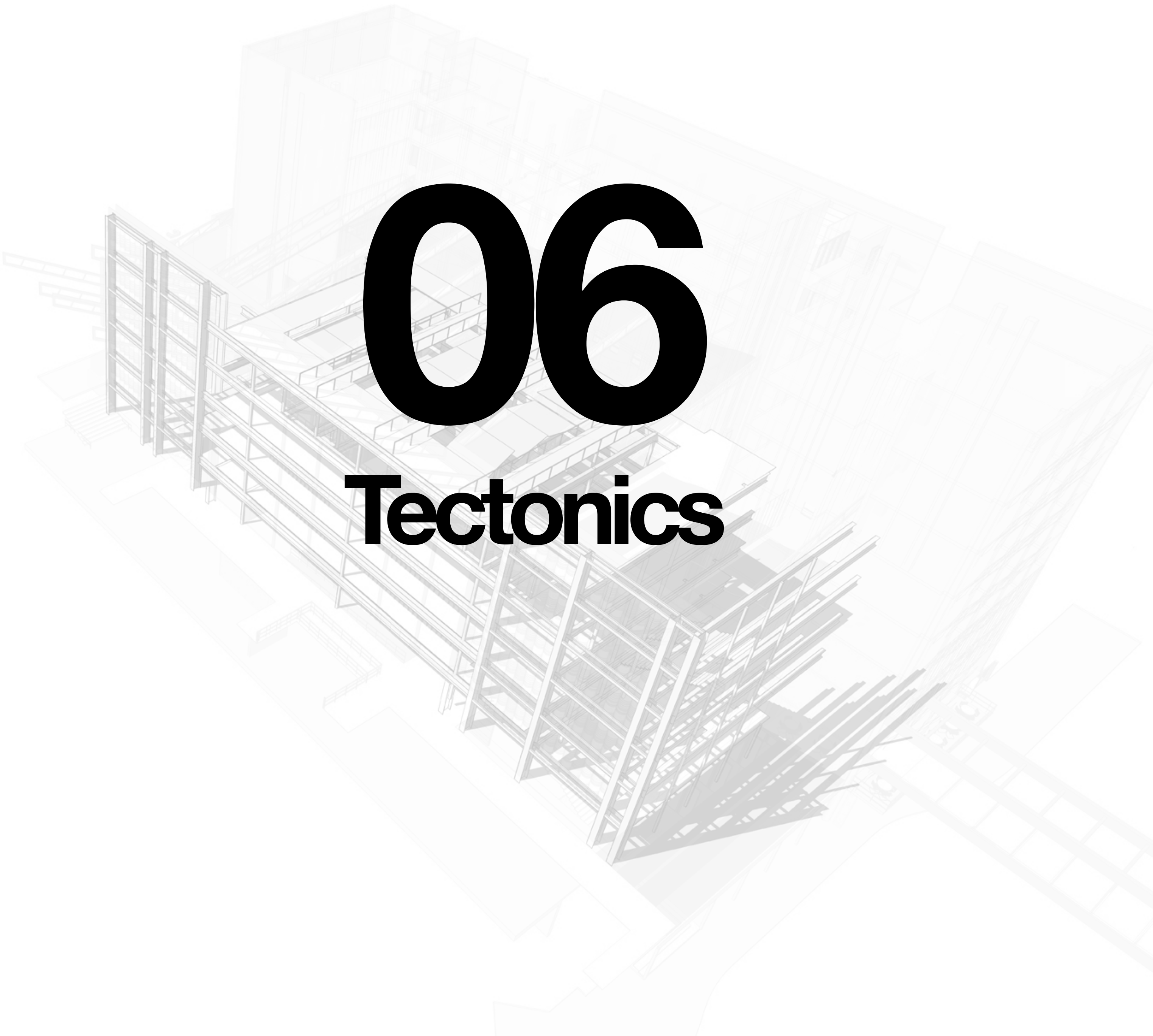


06

Tectonics

6.1 Progress Drawings

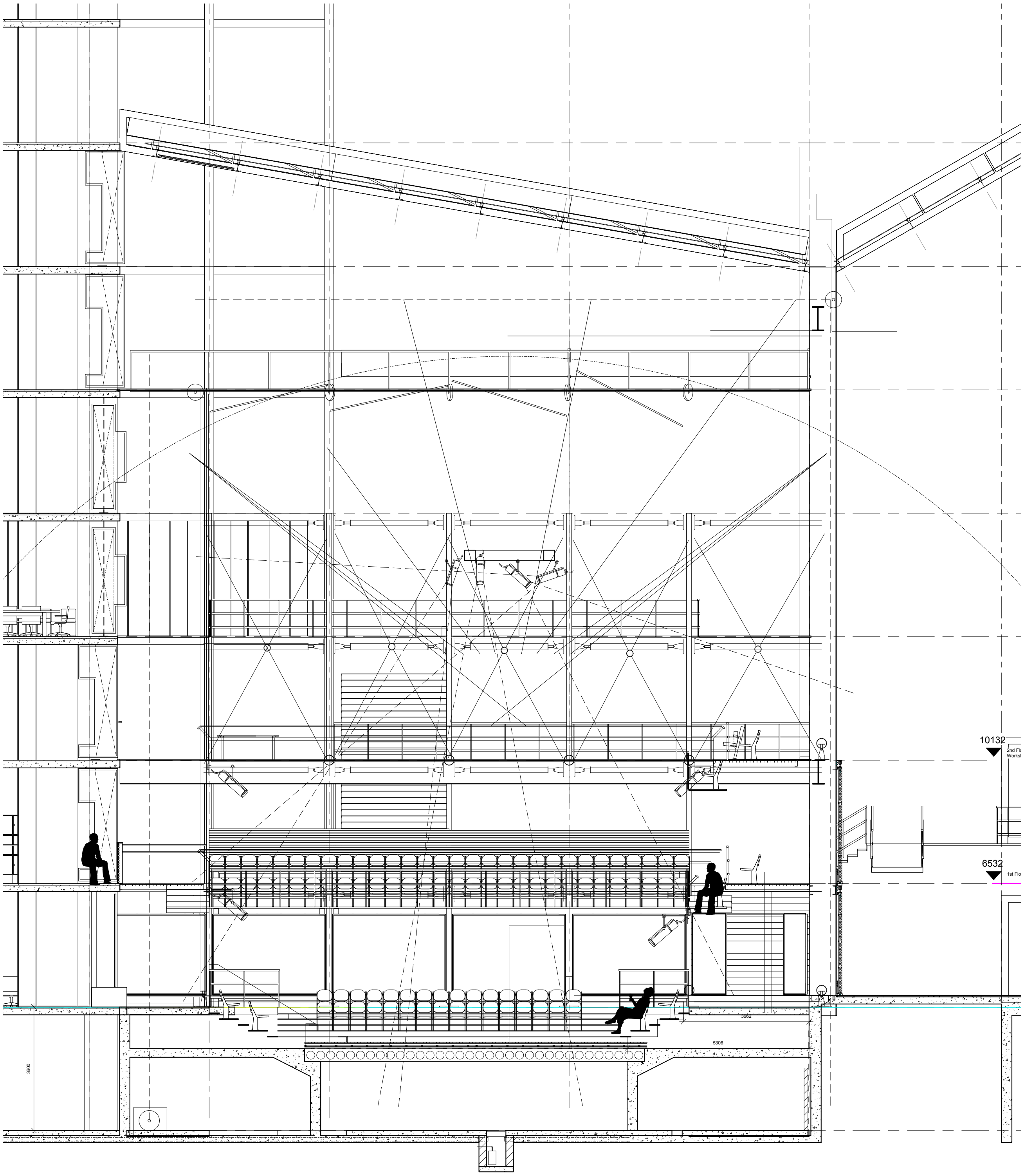


Fig. 6-138 SECTION A-A through forum theatre looking north.

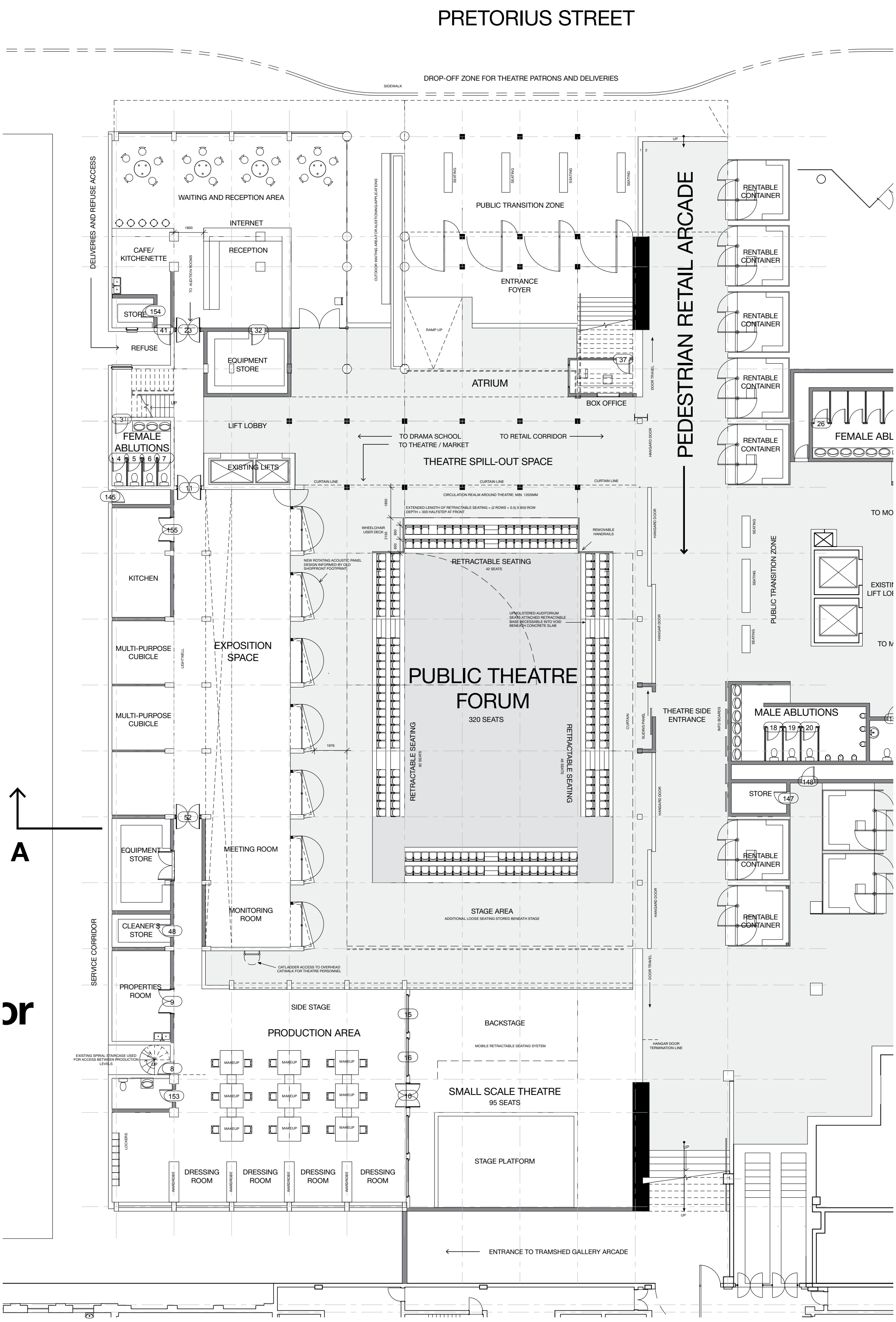
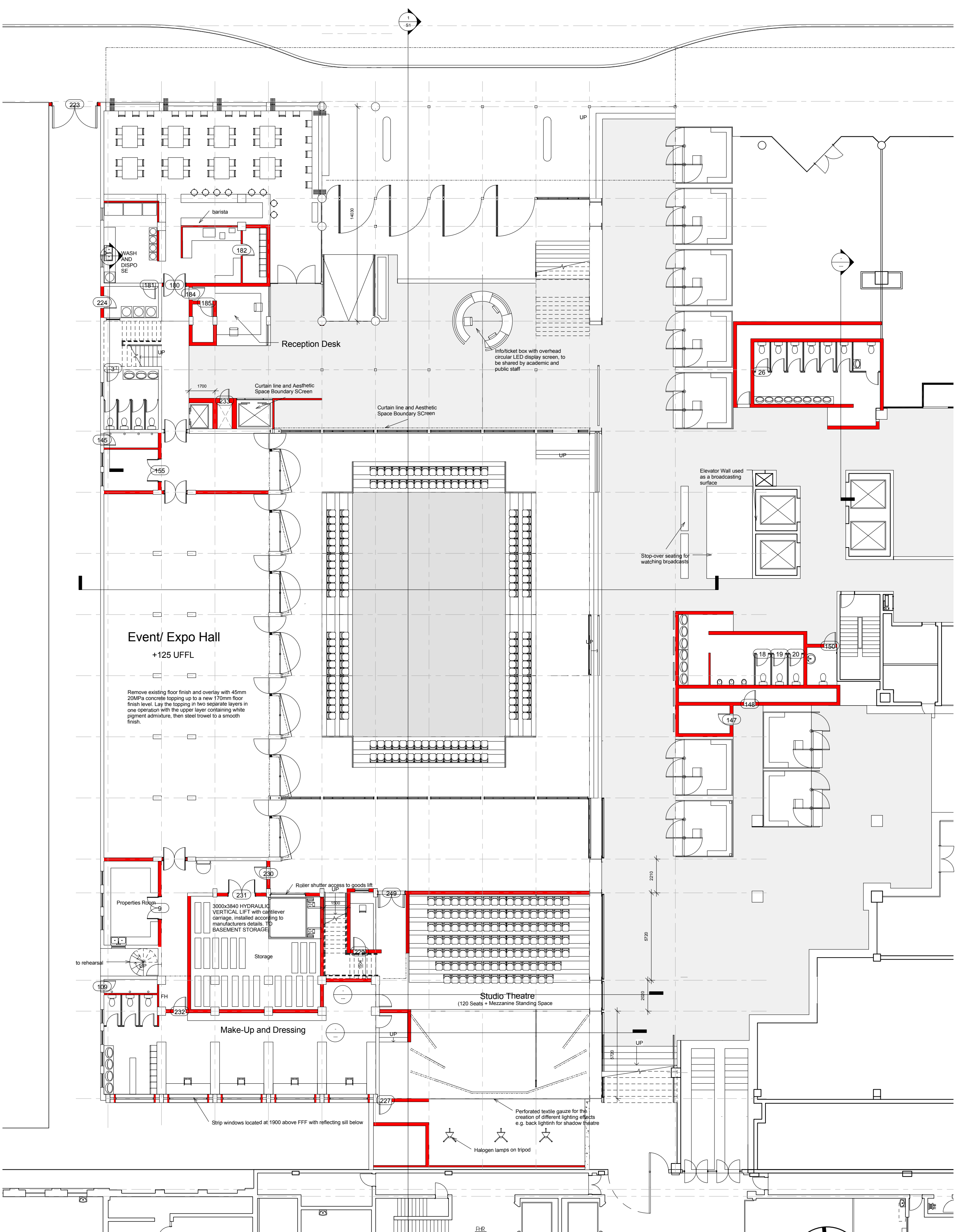


Fig. 6-139 GROUND FLOOR PLAN



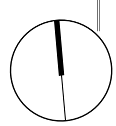


Fig. 6-140 GROUND FLOOR PLAN (more developed)

6.2 Structure

6.2.1 Primary Threshold Structure

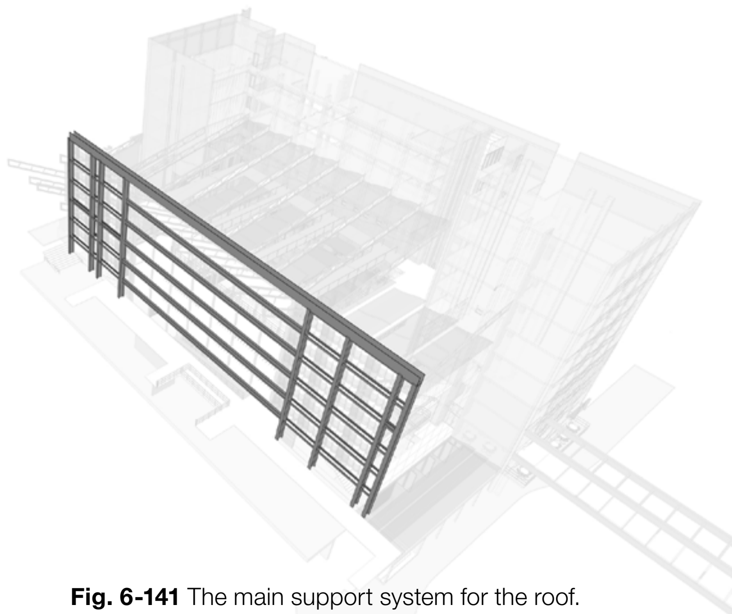


Fig. 6-141 The main support system for the roof.

The concept for the primary structure is to provide the following functionality:

- As a spatial ordering device that separates the theatre programme and pedestrian route. Access will be controlled along this threshold using hangar doors fitted with windows to allow views.
- As the primary support structure for the roof system, theatre structural systems and tensile shading systems.
- As a site memory device, an idea stemming from the concept of a site as an archive for displaying contextual information.

Fig. 6-144 Hangar doors serve to control public access but can be fitted with windows to allow passing pedestrians brief views into the theatre.

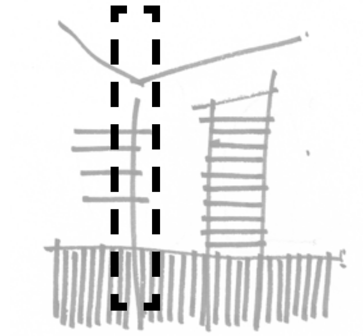


Fig. 6-142 Position of primary structure on parti diagram.

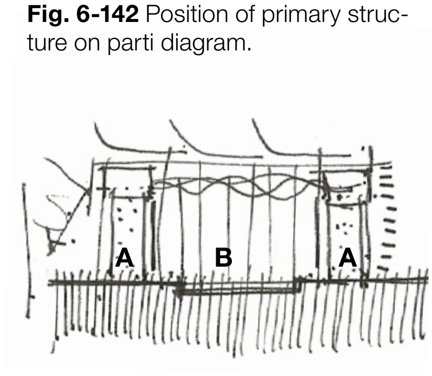


Fig. 6-143 Spatial concept sketch: two large permanent separations with a central flexible threshold that can either be opened to allow for public access, or closed to provide access control for private productions.

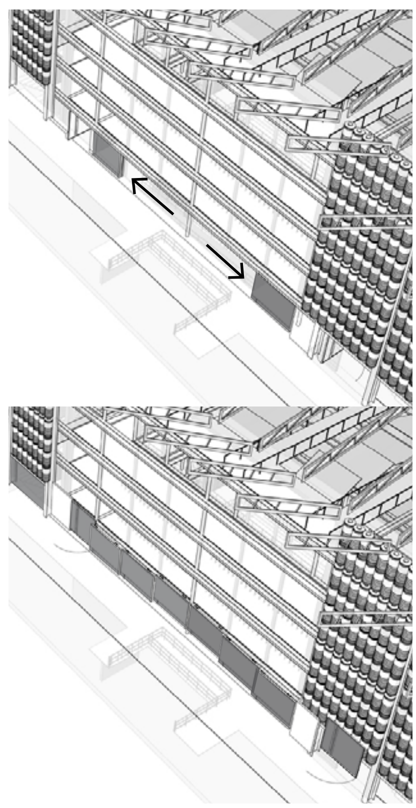


Fig. 6-145 Threshold with hangar doors in open position (top), and in closed position (bottom).

Construction:

The steel cage is composed of steel threaded rods tensioned between horizontal C-Channels. These in turn are bolted between vertical castellated columns which form the primary support for the entire cage system (see image at right). The castellated columns (spaced at 3 500 centimetres) are bolted onto steel base plates that are threaded and fastened into the underlying concrete substrate.

Detailing:

Detailing involves a combination of filling in and attaching of components to the steel cage system. Inf-ill material has been sourced from the demolished material from the adaptations to the Momentum building. Sections of in-fill can be omitted for allowing views and access ways.

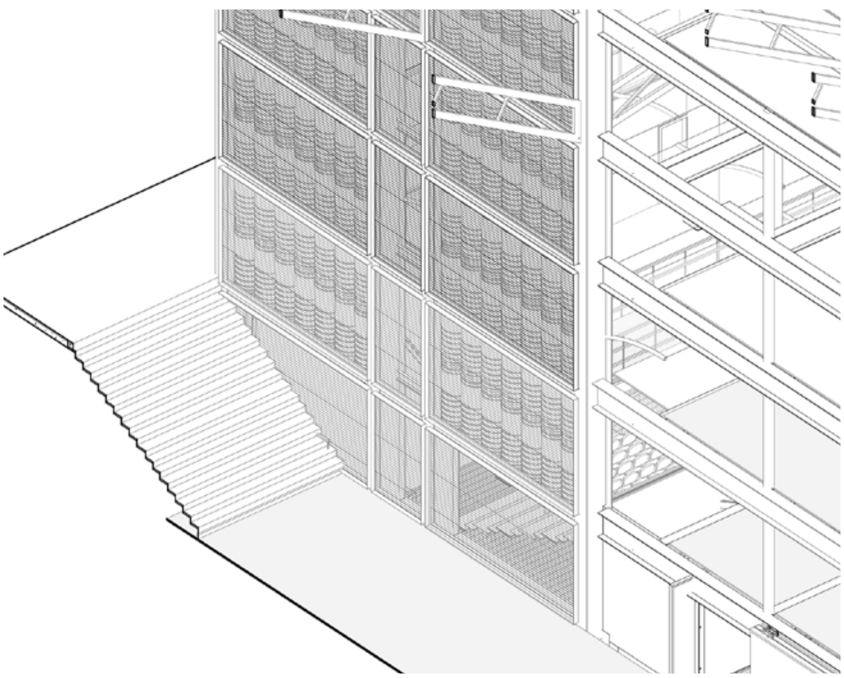


Fig. 6-146 Polycarbonate panels attached to primary steel structure.

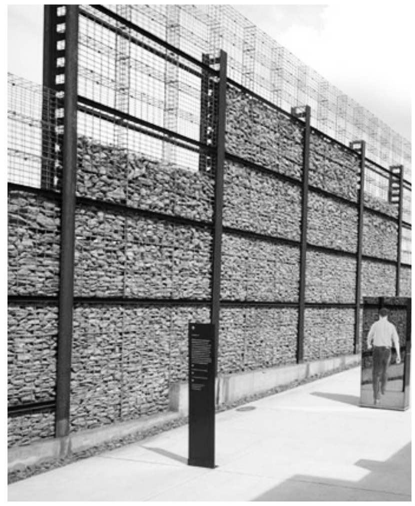


Fig. 6-147 Steel cage at Apartheid museum by Mashabane Rose Architects. The primary structure uses the same basic construction method. (Image source: internet.)

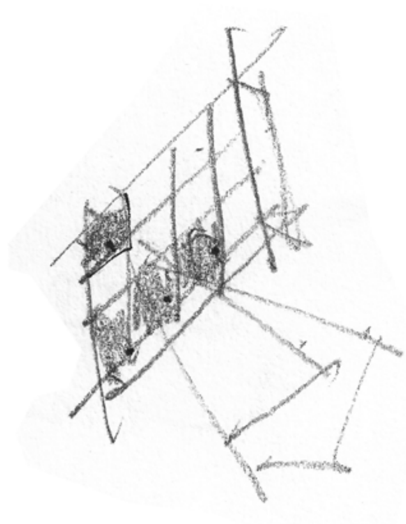


Fig. 6-148 Controlling views through the steel framework.

6.2.2 Forum Theatre Structure

The structure of the forum theatre comprises horizontal trusses and castellated beams that provide the following functions:

- Castellated beams fasten the primary threshold structure to the existing concrete structure of the Govpret building providing lateral stability which prevents the primary structure from collapsing.
- As the support structure for the translucent flooring.

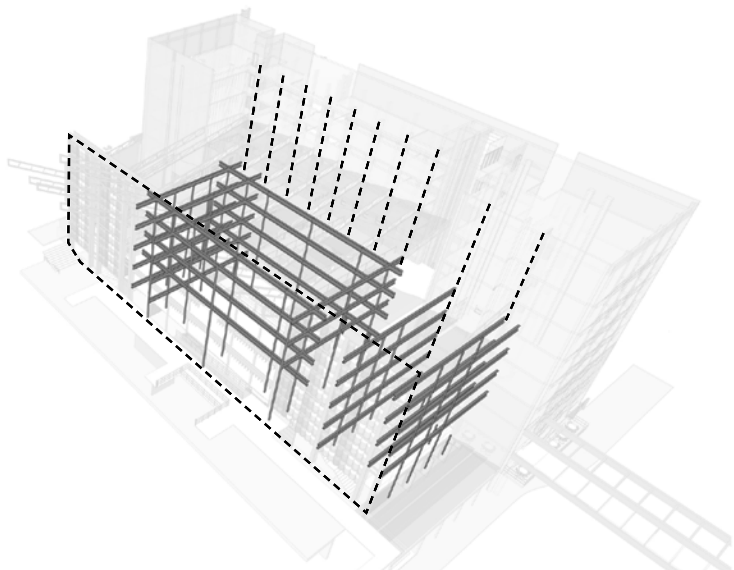


Fig. 6-150 Structural support system for floor and circulation systems. Horizontal beams structural members fasten the primary threshold structure to the Govpret structure (dashed lines) to provide lateral stability.

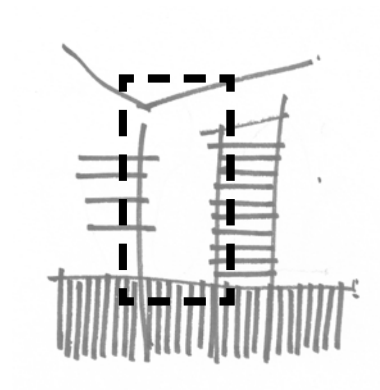


Fig. 6-149 Position of structure on parti diagram.

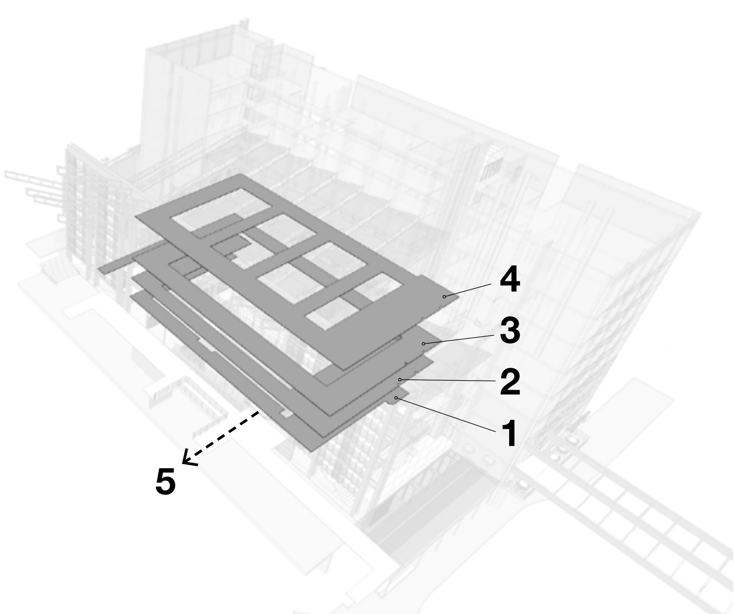


Fig. 6-151 Forum circulation galleries: (1) Gallery 1- public seating, and restaurant and bar amenities; (2) Gallery 2 - public seating; (3) Level 3, with spot lighting deck and roaming spectator gallery; (4) Technical deck for access to retractable spotbars (for stage lighting) and adjustable acoustic panels. (5) Access to ablution facilities.

Fig. 6-152 Translucent flooring is used in the forum galleries at Merck Serono Headquarters and Research Centre designed by Murphy/Jahn Architects. (Image source: internet.)

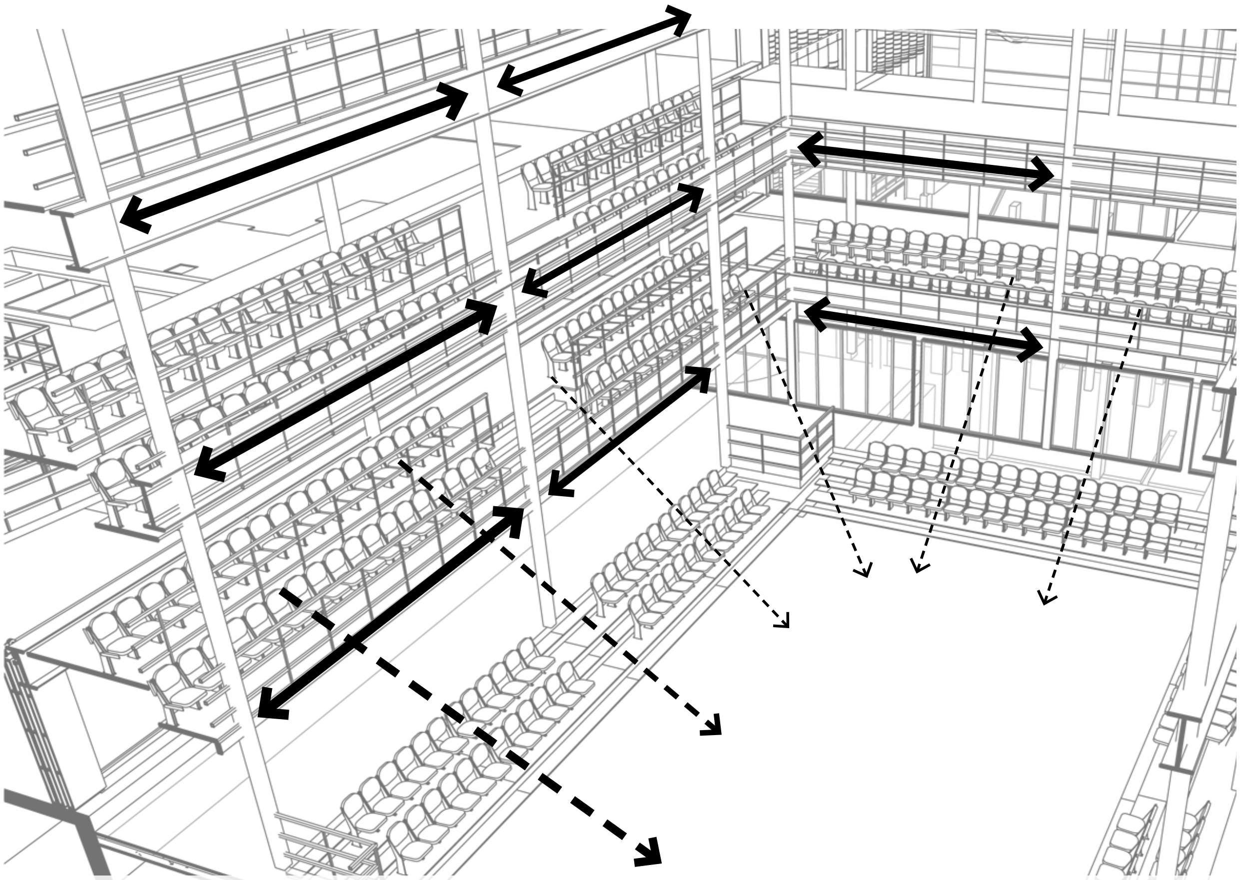


Fig. 6-154 The concept for the forum structure is to optimise the viewing capabilities of the spectator public. By using trusses that can span wide gaps, fewer columns can be used, meaning fewer viewing obstacles between spectators and actor. Columns are placed in line with stairwells, accordingly.

Fig. 6-153 Peter Seitowitz's residence utilises trusses on the galleries around its central atrium space. The use of trusses allows for spanning larger distances without the need of frequent intermediate columns, saving on materials and allowing clear views. (Image source: internet.)

Fig. 6-155 A simple truss constructed from steel rods threaded between bolted timber sections. A slender round steel section supports offers mid-span support. (Photo by author.)

6.2.3 Structure Build-Up Sequence

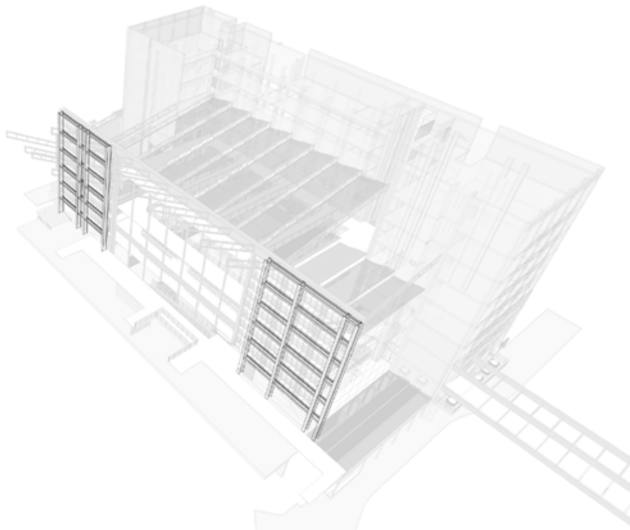


Fig. 6-156 Primary structure: vertical steel columns stiffened by horizontal channels.

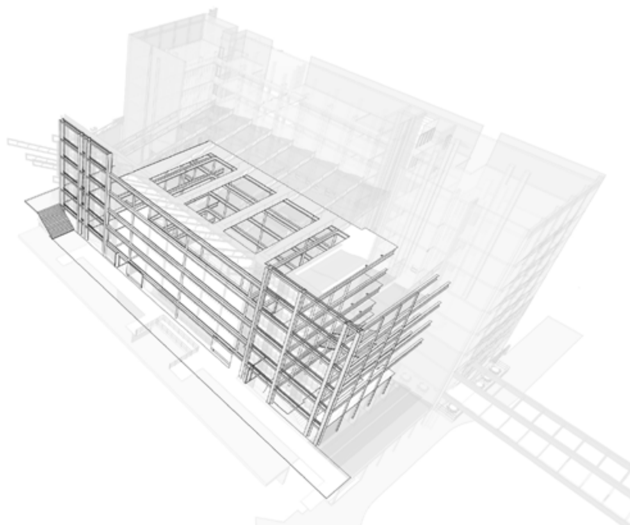


Fig. 6-157 Secondary structure plus floors: horizontal trusses tie the primary structure to the columns of the existing Govpret building. Floors provide stability for the secondary structure.

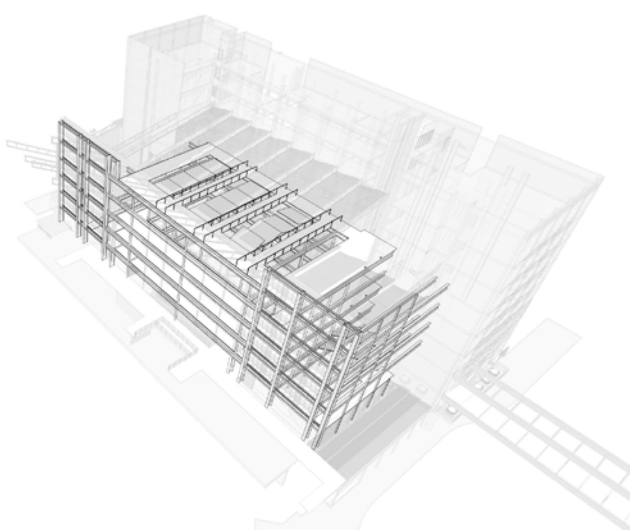


Fig. 6-158 Overhead acoustic panels suspended from steel trusses.

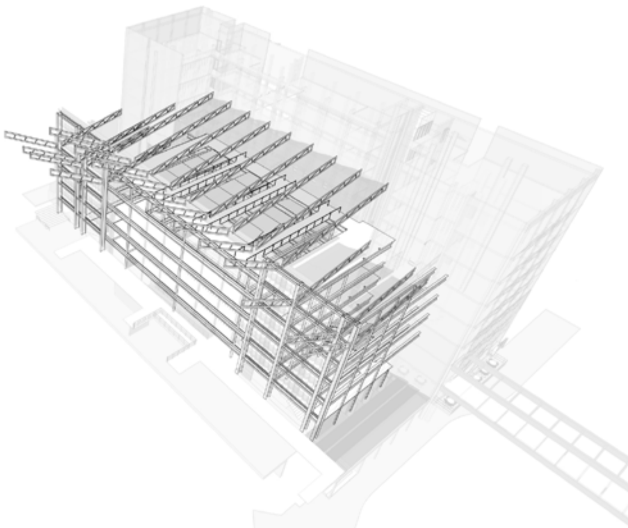


Fig. 6-159 Roof structure: the primary structure supports the roof truss structure.

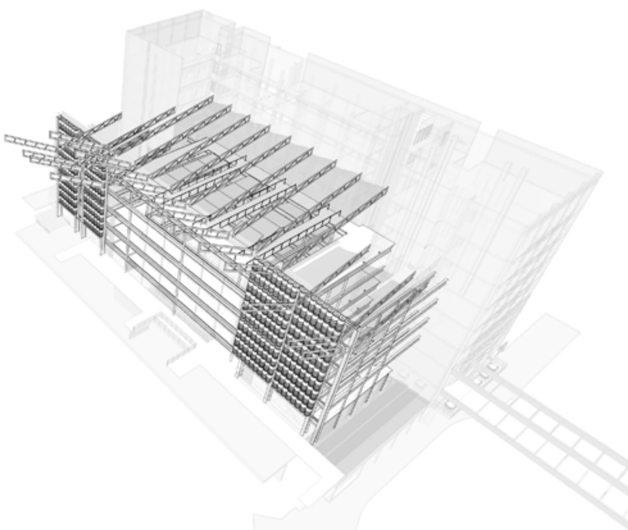


Fig. 6-160 Water tanks inserted into the northern and southern end sections of the primary structure.

6.3 Theatre Design

6.3.1 Introduction

In forum theatre, a drama will incorporate what Boal refers to as "simultaneous dramaturgy" (Boal, 1995:15), whereby the dramatic process can be halted and the spectators, or "spect-actors", are allowed to intervene and make suggestions as to how the drama should proceed:

- The play typically commences with a conventional story line, and usually with a realistic plot.
- At a point, the actor (protagonist) will encounter some or other socio-economic issue as an obstacle or form of oppression, at which point a critical decision will need to be made.
- The play will be halted.
- The spectators will be able to give their own opinions as to how the problem should be resolved, thereby becoming active participants in the dramatic process.

Forum theatre attempts to create opportunities for interactions and participation by audience members. This has certain implications for the design of a theatre that must do more than cater only for a one-way spectator experience. Easy accessibility to the stage becomes an important aspect to consider. The study will analyse aspects of theatre design in terms of audience participation.

6.3.2 Shape

Theatres are built in a wide variety of forms, chief amongst which are rectangular, square, polygonal, fan or horseshoe (Lord and Templeton, 1986:61).

For the purposes of this project, which deals with forum-based theatre, a rectangular shape was chosen above the other forms. Firstly, the rectilinear geometry of the site, together with its existing structures (the Govpret building), lends itself to a rectangular design. Both rectangles and squares are able to provide a higher degree of flexibility in seating arrangements when compared to other forms, but the smaller width of a rectangular space means that the audience are bought closer to the action on the stage. In a forum-based theatre that requires the participation of the audience, this will prove to be more beneficial in the long term.

6.3.3 Size

The theatre caters for 640 seated spectators. Circulation galleries are able to accommodate both seated and standing spectators.

Fig. 6-162 Forum theatre in the Theatro Oficina in Sãu Paulo. (Image source: internet.)

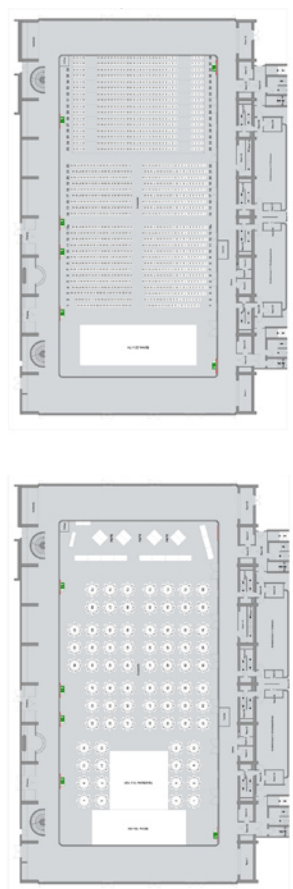


Fig. 6-161 The Europhalle has an adaptable layout which allows it to transform from a proscenium theatre into a banquet hall with a thrust stage. (Image source: internet).

6.3.4 Seating Arrangements

The theatre is intended as a venue for forum theatre, musical concerts, expos, talent shows and exhibitions. It therefore requires a great adaptability in its seating arrangements.

The majority of theatres employ conventional proscenium design (see Capitol Theatre, Chapter 2), thrust stage or theatre-in-the-round seating arrangements. This design focuses mainly on the latter two, which are better suited to the participatory nature of forum-based theatre, whereby spectators surround the acting area on more than one side.

From the wide spectrum of available products, a mobile retractable system was chosen for its mobility and adaptability. The system is composed of retractable risers that fold up into a rostra supported on a wheeled base. Rostras can be repositioned for different types of performances, and can be stored neatly underneath the floors surrounding the stage area.

The provision of upholstered seating for comfortable viewing is a standard expectation in contemporary theatres (Lord and Templeton, 1986:62). Not only does upholstered seating provide a higher level of comfort than conventional seating, but it also provides a certain degree of sound absorption.

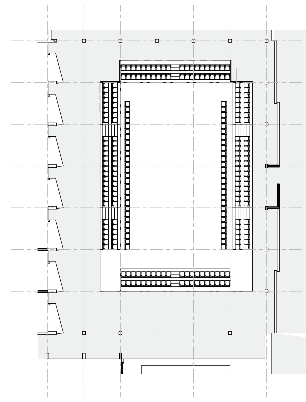


Fig. 6-164 Theatre-in-the-round

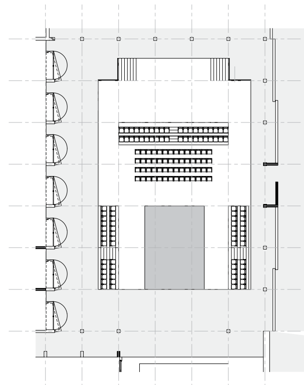


Fig. 6-165 Thrust Stage

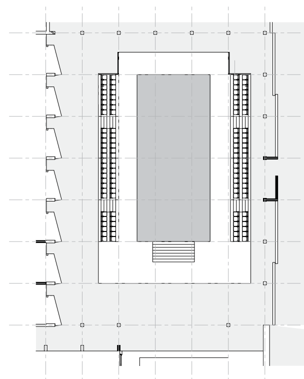


Fig. 6-166 Transverse Stage

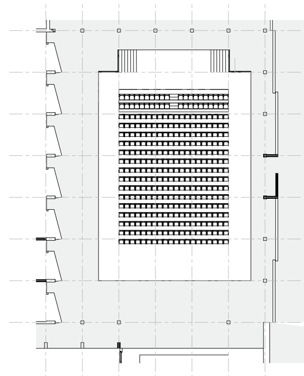


Fig. 6-163 End-stage

Fig. 6-167 Lina Bo Bardi's Theatro Oficina, is a forum-based theatre in Sau Paulo that occupies an old service pit. The narrow shape of the led to the installation of vertical scaffolding with bench seating. It is an example of the kind of informal occupation that theatre is able to make. (Photo courtesy of Anne Graupner.)

6.3.5 Sound Reinforcement

The main aim of sound reinforcement in theatres for drama is the transmission quality of vocal sound from actors to spectators. According to Lord and Templeton, "it is becoming rarer to hear, in public performances, the human voice… unaided by some form of sound reinforcement" (Lord and Templeton, 1986: 72). This is primarily due to the advent of television and the consequent demand that a show be a "live" version of its broadcast equivalent (*ibid.*).

The main form that vocal reinforcement takes is the use of live microphones and amplification. This can be beneficial for performances where sound needs to reach a large number of spectators. However, it also means that theatre loses its intimate scale that contributes to its "immediacy of presence" (Lord and Templeton, 1986:73).

Intimacy and immediacy of presence are essential parts of the participatory process and dramatic experience. However, as a multipurpose venue, the theatre also needs to be able to be adapted for performance scenarios that might require amplification.

The instalment of speech amplification makes the theatre vulnerable to unwanted reverberation behaviour, such as regenerative reverberation. This requires that the overall reverberation during these performances be reduced by around 10-15 per cent (*ibid.*). To facilitate this change in reverberation characteristics, the design utilises a combination of mechanisms. The optimum reverberation time (RT) for a theatre such as that envisaged for the current project is recommended at around 1.4 seconds for the hall when empty.

- Bass traps built into theatre school benches

Quarter-wavelength bass traps constructed out of bass-resonant low-density insulation wool will aid in mitigating low-level frequencies from speaker systems. These traps have been built into the low bench walls along the Tram-Theatre school ground level facade. The walls act as backing that is necessary for the functionality of the bass traps.

- Swivelling panels mounted on theatre school benches

The old shop front design of the Tram-Theatre school serves as a blueprint for the forms of the new adjustable acoustic panels. These are mounted onto the same benches as the bass trap installations. The acoustic treatments on either side of the panels vary to suit different acoustic requirements: reflection and absorption. The panel is rotated until the corresponding side faces the stage area. The more absorbent side is constructed of perforated plywood and mineral wool filling, and aids in mitigating medium- to low-frequency sounds. The opposite side functions as a vocal reflector, and comprises a smooth surface without any perforations. It is constructed of a painted phenolic bonded exterior grade plywood.

- Hangar doors filled with absorptive filling

The hangar doors incorporate unperforated, slotted plywood panels with a 25 mm mineral wool fibre filling to absorb medium-to low-frequency sounds, while simultaneously preserving higher frequency sounds that are important for preserving vocal intelligibility from the stage.

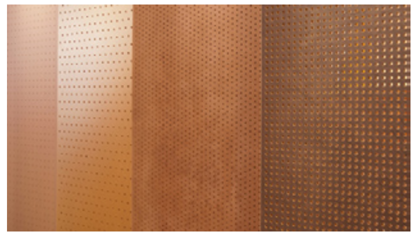


Fig. 6-170 Perforated plywood screens in a variety of warm hues.

Fig. 6-169 Slotted plywood panels used on the hangar doors, end screens and swiveling panels.

Fig. 6-168 Cavity batt sound insulation installed behind plywood screens to absorb low- to medium frequency sounds during amplified performances.

The following characteristics of plywood make it an appropriate choice for the theatre's design:

- Renewability
- Natural aesthetic qualities (plywood has a warm natural colour which contributes to a comfortable public atmosphere.)
- Versatility (plywood can be molded into the desired shapes.)
- Durability (plywood is long-lasting and low in maintenance).
- Efficiency (more of the tree is used when manufacturing plywood)
- Strength (plywood is stronger than steel by weight, making it structural).

- Adjustable overhead panels

These have been loosely modelled on the reflection panels used in the Europahalle in Castrop-Rauxel, Germany, designed by Dissing and Weitling. The panels aid in reflecting early reflections (the first few reflected sounds off immediate surfaces) from vocal and instrumental sources from the stage, and are constructed of 12 mm thick exterior grade plywood with gypsum plaster backing (Lord and Templeton, 1986:134). This results in a lightweight construction that can easily be suspended above the audience. The current project will adopt an automated rotating mechanism which will allow the panels to rest in the open vertical position. In this way, the filtration of natural light will be unimpeded during most of the theatre's uses.

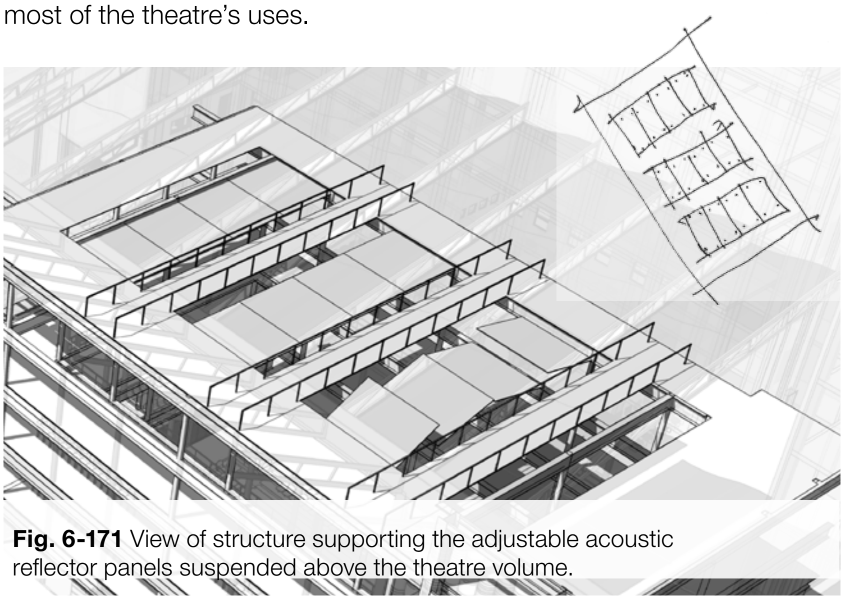


Fig. 6-171 View of structure supporting the adjustable acoustic reflector panels suspended above the theatre volume.

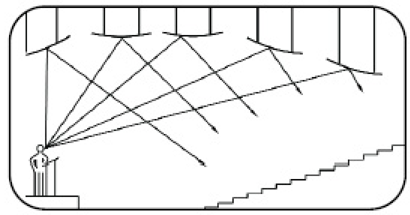


Fig. 6-173 Reflection pattern off overhead reflector panels. The desired effect is the reflection of early reflections which aid in voice intelligibility.

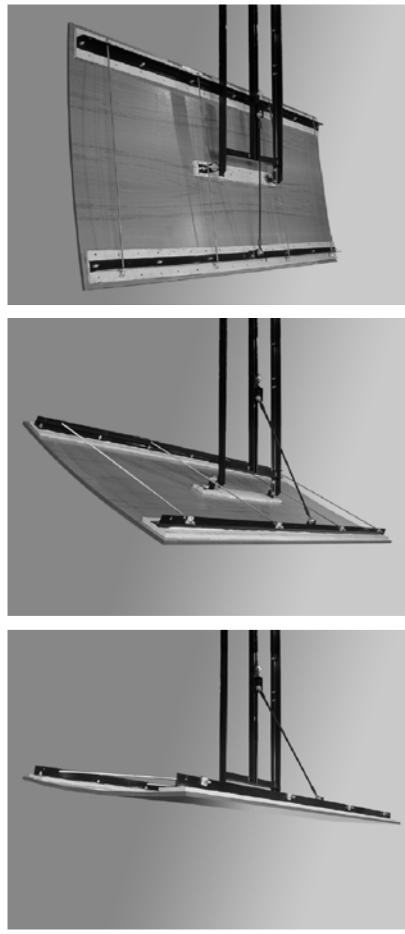


Fig. 6-172 Example of an adjustable acoustic reflector panel in different positions. (Image source: internet.)

- End separating screens

The end screens are placed at the northern and southern ends of the acting area and following a similar construction to the hangar doors.

- Upholstered seating

The upholstering in the seating around the stage provides additional sound insulation.

- Sprung floor for performances

Special sprung timber floors incorporating extra traction, acoustic insulation and elasticity have been specified for the stage area. High neoprene pads provide added bounce to the floor for dance performances, while minimising the intensity of impact noise.

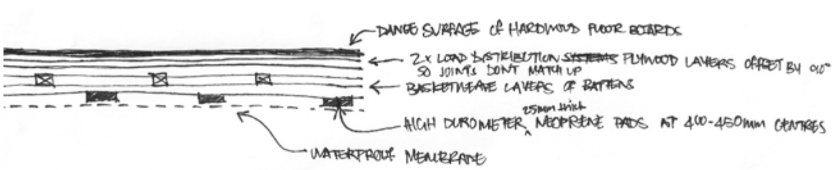
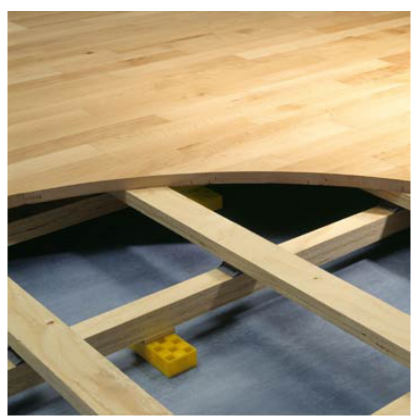


Fig. 6-175 Sprung floor detail sketch.

Fig. 6-174 (Right) Sprung floor: timber construction supported on neoprene pads.



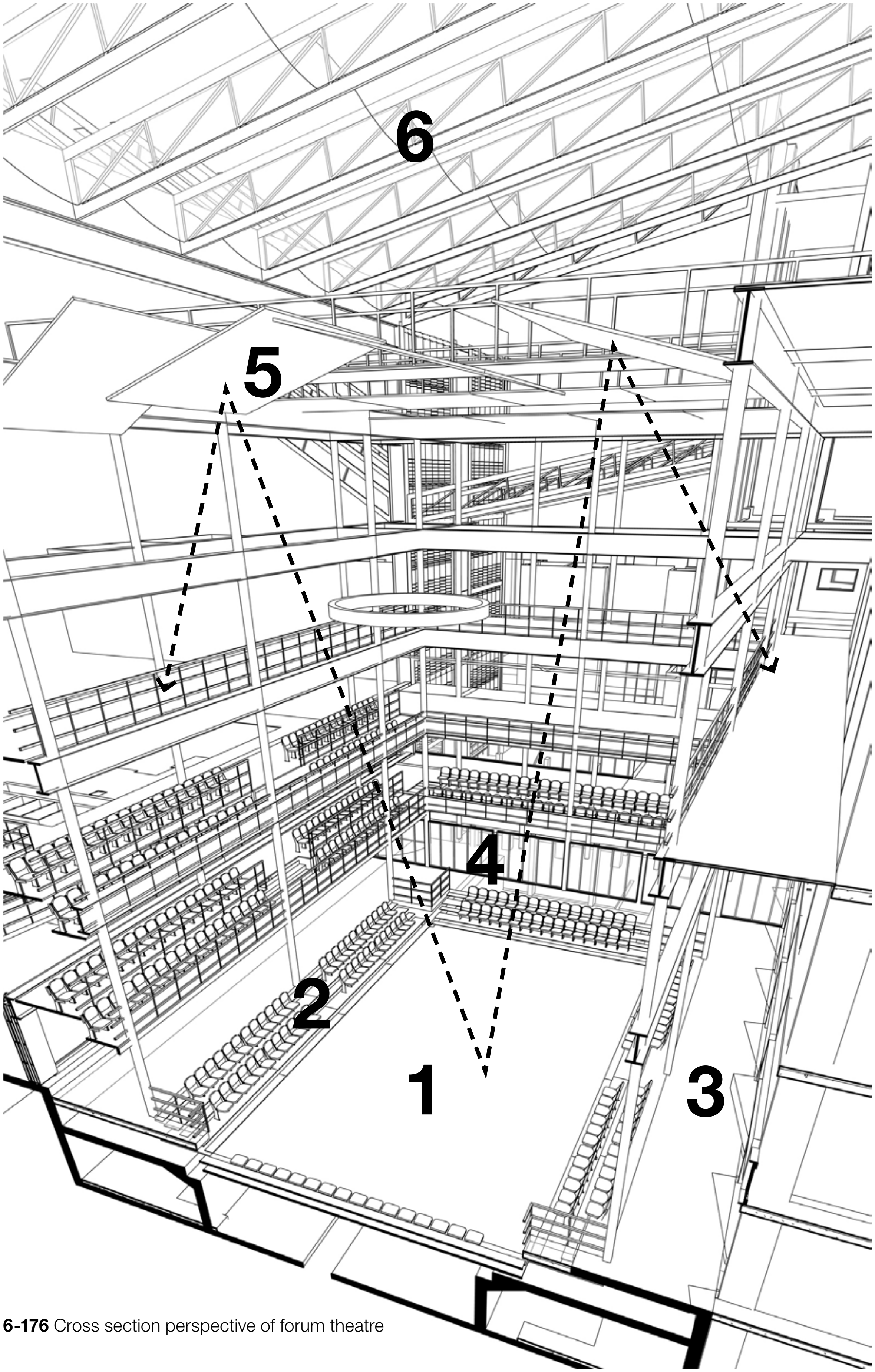


Fig. 6-176 Cross section perspective of forum theatre

1 Stage/acting area with sprung floor.

2 Upholstered seating with absorptive qualities.

3 Walkway and position of bass traps and rotating panels.

4 Slotted plywood end screens.

5 Unperforated plywood reflection panels.

6 Roof construction with double polycarbonate structure.

6.3.6 Additional Considerations

Contemporary theatres have started including a range of new features not offered by older theatres. The current design has attempted to accommodate some of these new elements, which include:

- The ability to record quality live performances

The high broadcasting demand for "live" recorded material has influenced many modern theatres to opt for theatre designs that cater for the recording of performances (Lord and Templeton, 1986:62). To facilitate on-site recording (and live broadcasting), appropriate control rooms and studios have been incorporated into the interface between the theatre school and the forum space. This location offers good visibility of the performances below, enhancing control. Situating media facilities in close proximity to each other also facilitates the production process.

The adaptable scale of the current theatre design allows for recording performances at a more intimate scale, enhancing recording quality. A typical scenario could be when an actor's voice needs to be recorded above the din of background noise. A more intimate scale makes this task easier than it would be in a larger theatre, with more unpredictable acoustics.

- "Democracy of Hearing Quality" throughout theatre (Lord and Templeton, 1986:62)

Modern theatres attempt to provide an equal experience to all audience members, unlike older theatres, which typically divided audiences into paying categories. This entails all audience members having equal access to the performance. Democracy and equality are also fundamental tenets of forum theatre, which tries to break down social barriers by giving spectators an equal voice, raising them to the status of active participants (actors).

- A comfortable cultural experience

The theatre aims to offer audiences with a high level of comfort while they experience the theatre. Support facilities such as restaurants, bars and galleries are accessible in close proximity to the theatre activity.

6.4 Natural Lighting

The structure is designed to control the amount of natural light that is allowed to enter the central volume. The greater proportion of this light enters through the overhead transparent polycarbonate roof, which mimics how other structures in the surrounding block deal with natural light.

Like glass, the clear polycarbonate used for the roofing material transmits a generous proportion of the available incidental light radiation (more than 85%) but only admits a small fraction of infrared radiation (heat).

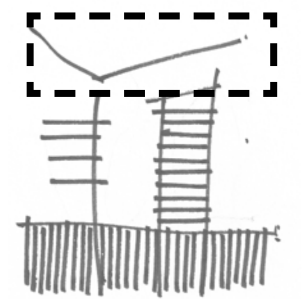


Fig. 6-181 Position of roof on parti diagram.

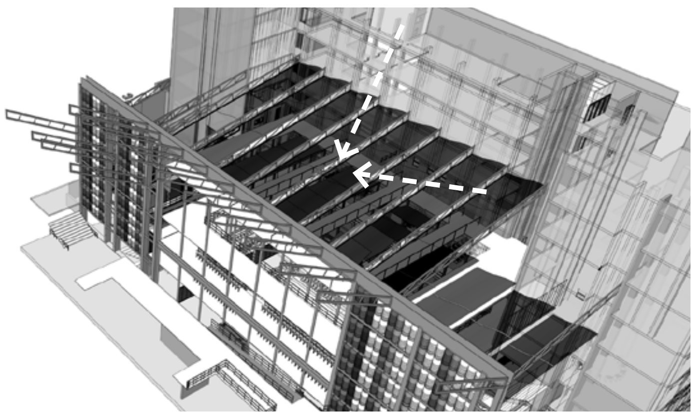


Fig. 6-180 Light filtering ceiling panels highlighted in dark. At this stage of the design, the aim was to explore a tensile system of larger S-panels. The decision was finally made to use a sturdy and durable material such as plywood that could be painted to reflect diffuse light into the central space during summer, and allow direct light to enter in winter.

Seasonal Lighting

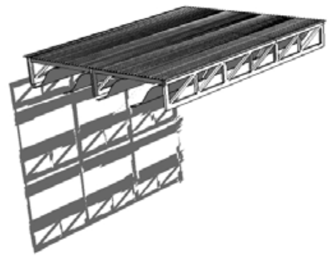


Fig. 6-177 Shadow cast by ceiling panels during winter solstice: 21 June. Angle of Incidence: 40.8°. Light is allowed to enter during the darker and colder periods of the year.

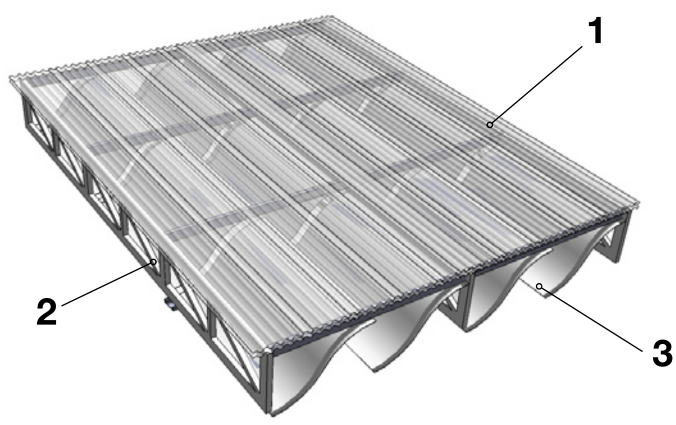


Fig. 6-179 Perspective of typical detail of a segment of the roof. (1) “Big six” translucent white polycarbonate (Opal 50) roof sheeting. A double layer is optional and useful for dampening impact noises caused by rain and hail; (2) Galvanised hot rolled steel truss; (3) 12 mm plywood ceiling panel formed into S-shape to control light.

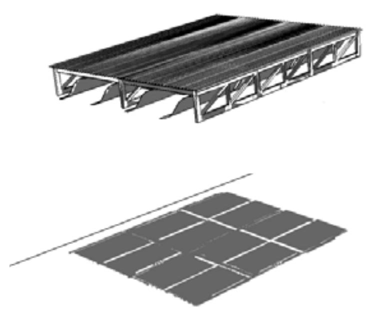


Fig. 6-178 Shadow cast by ceiling panels during summer solstice: 22 December. Angle of Incidence: 87.5°. Light is prevented from entering the main volume to excessive heating.

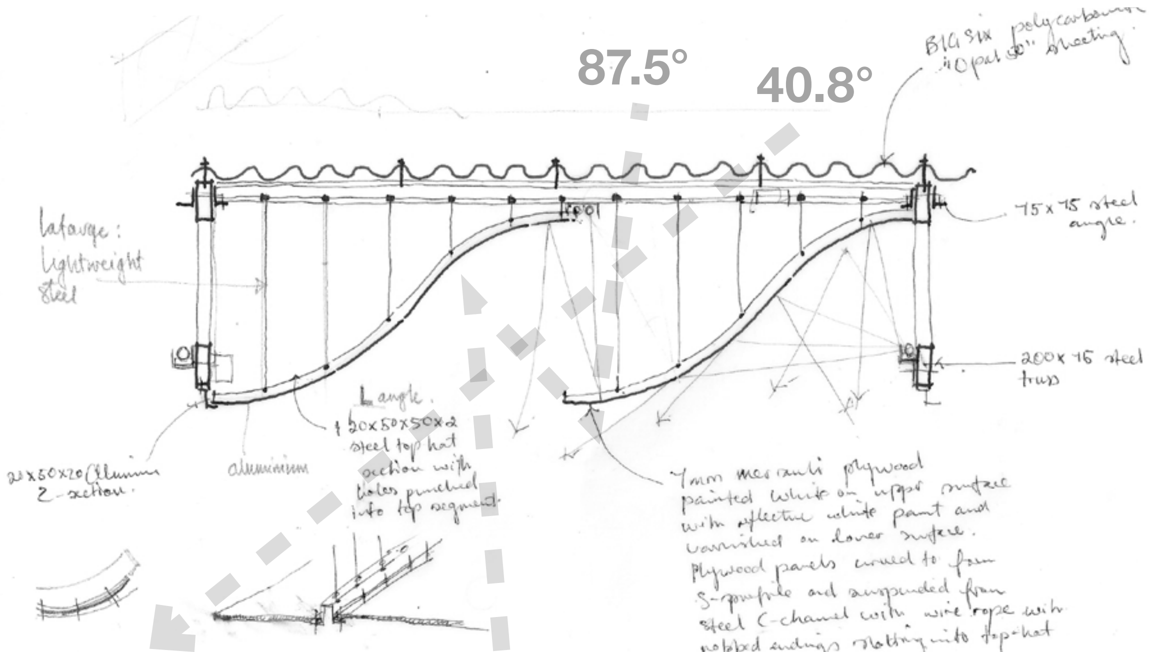


Fig. 6-182 Detail design sketch experimenting with seasonal light angles and profile shapes. Plywood panels are painted white on their upper sides to reflect direct light away during summer and create diffuse lighting.

The amount of light that enters the theatre volume is controlled via a retractable drape that moves across the theatre volume on rails. This facilitates the flexible use of the theatre, which at times needs to be blacked out completely for certain types of performances, e.g. shadow theatre. The greater proportion of this light enters through the overhead transparent polycarbonate roof, which mimics how other structures in the surrounding block deal with natural light.

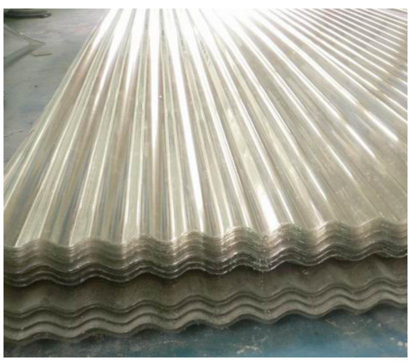


Fig. 6-186 Clear corrugated polycarbonate sheeting.

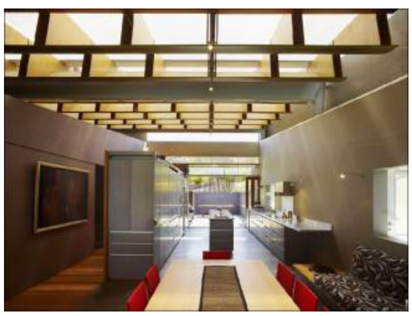


Fig. 6-183 Skylights in Peter Stutchbury's Outcrop House, Sydney, Australia. (Photo source: internet)

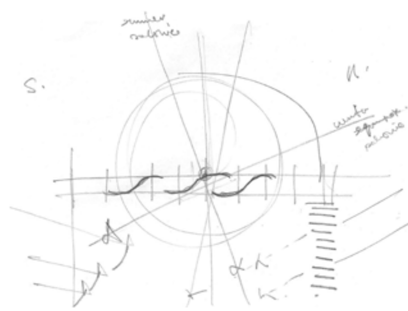


Fig. 6-185 Panel design sketch indicating sun angles and directions.

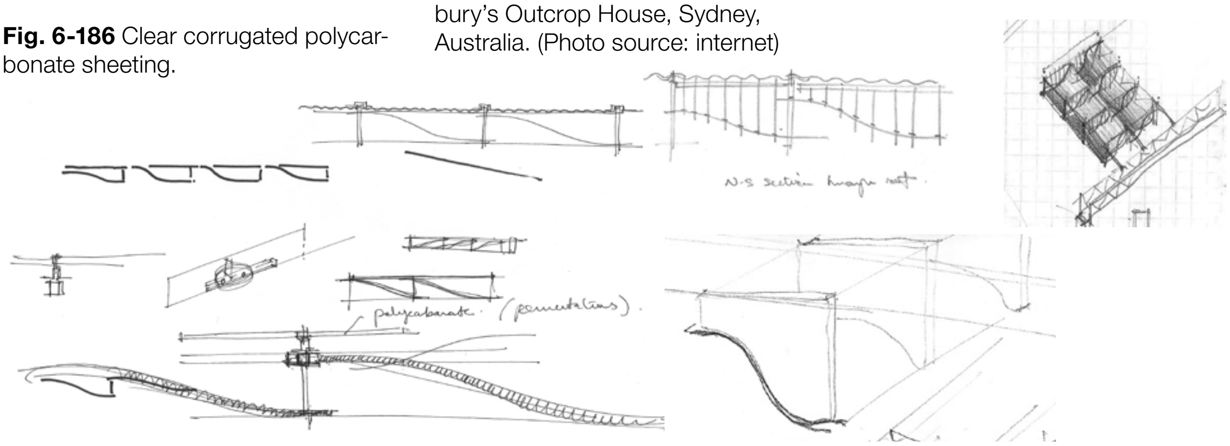


Fig. 6-184 Detail sketches of roof panel design.

6.5 Stage Lighting

6.5.1 Introduction

In response to the flat two-dimensional approach to stage lighting of the nineteenth century, Adolphe Appia proclaimed a new philosophy of stage lighting: Gestaltendes Licht. This was dramatic step forward that revolutionised stage lighting as a dynamic, three-dimensional "form revealing light", that could transmit to the audience the full emotion of the actors on the stage (Appia in Pilbrow, 1992:12).

Gestaltendes Licht brings into balance a dynamic interplay of two general lighting types: general indirect light, which Pilbrow likens to skylight or diffuse light, and directional light – analogous with sunlight (Pilbrow, 1992:12).

The interplay between these two types can be described in terms of colour, intensity distribution and movement, which in the right proportions can bring about effects demanded by the situation (ibid.).

Modern stage lighting aims to achieve the following four objectives that the lighting designer should always take into consideration when setting up:

- *Selective visibility* controls the ability of the audience to view the intended spectacle, and relates to the manner in which the objects of attention are illuminated to draw focus. Audience focus tends to be drawn to objects that are illuminated, as opposed to objects falling into shadow.

- *Revelation of form* implies the three-dimensional quality of modern day stage lighting, which does more than simply illuminate the stage. Rather, stage lighting involves a careful balance of light and shadow (shadow being the means by which three-dimensional objects are perceived in space).

- *Composition* involves how light is used to "paint" the stage, resulting in dramatic compositions and spectacular effects.

- *Mood* relates to how well the lighting designer is able to balance the first three properties to create a feeling or atmosphere that matches the content of the performance.

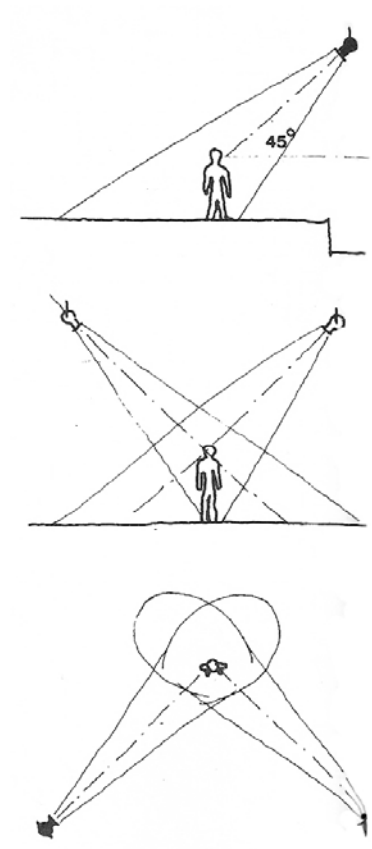


Fig. 6-187 Lighting the face of the actor. (Sketches by Richard Pilbrow).

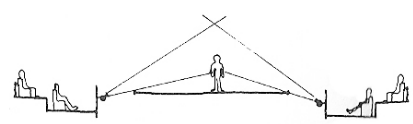


Fig. 6-188 Lighting the actor on a thrust stage using low-level lighting (Sketches by Richard Pilbrow).

6.5.2 Method of Stage Lighting

The objective of lighting is to reinforce the central idea or story of the performance, and to enable a perception of space around the actor in delivering the story (Pilbrow, 1992,30).
To efficiently light the acting area, a combination of multiple lights is necessary. Pilbrow has provided an outline of his personal approach to stage lighting:

1. *Dominant lighting:* this involves intentional lighting of the dramatic content on stage. In forum theatre, the lighting of actor's face is of primary importance.
2. *Lighting the acting area with secondary lights and rim-lights:* secondary lights provide the primary means of illuminating the acting area, especially when actors move out of the dominant zone. They tend to be complex in their arrangement and combine a wide variety of different lighting intensities, colours and distributions. Rim-lights are lights used to create dramatic effects, and are usually placed at the sides and rear of the actor. The further a source moves behind the actor, the more dramatic the effect and element of mystery become. Rim-lights will only be used in specific circumstances in the current project, because forum theatre generally focuses more on the content of the play and interaction with the audience, than on special effects and spectacles.
3. *Supplemetary acting areas*: these are areas that fall out of the general acting areas. In forum theatre, this could include audience seating areas. At times when actors exit the stage area to mingle amongst the audience , lighting will be required.

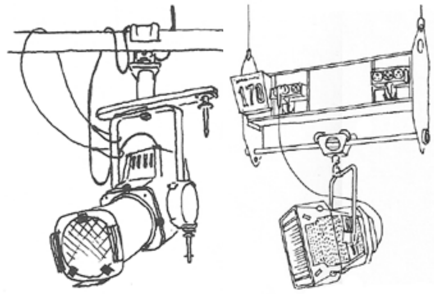


Fig. 6-189 Different attachment options: (left) A pole operated patt spot attached to a lighting boom; (right) A short TV-type spot bar. The aim is to lower these from the overhead technician decks (see image below). (Sketch by Richard Pilbrow.)

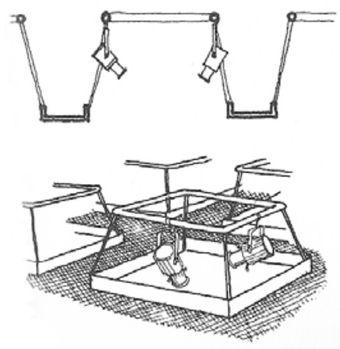


Fig. 6-190 Egg crate lighting grid. (Sketch by Richard Pilbrow.)

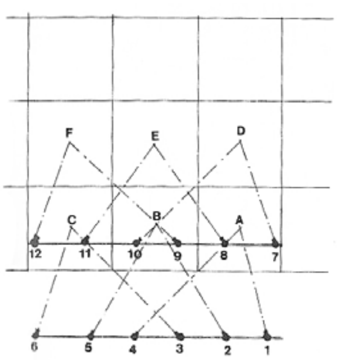


Fig. 6-192 Stage lighting of acting areas (Sketch by Richard Pilbrow).

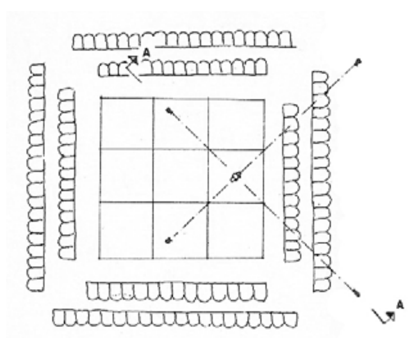


Fig. 6-191 Arena stage lighting (Sketch by Richard Pilbrow).

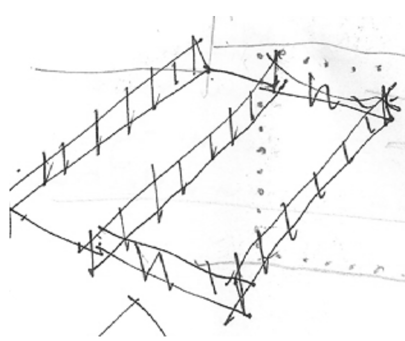


Fig. 6-193 The forum theatre utilises a similar concept for overhead access to lighting setups.

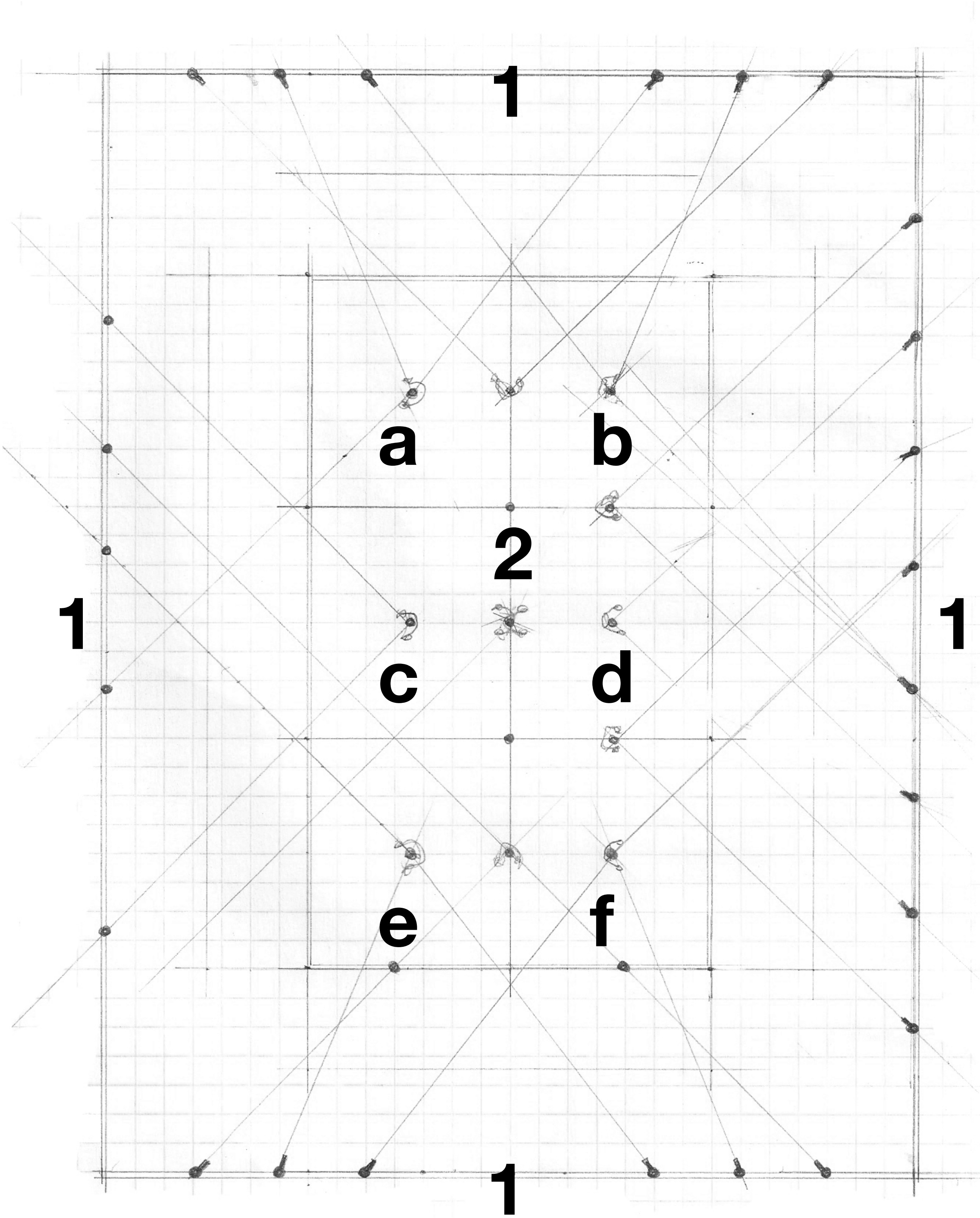


Fig. 6-194 The diagram illustrates how the method defined by Pilbrow has been used to position spotlights (1) to appropriately light the acting area (2). The main principle is to use a grid to divide the stage into smaller acting areas (a-f), which makes it easier to know where to locate the corresponding spotlights. The ideal angles for optimum actor lighting are 45° in the vertical plane and 45° in the horizontal plane. A minimum of two beams are required for adequate three-dimensional lighting.

6.5.3 Light Selection

The main consideration in the selection of stage light is the efficiency of the lantern model, and the intended use of the light. Modern developments in LED lighting technology have introduced models that incorporate greater functionality. Special lighting effects that previously relied on combinations of many different luminaire types can now be realised using individual, highly sophisticated LED units, with digital interfaces. The multi-functionality and efficiency of LEDs make them an appropriate choice in the context of the current demand for sustainable building solutions. LEDs form the sustainable component of the conventional stage lighting setup for this project.

The design makes the following recommendation for stage lighting:

- Spotlights: these form the static component of the theatre's dominant lighting, and will be placed in fixed locations. The lighting designer will control these from a central lighting control desk that is mobile. The project recommends the theatre use the following spotlight models: the *Philips Selecon "Arena" 4.5° – 60° PC Spotlight*, which offers crisp-edged beams and is intended for long-throw distances suited to the large volume of the theatre space; the *Philips Selecon "Rama" 175 HP 80V Fresnel Spotlight*, with a soft-edged beam and intended for medium-throw distances. These will be attached to overhead lighting booms and side gallery trusses. For colour spotlighting, a high output *Philips Selecon PL1 LED Luminaire* is recommended. This spotlight offers precise focus and mixable colour profiles without changes in intensity, which can be useful for creating dramatic stage effects.

- Follow spots: these form the dynamic component of the theatre's dominant lighting and can be moved to different locations. They are manually operated. A possible model could be the *Philips Selecon Pacific 7.5° – 19° Followspot*.

- LED colour wash and variable beam luminaires including tuneable whitewash will be used for both dominant and secondary lighting applications. A recommended model for colour washing is the *Philips Selecon PL RGB Floodlight*, which provides a wide variety of colours. For white washing, the design recommends the *Philips Selecon PL White Floodlight*, which offers different tones of temperature.

- HMI lights are used to mimic natural lighting in interior environments, and are typically chosen for TV and film lighting. For the purpose of delivering broadcast quality theatre, these lights will be used. Recommended lamp model: a high efficiency model such as the *Osram HMI 18000 W/SE/GX51*.

- Suspended LED house lights. This is a custom feature of the design and will provide centralised house lighting in the form of a suspended chandelier.

Fig. 6-195 Philips Selecon "Arena" 4.5° – 60° PC spotlight.

Fig. 6-196 Philips Selecon PL1 LED Luminaire.

Fig. 6-197 Philips Selecon Pacific 7.5° – 19° Followspot.

Fig. 6-198 Philips Selecon PL RGB Floodlight.

6.6 Ventilation

The main consideration for ventilation is the prevention of the build-up of excessive heat in the main theatre volume. The main process behind this build-up is the greenhouse effect, whereby material surfaces are heated up and radiate heat back into the space. This longer-wave radiation is unable to escape and creates an uncomfortable interior environment.

The near consistent shading of the site probably means that excessive heat build up will not pose a serious problem for this specific design. However, to prevent the build-up of excessive heat, the design relies on a process of passive ventilation to remove heated air from the theatre volume. This process combines the stack effect created by rising warm air, with the sloped inclination of the roof, to generate a thermal movement towards the top section of the volume, where an escape valve allows it to escape (see diagram).

The suction created by this process serves to remove stale air from the theatre volume, which would otherwise result in poor air quality. Fresh, ducted air supplied to outlets around the stage area and seating is drawn out, replacing the stale air above it.

The heat generated by the wide array of stage lighting also contributes to the heat stack effect. For instance, the average Fresnel spot lantern uses between 500 and 2000 Watts of electricity. A large percentage of this is lost as heat energy.

Lastly, the heat generated by theatre spectators will make a considerable contribution to the heat stack effect.

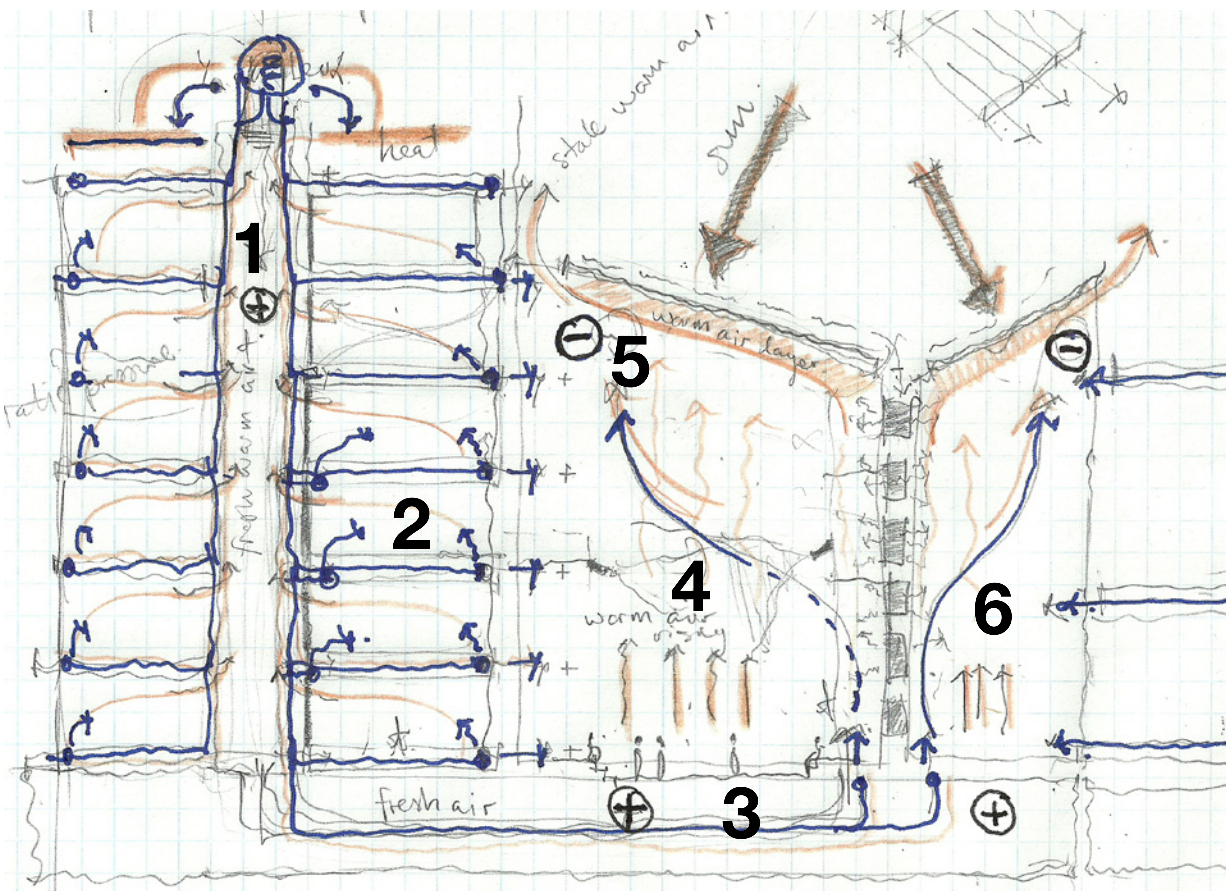


Fig. 6-199 VENTILATION CONCEPT SKETCH: cooled fresh air is vented under high pressure down the Govpret (1), into plenum floors with outlets on the Govpret facade (2) and into the basement level underneath the stage (3). The heat stack effect created by heat from solar radiation, electrical equipment and people (4), creates a negative pressure at the top end of the theatre volume (5). This pulls the fresh air out of the basement level and into the theatre. The same process serves to cool and ventilate the pedestrian corridor (6).

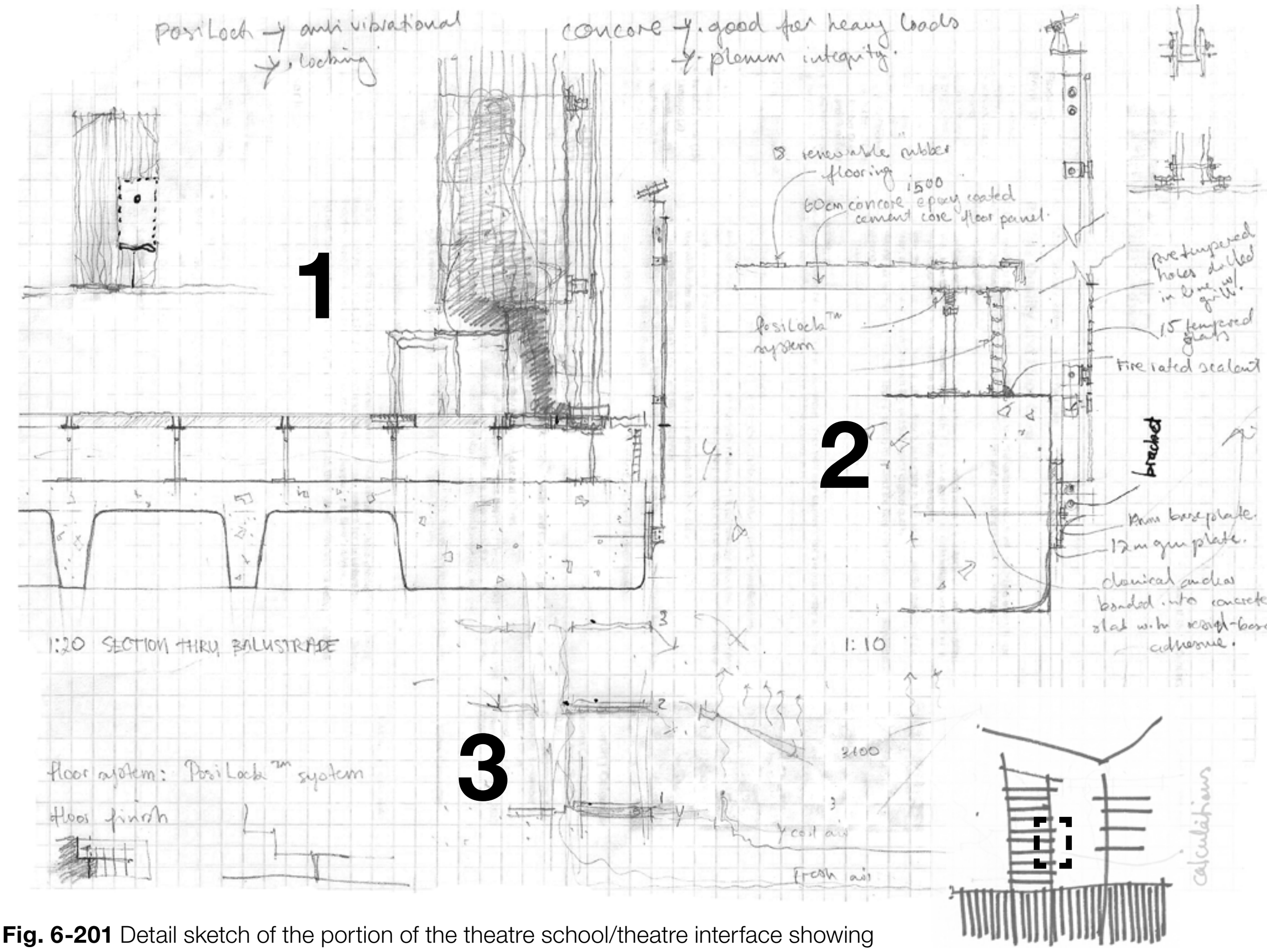


Fig. 6-203 Position of detail on parti diagram

Fig. 6-201 Detail sketch of the portion of the theatre school/theatre interface showing elements of the proposed ventilation strategy: (1) Section through new plenum floor built on existing concrete slab, with adaptable seating and balustrade; (2) Close-up detail section of plenum floor outlet and balustrade; (3) Spatial heating and ventilation concept sketch.

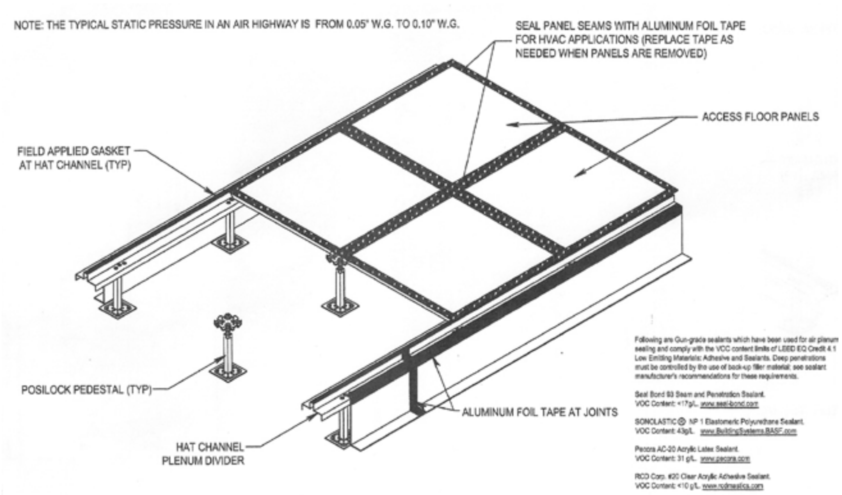


Fig. 6-200 Typical construction of a sealed posi-lock plenum floor that provides a static air highway between the theatre school light shaft and exterior interface.

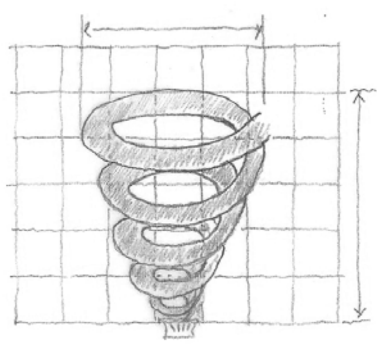


Fig. 6-202 Helix distribution pattern of fresh cool air from plenum floor outlet.

6.7 Rainwater harvesting

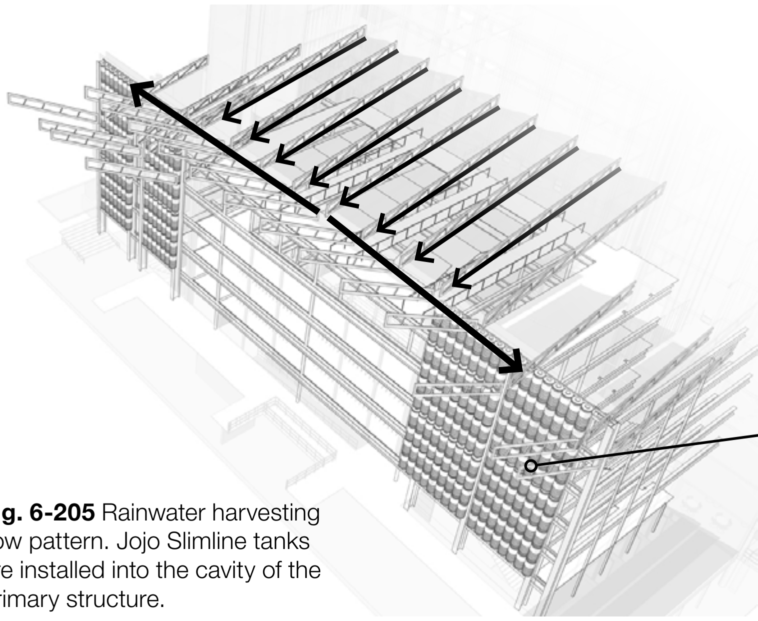


Fig. 6-205 Rainwater harvesting flow pattern. Jojo Slimline tanks are installed into the cavity of the primary structure.

Fig. 6-204 Jojo Slimline tank.

6.7.1 Rainwater Harvesting Calculations

Average monthly rainfall for Pretoria (mm):

January	122	July	10
February	106	August	10
March	91	September	21
April	33	October	60
May	22	November	117
June	6	December	117

(Source: http://www.climatetemp.info/south-africa/pretoria.html)

General Water consumption:
Sinks: 24L/person/day
Dishwashers: 8L/person/day
Basins: 5L/person/day
Showers: 56-80L/person/day
Toilets: 5x5L/person/day

Population to be served with rainwater:
Main theatre: 400 people (water needs: toilets in public bathrooms)
Studio theatre: 120 people (water needs: toilets in public bathrooms)
Vendors: 20 people (water needs: toilets in public bathrooms)

Daily consumption (toilet use) provided for:
400x5L= 2000L
120x5L = 600L
20x5L=100L
Total=2700L/day
=81000L/month

Rainwater availability:
runoff=A x (rainfall-B) x roof area
Vt=Vt-1 + runoff-demand

runoff jan= 0.85(122-2)x1215.5=123981
runoff feb=0.85(106-2)x1215.5=107450
runoff march=0.85(91-2)x1215.5=91953
runoff april=0.85(33-2)x1215.5=32028
runoff may =0.85(22-2)x1215.5=20664
runoff june=0.85(6-2)x1215.5=4133
runoff july=0.85(10-2)x1215.5=8265
runoff aug=0.85(10-2)x1215.5=8265
runoff sept=0.85(21-2)x1215.5=19630
runoff oct=0.85(60-2)x1215.5=59924
runoff nov=0.85(117-2)x1215.5=118815
runoff dec=0.85(117-2)x1215.5=118815

Vt nov=0+118815-81000=37815
Vt dec=37815+118815-81000=75630
Vt jan=75630+123981-81000=118611

Vt feb=118611+107450-81000=145061
Vt march=145061+91953-81000=156014
Vt april=156014+32028-81000=107042
Vt may=107042+20664-81000=46706
Vt june=46706+4133-81000=0

Rainwater supply is self sufficient for toilet water supply from November to May (7 of 12 months)
The rainwater supply is also adequate for the above 7 months to supply 9000L of water for fire protection purposes.

Between June and October the rainwater stores will have to be supplemented with the municipal water supply.

Fire protection water requirements (as per SABS 0400-1990 part TT37.4 & 37.5):
9000L water storage above building's highest level
1 portable fire extinguisher per 200sq m. Therefore 20 fire extinguishers required for 4000sq m.
(20x9L water-type extinguishers or 20x4.5kg dry chemical type)

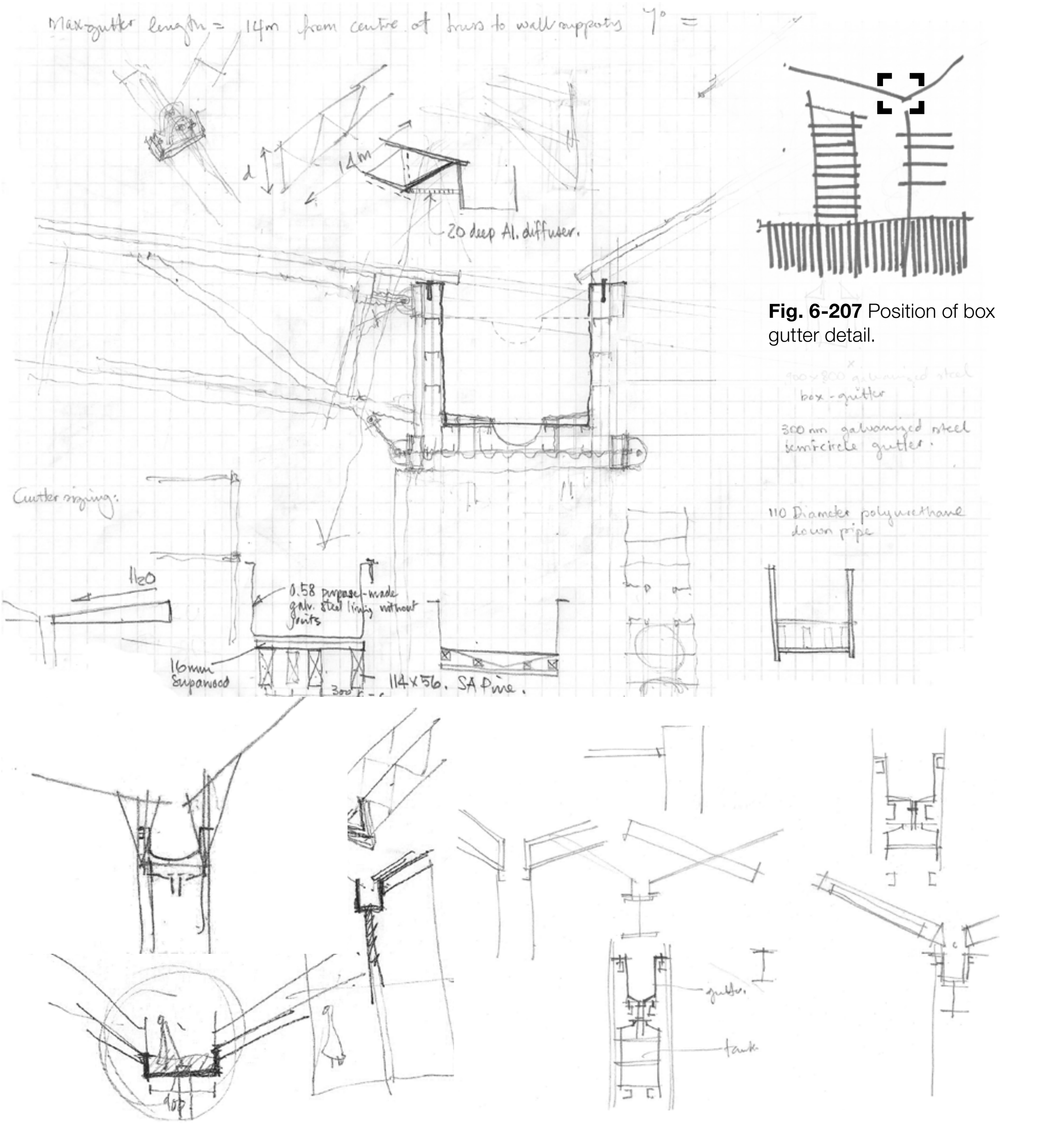


Fig. 6-207 Position of box gutter detail.

Fig. 6-206 Box gutter detail design sketches. The box-gutter lining is made from 0.58 galvanised steel lining on a 16mm supawood base nailed to 114x76 SA pine timber sections.