stage proportions

Stage proportions are developed from the lines of vision from the auditorium. The stage area is the playing area plus walkways (around the back of the stage) and working areas. The principle design of a traditional full stage → ① - ②.

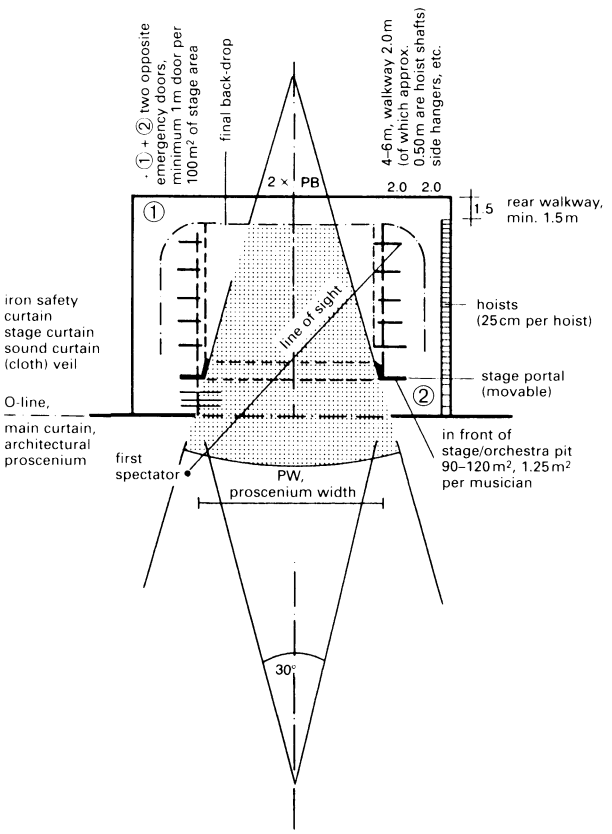
Mobile set areas are formed from height-adjustable platforms or lifting podia. Variable shapes are achieved by splitting the area into individual elements. Basic dimensions 1 m × 2 m → ③ - ④.

Stage ventilation

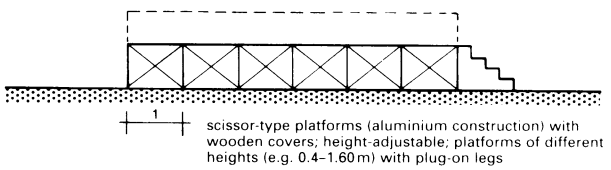
Means should be provided for ventilating smoke and hot gases resulting from fire on the stage, e.g. provision of haystack lantern light or fire ventilator sited in highest point in roof over stage and as near to centre of stage as is reasonably practicable. An additional fresh air inlet may prove effective.



① **Cross-sectional proportions of a traditional stage (side view)**

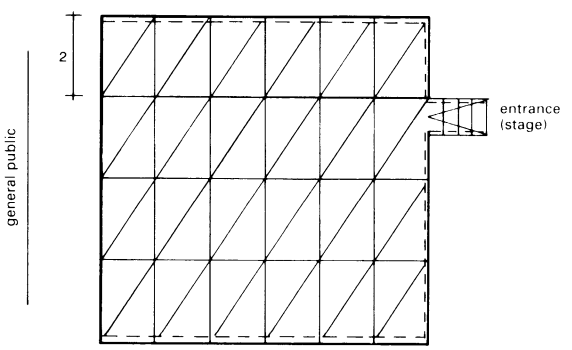


② **Proportions of a traditional stage (plan view)**



scissor-type platforms (aluminium construction) with wooden covers; height-adjustable; platforms of different heights (e.g. 0.4–1.60 m) with plug-on legs

③ **Set area**



plug-in railings on the sides not in view of the public (with conventional scenery)

④ **Set area (plan view)**

STAGES AND SECONDARY AREAS

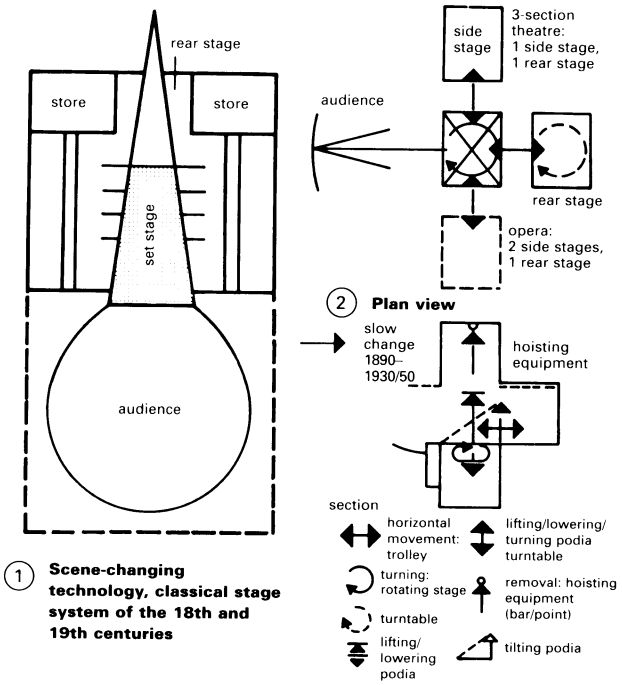
Adjacent (Secondary) Stages and Scene Changing Technology

The classical stage systems in the 18th and 19th centuries only recognised the main stage; scene-changing was done using minimum space and with astonishing speed with sliding scenery. A small backstage was used to provide space for deep stage perspectives → ①.

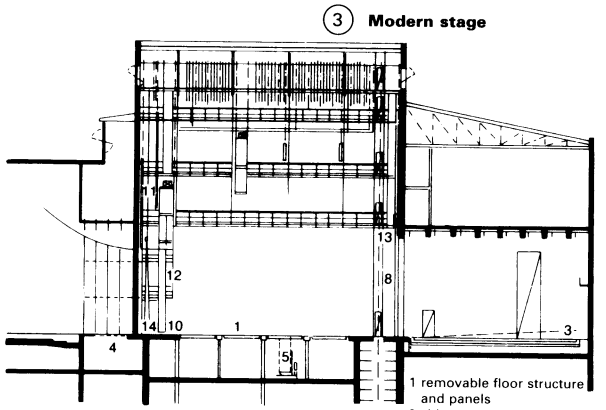
The modern stage has 3D stage structures (sets). Scene-changes require secondary stages to which the sets can be transported with flat stage trolleys. Apart from the removal of sets, there are additional scene-changing techniques → ②–③.

Opera requires two side stages and one rear stage → ⑥–⑦.

The small three-section theatre only has one side stage and one rear stage → ④–⑤.



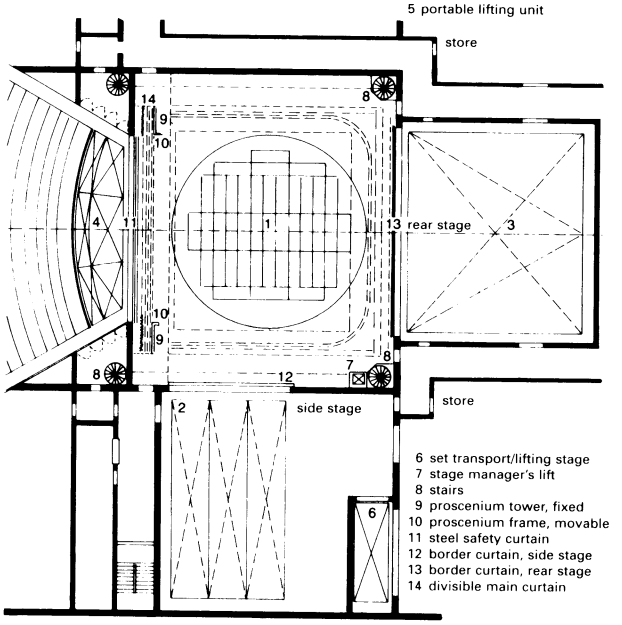
① **Scene-changing technology, classical stage system of the 18th and 19th centuries**



③ **Modern stage**

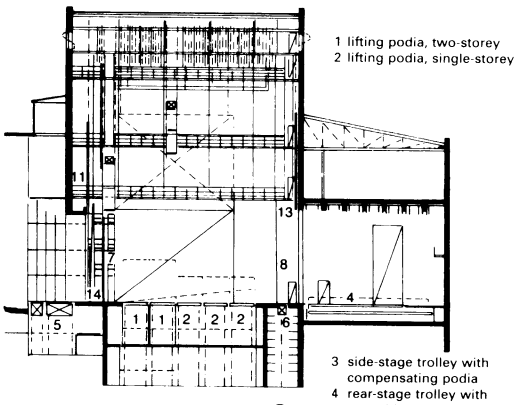
1 removable floor structure and panels
2 side-stage trolleys with compensating podia
3 rear-stage trolleys with turntable, tilting
4 manual orchestra covers
5 portable lifting unit

④ **Typical three-section theatre (section)** → ⑤



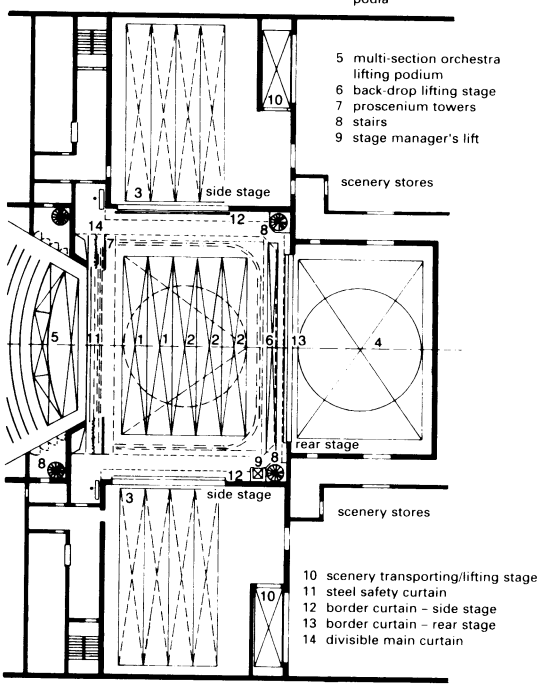
6 set transport/lifting stage
7 stage manager's lift
8 stairs
9 proscenium tower, fixed
10 proscenium frame, movable
11 steel safety curtain
12 border curtain, side stage
13 border curtain, rear stage
14 divisible main curtain

⑤ **Typical three-section theatre stage area (plan view)**



1 lifting podia, two-storey
2 lifting podia, single-storey
3 side-stage trolley with compensating podia
4 rear-stage trolley with turntable and compensating podia

⑥ **Typical opera building (section)** → ⑦



5 multi-section orchestra lifting podium
6 back-drop lifting stage
7 proscenium towers
8 stairs
9 stage manager's lift
10 scenery transporting/lifting stage
11 steel safety curtain
12 border curtain – side stage
13 border curtain – rear stage
14 divisible main curtain

⑦ **Typical opera building (plan view)**

STAGES AND SECONDARY AREAS

Secondary Areas

Open stages require secondary areas for the sets, and storage areas for platforms and stands – around 30% of the whole room. (The secondary areas should be the same size as the playing area; and the space required for storage areas can be calculated from the folded platforms and stands.)

Open stages require considerably less scenery than normal stages because the playing area is viewed from several sides.

Regulations limit the use of scenery for safety reasons → ①.

Storage rooms are used for the stage items and scenery. They can be subdivided into: sets, back-drop, furniture, props store, store for costumes, hats, shoes, masks, wigs, lighting, etc.

Scenery and costume stores need the greatest amount of space.

Scenery store: (particularly for heavy parts) at stage height and in the immediate vicinity of the stage. Rough values for the dimensions of scenery and costume stores can be obtained from the number of productions in the repertoire. For theatres and multipurpose theatres, this is normally 10–12; for opera, it is up to 50 productions and more.

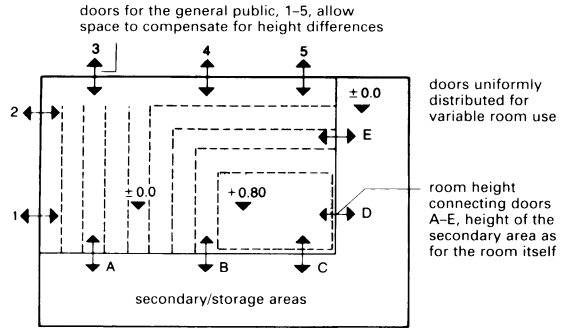
Per play/production, around 20–25% of the playing area is required as storage area, i.e. for theatres about three times the playing area, and for opera, at least ten times. Practice has shown that, with time, the stores turn out to be too small; therefore, theatres and, especially, operas create storage areas outside the theatre.

The significant amount of transporting has inevitably led to the introduction of the most up-to-date transportation and storage technology: container systems with computer-controlled storage.

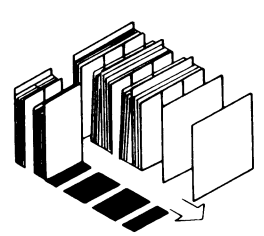
Around 2–4 containers are required per production (special operas may require up to 12 containers).

Examples: the Deutsche Oper (Berlin) stores are in direct connection with the stage → ④; the National Theatre (Mannheim) storage is outside the theatre, in containers → ⑤.

Surface area required for costumes is also calculated according to the number of productions in the repertoire and the size of the ensemble (e.g. opera) apart from the performers, the choir and ballet. Space requirement for costumes: 1–12 cm/costume or 1–15 costumes per rod → ⑥ – ⑦.

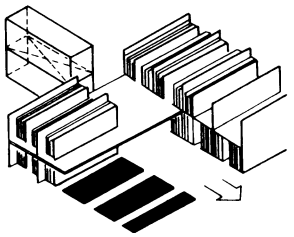


① **Secondary/storage areas**



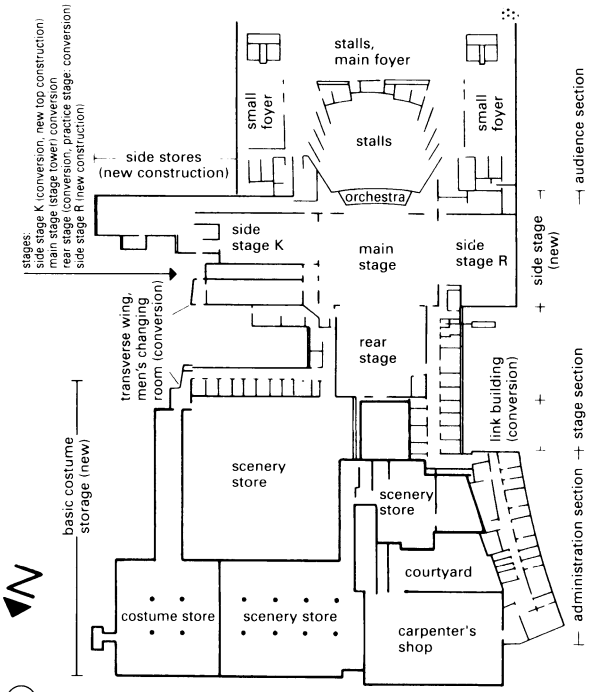
traditional storage of back-drops
- on edge in boxes, manual transport, large proportion of area required, height: 9–12 m
- in boxes, manual transport, large proportion of area required for moving

② **Storage**

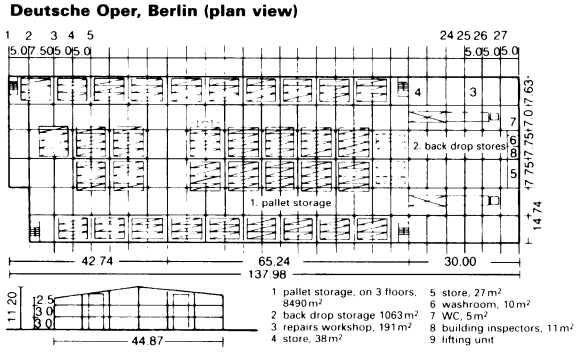


modern back-drop storage
- loading of containers by hand from secondary stage, or specific storage areas
- transport of container to external store
- computer-controlled storage of containers in multi-storey shelving

③ **Storage** → ⑤

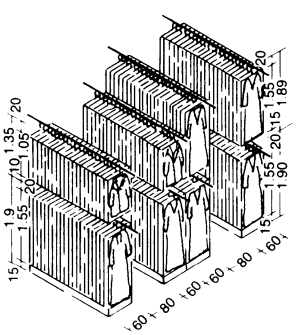


④ **Deutsche Oper, Berlin (plan view)**

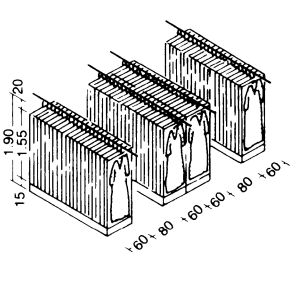


Architect and Stage Technician: Biste & Gerling

⑤ **Ground floor of scenery store, National Theatre, Mannheim (plan view and section)**

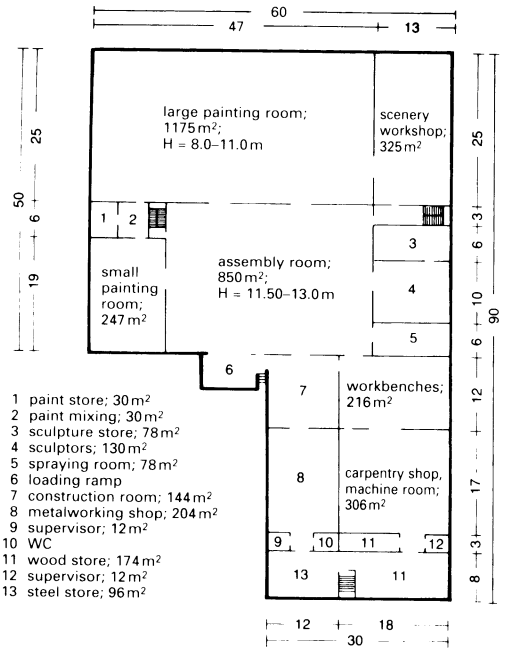


⑥ **Fixed two-storey clothes stands for the hanging and storage of costumes**



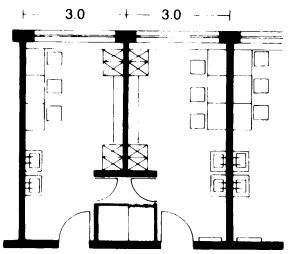
⑦ **Single-storey** → ⑥

STAGES AND SECONDARY AREAS

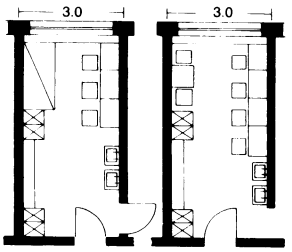


Architect and Stage Technician: Biste & Gerling

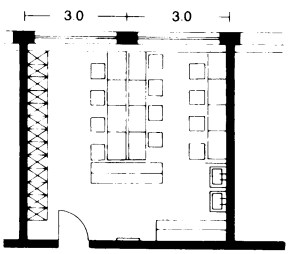
① **Workshop building/ground floor**



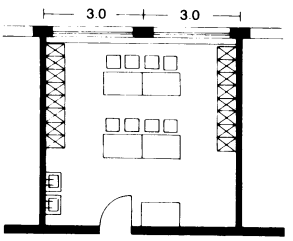
② **Soloists' changing rooms; min. 3.8–5 m²/person**



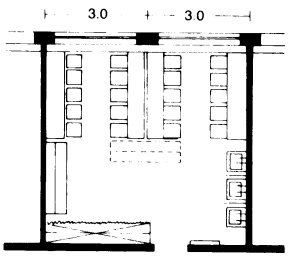
③ **Soloists' changing rooms; min. 5 m²/person**



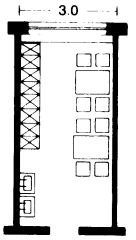
④ **Choir changing room; min. 2.75 m²/person**



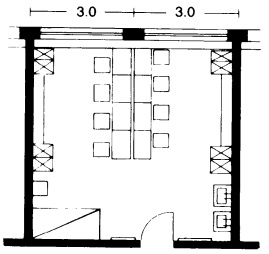
⑤ **Changing and tuning room (green room) for members of the orchestra; min. 2 m²/person**



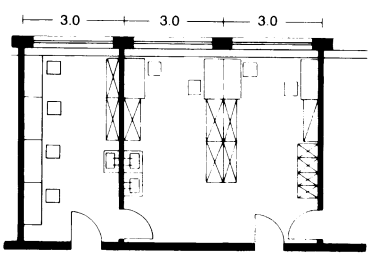
⑥ **Changing room for extra choir and/or minor players; min. 1.65 m²/person**



⑦ **Changing and rest room for technical personnel**



⑧ **Changing room for ballet group; min. 4 m²/person**



⑨ **Make up and work room for mask makers**

Workshops for making scenery

In his 1927 book *Stage technology today*, stage technician Kranich demanded that workshops should be excluded from the theatre. He gave two reasons: danger of fire, and limited space options.

In old theatres, the workshops were often installed in completely inaccessible places. Today, the demand is to have the workshops within the theatre with the aid of appropriate space planning so as to retain the specific, positive operating climate in the theatre (identification with the work). However, for space or economic reasons, in the case of large theatres, the workshops are often installed in separate buildings. Space required for scenery workshops in medium theatres (normal and multipurpose theatres) is 4–5 times the area of the main stage. In large opera houses or double theatres (opera and plays), ten times the area is required. Always install workshops on one level whether in or outside the theatre.

There are several classes of scenery workshop:

(a) The painting room area must be sufficient to allow two large back-drops or round horizons can be spread flat on the floor for painting. Average size of a round horizon is 10 m × 36 m. Due to spraying work, it is necessary to subdivide the room with a thick curtain. Floor heating is needed for drying the painted back-drops, and a wooden floor for spreading the canvases. A sewing room should be near the painting room for sewing together the canvas sections. Its size should be about 1/4 of the painting room.

(b) The carpenters' shop is subdivided into bench and machine rooms. It has wooden floors and a connected wood store for 3–10 productions.

(c) The upholstery room is about 1/10 the size of the painting room.

(d) Metalworking shop: size as for carpenters' shop, with a screed floor.

(e) Laminating shop: size as for (b) and (d).

(f) The workshops should be grouped around an assembly room, which serves for practice setting up of the scenery. The surface area should be as for the stage, and height according to proscenium height plus 2 m, 9–10 m across.

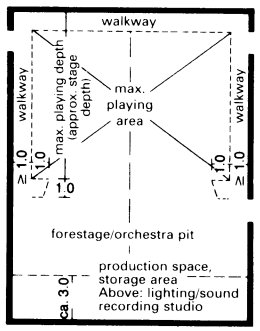
(g) Changing, washing and rest rooms (canteen) are required for technical personnel. Offices are needed for technical management personnel. Additional workshops are needed for sound, lighting, props and costumes. The size of these rooms should be according to requirements (i.e. production intensity, personnel numbers, etc.).

Personnel rooms

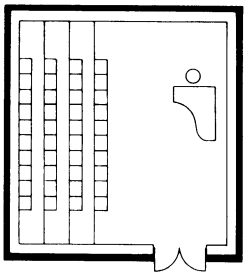
These are needed for artistic personnel, directors, and administration. From an historic perspective, the personnel rooms were placed on either side of the stage: women to the left and men to the right. However, this was unfavourable for the operation, so, nowadays, personnel rooms are built on one side, opposite the technical side, and on several floors. Here also are found the mask-making shops, frequently also the costume workshop, administration and directors.

Changing rooms: → ② – ⑨ typical plan views.

STAGES AND SECONDARY AREAS

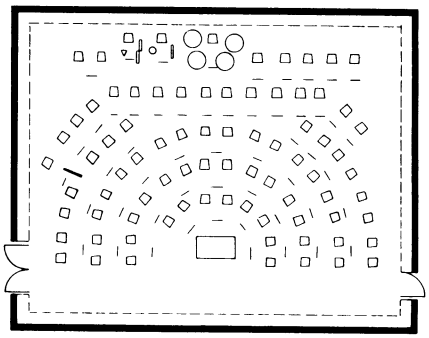


① **Typical large rehearsal stage (plan view)**



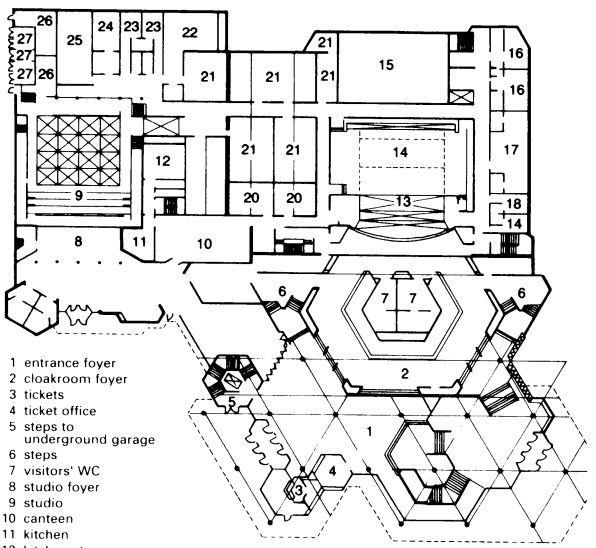
ca. 1.4 m²/singer, minimum 50 m²
ca. 7 m³/singer

② **Typical choir rehearsal room (plan view)**



ca. 2.0–2.4 m²/musician
ca. 8–10.0 m³/musician

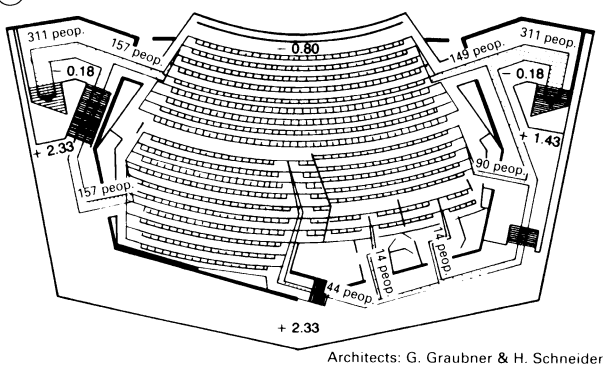
③ **Typical large rehearsal stage (plan view)**



1 entrance foyer
2 cloakroom foyer
3 tickets
4 ticket office
5 steps to underground garage
6 steps
7 visitors' WC
8 studio foyer
9 studio
10 canteen
11 kitchen
12 kitchen store
13 orchestra pit
14 substage
15 rehearsal room
16 extras
17 choir
18 conductor
19 director
20 tuning room
21 stores
22 electrical shop
23 changing rooms
24 battery room
25 low-voltage switchroom
26 medium-voltage switchroom
27 transformer cells

Architects: Biste & Gerling

④ **Entrance hall floor of Heilbronn Theatre**



Architects: G. Graubner & H. Schneider
Stage Technician: A. Zotzmann, 1964

⑤ **Evacuation plan: Trier Theatre (626 seats)**

Rehearsal Rooms

To reduce the load on the main stage, every theatre must have at least one rehearsal stage e.g. in a small theatre, the scenery for the current piece is on the stage, with rehearsal on the rehearsal stage. Dimensions of the rehearsal room should be as per the main stage. Plan view of typical rehearsal stage for traditional theatre → ①. Orchestra rehearsal rooms → ③, choir rehearsal rooms → ②, soloist rehearsal rooms and ballet rooms are needed in multipurpose theatres or opera houses.

Experimental theatre

Personnel and rehearsal rooms, workshops and stores are also required in reduced form for continuous operation.

Technical utilities

Transformer room, medium- and low-voltage switchroom, emergency power batteries, air-conditioning and ventilation plant, water supply (sprinkler system) according to local requirements and specialist planning.

Public areas

The classical Italian opera houses had only narrow access doors and stairs – there was no actual foyer – whereas the huge public areas of the Grand Opéra House in Paris were impressive. The theatre fire in Vienna, in 1881, resulted in fundamental changes. Self-contained emergency stairs, separate for each level, were now required for the audience. Such a requirement in principle still applies today.

In the traditional theatre, the foyers are subdivided into the actual foyer, restaurant (buffet) and a smoking foyer. An area of foyer 0.8–2.0 m²/spectator and 0.6–0.8 m²/spectator, respectively, is realistic. The function of the foyer has changed today. It may be supplemented with displays, performances and other activities. Theatre performances must be taken into account during planning: room height, wall, ceiling and floor configuration.

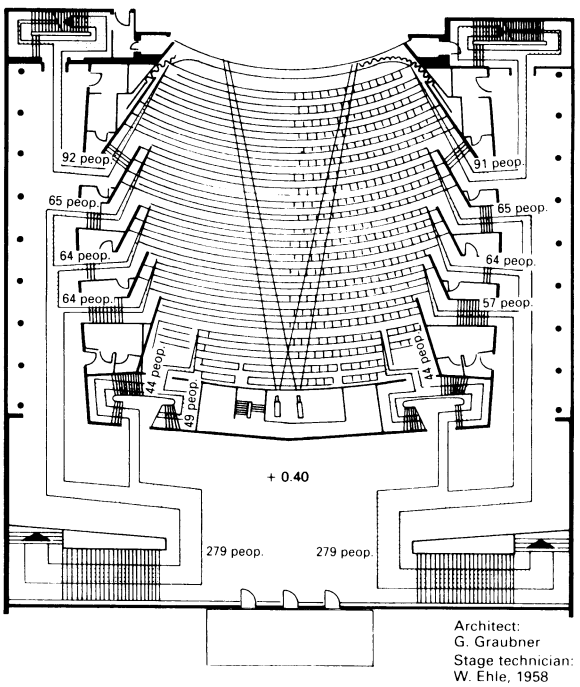
Cloakrooms

Minimum: 4 m per 100 visitors. Nowadays, cloakrooms often have lockers: 1 locker per 4 visitors. The foyer is also the waiting and queuing area. WCs are installed with respect to the foyer in the normal ratio (i.e. 1 WC/100 people: 1/3 men, 2/3 women): there must be at least one men's and one ladies' toilet. The entrance hall (lobby) contains the day and evening ticket offices, which should be opposite each other.

External access and emergency routes

These are needed in accordance with local requirements and will depend on the location:

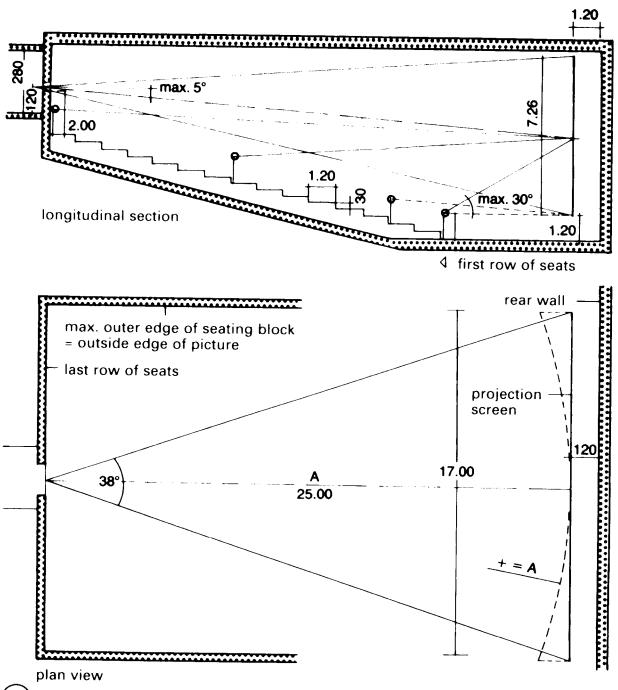
- prestigious location in an urban square
- location in a park or on a main street
- as part of a large building.



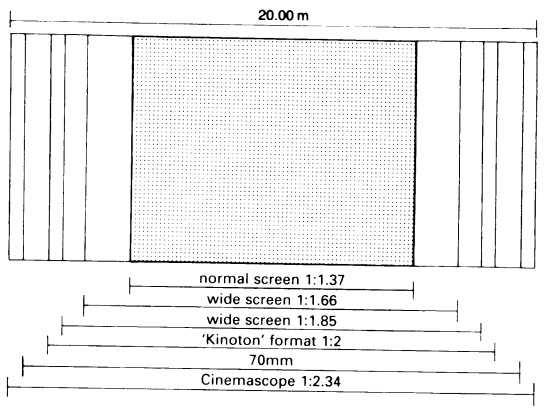
Architect:
G. Graubner
Stage technician:
W. Ehle, 1958

⑥ **Evacuation plan: Lünen Theatre (765 seats)**

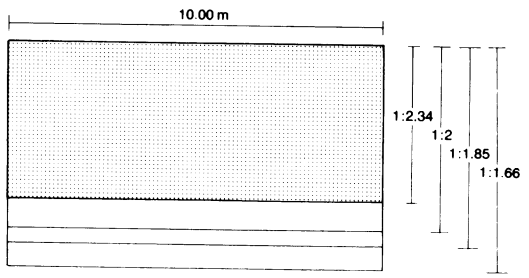
CINEMAS



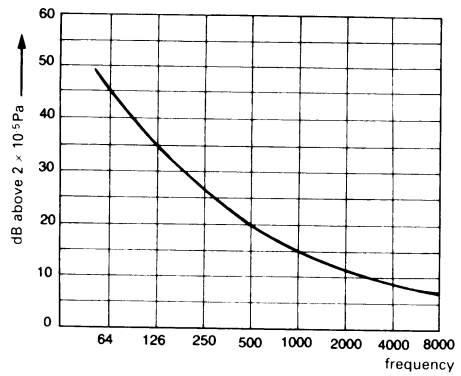
① **Optimum auditorium**



② **Screen formats for the same screen height**



③ **Screen formats for the same screen width**



④ **Permitted noise level**

Before planning, bring in a cinema technology firm for advice.

Film projection: Fire separation materials are no longer required for the projection room with safety film. Projectionists operate several projectors; the projection room is no longer a continuously used workplace for staff. 1 m of space behind the projector and at the operating side, 2.80 m high, ventilation, noise insulation to the auditorium side. Projection rooms may be combined for several auditoriums.

Film widths of 16 mm, 35 mm and 70 mm. The centre of the projected beam should not deviate more than 5° horizontally or vertically from the centre of the screen, or it should be deflected via a deflection mirror. → ①

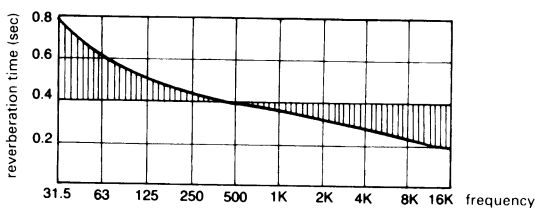
Conventional systems use two projectors in a superimposing operation. Nowadays, automatic operation with only one projector using horizontal film plates provides no-break film presentations with 4000 m spools. This system is sometimes used with several projection rooms and remote control from projection and control points. The film automatically gives control signals for all the functions of the projector, lens changes, auditorium lighting, stage lighting, curtain and picture cover.

Picture sizes depend on the distance of the projector from the screen; height/side ratio is 1:2.34 (Cinemascope) or 1:1.66 (wide screen) for smaller room widths. The angle from the middle of the last row of seats to the outer edge of the picture should be at most 38° for Cinemascope. The ratio of the spacing of the last row of seats to the projection screen should be 3:2 → ② - ③.

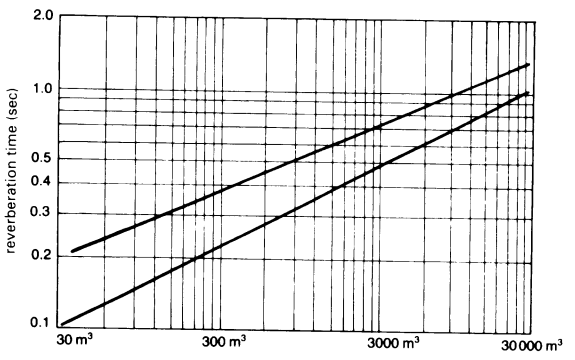
Projection screen: Minimum distance of projection screen from wall in the case of THX is 120 cm, according to theatre size and system reducible to 50 cm with respect to the sound system configuration.

The projection screen is perforated (sound-permeable). Movable blinds or curtains limit the projection screen to the side for the same picture height. Large projection screens are curved with a radius centred on the last row of seats. The lower edge of the projection screen should be at least 1.20 m above the floor → ①.

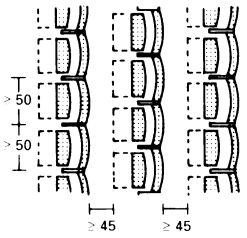
The auditorium should have no outside light other than emergency lighting. Walls and ceiling are made from non-reflective materials and in not too bright colours. Spectators should sit within the outside edge of the screen. The viewing angle from the first row of seats to the centre of the picture should not exceed 30°.



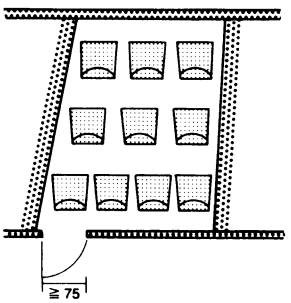
⑤ **Permitted reverberation time depending on frequency**



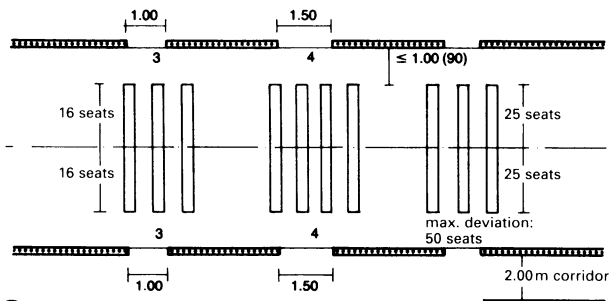
⑥ **Reverberation time with respect to room volume**



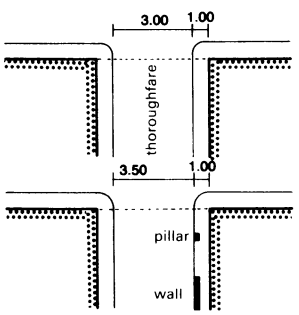
① **Spacing and seating rows**



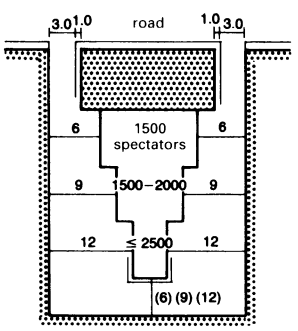
② **Boxes max. 10 loose chairs; min. 0.65 m²/person floor area**



③ **Seating**

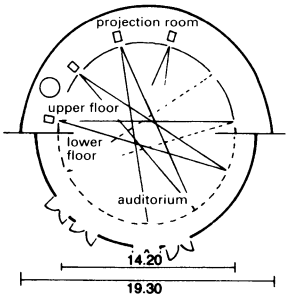


④ **Access roads and thoroughfares**

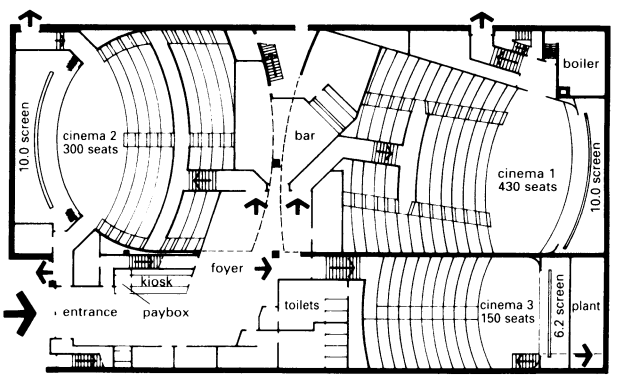


floor area: 2500 spectators @ 1 m²/ 4 persons; >2500: 1 m²/ 3 persons

⑤ **Spacing within building boundaries**



⑥ **Circarama: All-round film surface (360°) showing a connected film, projected by 11 synchronously running projectors, e.g. ExPo Brussels**



⑦ **Three-screen cinema in Putney, London**

The floor gradient is achieved by an inclination of up to 10% or by the use of steps with a maximum step height of 16 cm and with aisle widths of 1.20 m.

Acoustics

Neighbouring auditoriums should be separated with partitioning walls of approximately 85 dB 18–20 000 Hz.

Acoustic deflecting surfaces on the ceiling with low acoustic delay difference time. The reverberation time can increase with increasing room volume and decreases from 0.8–0.2 seconds from low to high frequencies → p. 486 ⑥.

The rear wall behind the last row of seats should be sound absorbent to prevent echo.

The loudspeakers should be distributed around the auditorium so that the volume difference between the first and last row of seats does not exceed 4 dB.

Sound reproduction

In future, apart from mono-optical sound reproduction, the Dolby stereo optical sound system in 4-channel technology is also necessary with three loudspeaker combinations behind the screen and the fourth channel with additional speakers to the side and rear.

For 70 mm film 6-channel magnetic sound, the additional speaker combination is behind the screen.

In the case of BTX, there is a sound absorption wall behind the screen according to the Lucas Film System into which the loudspeaker combination is built.

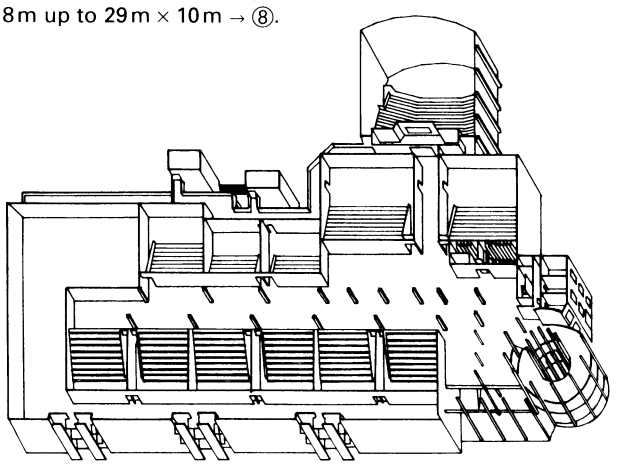
Ticket offices are now superseded by electronic booking and reservation systems.

Multi-screen complexes are now considered necessary to be commercially viable. Various theories are used to determine the total seats needed. A basic requirement is to give visitors a choice of programmes and to enable the operator to show each film in an auditorium with a capacity to match anticipated public demand. Thus, a film playing to half capacity audiences can be transferred to smaller auditorium or vice versa. Seating capacity varies between 100 and 600 chairs.

In larger units, there are boxes for smokers and families with children which have fire-resistant and sound-insulating partition walls and special sound reproduction systems.

Car parking space: normally one per 5–10 spectators. New larger cinemas with several projection rooms in combination with multi-level communications, leisure, sporting and shopping options provide entertainment for the whole family under one roof, and they can also be used for seminars and events.

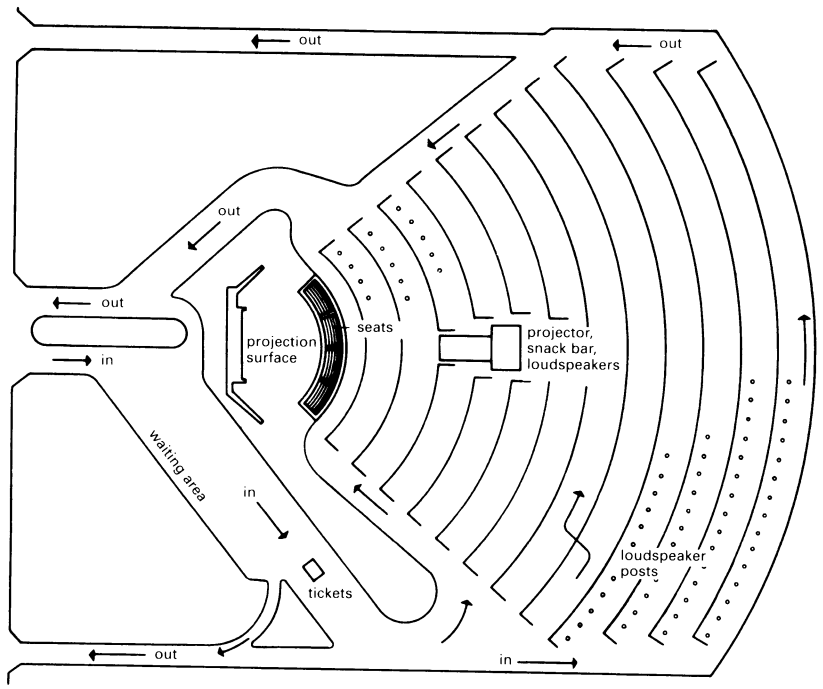
Can be located in peripheral areas of towns with corresponding car parking spaces, e.g. Kinopolis in Brussels with an amusement park, 27 projection rooms with 7500 seats (150 and 700 per room) and screens from 12 m × 8 m up to 29 m × 10 m → ⑧.



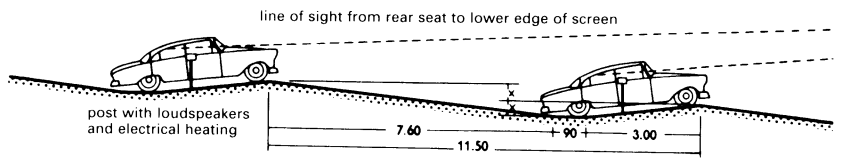
Architect: Peter de Gelder

⑧ **Kinopolis, Brussels**

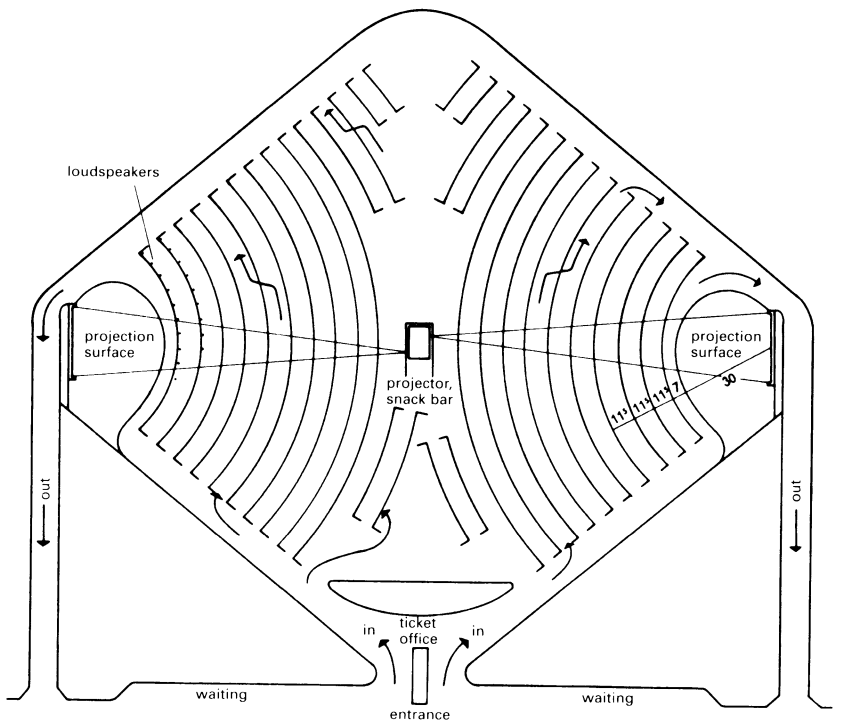
DRIVE-IN CINEMAS



(1) **Fan-shaped drive-in cinema with inclined ramps and low projection cabin which only takes up two rows**



(2) **Ramp arrangement and dimensions; elevations can be different according to screen picture height**



(3) **Double cinema (one projection room for both screens) creates the option of having half-time offset starting times; all other rooms (ticket offices, bar, toilets etc.) are shared.**

Drive-in cinema spectators do not leave their cars; they watch the film from their cars.

The size is limited by ramps and the number of cars (max. 1000–1300) which still permits a good view. Normal size is 450–500 cars · (1).

cars	no. of ramps	projection screen to rear edge of ramp (m)
500	10	155
586	11	170
670	12	180
778	13	195
886	14	210
1000	15	225

The location should be near to a motorway, petrol station or service area, and screened off so that light and noise from passing vehicles does not interfere.

An entrance with a waiting area will avoid traffic congestion on the road. A drive-past ticket office allows tickets to be obtained from the cars · (1).

Exiting is best done by leaving the ramp towards the front.

Ramps are inclined in curves so that the front of each vehicle is raised providing even the rear-seat passengers with a good view of the screen over the roofs of the front row of cars · (2).

The design of the whole ground area should be dust-free and not slippery when wet.

Ticket booths: one booth for 300 vehicles, two for 600, three for 800, and four for 1000 vehicles.

The screen size varies according to the number of vehicles, 14.50 m × 11.30 m for 650 cars; 17.0 m ×13.0 m for 950 cars. The screen is best facing east or north since this permits earlier performances and in areas with harsh climates the screen should be housed in a structure with solid walls.

The height above the ground depends on the ramp slope and angle of sight. A screen which is inclined towards the top reduces distortion. The framework and screen wall must be capable of withstanding the wind pressure.

Rows of seats should be included and a children's playground is desirable.

The projection building is usually centrally located at 100 m from the screen. The projection room contains film projector(s), generator and sound amplification system.

Sound reproduction is best with loudspeakers inside the cars. These speakers (for two vehicles) are located on posts set 5.0 m apart and are taken into the car by the cinema visitors.

Heating may be supplied on the loudspeaker posts with possible connections for internal car heating.