UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

technical investigation

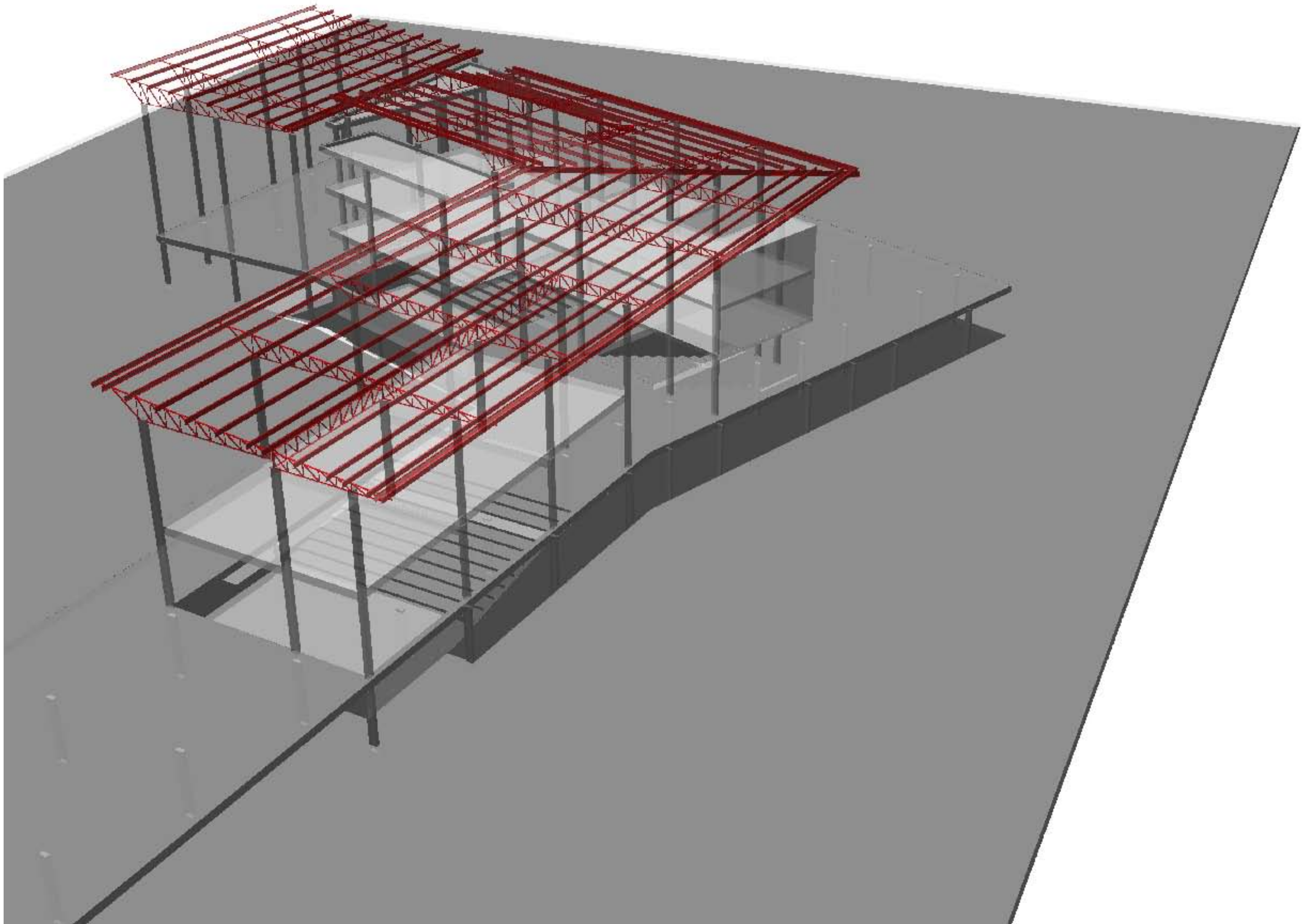
tectonic and stereotomic elements

Gottfried Semper distinguished structural elements as either lightweight tectonics of the frame or heavy stereotomics of the earthwork. The tectonic signifies lightweight linear components assembled to embody a spatial matrix, while the stereotomic is framed out of the repetitious stacking of heavy-weight elements to generate volume. In German, tectonic or 'Die wand', indicates a screen-like woven fabric while stereotomic, or 'Die mauer', signifies massive fortification (Edwards, 2004).

The word 'tectonic' originates from the Greek 'tekton' which means carpenter or builder. Therefore, tectonic signifies the "fusion of technique with art, of construction with poetry" (Lecuyer, 2001:15), as when the potential of construction and material is explored beyond their structural purpose. The art of construction becomes expressive.

The technical investigation addresses these two components and reflects the reality of changing technologies and social behaviours.

Figure 163: Structural model of the proposed building.



Stereotomic

A concrete structure was selected to serve as load-bearing component.

The building structure originates in the basement. Due to the shallow ground water level in Pretoria, a tanked basement system is employed to withstand horizontal and vertical ground water pressure. Storm water penetration or water entering the basement through ventilation louvres can be drained by mechanical sumps. Ventilation shafts, located at strategic points, introduce fresh air and ensure cross ventilation at basement level.

From the entrance, the basement slopes to gain the required depth to accommodate the cinema and lecture rooms which step down from ground floor level. Once clear of the above obstructions, the basement floor slopes upwards to minimize excavation costs. The extra ceiling height created in the centre allows for a suspended steel-frame mezzanine used for air-conditioning and services.

A column grid of 8.5m x 8.5m with alternating 4.5m intervals is determined by the need for an economic parking layout at basement level, as well as by the wide unsupported spans required by the cinema and lecture rooms. A waffle slab, with a minimum depth of 85mm and a maximum depth of 510m, is used to accommodate the wide spans. Where columns are removed in the cinema and lecture rooms, a 1m deep concrete beam is introduced.

Figure 164: Structural model of the lecture room.

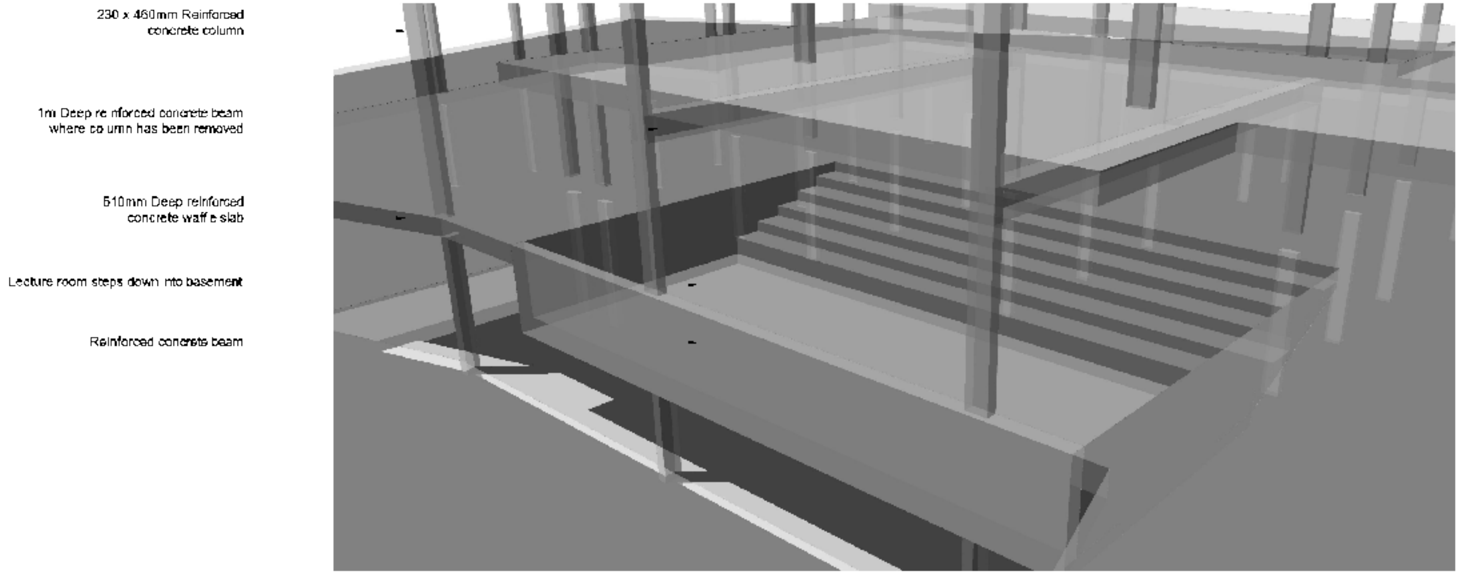
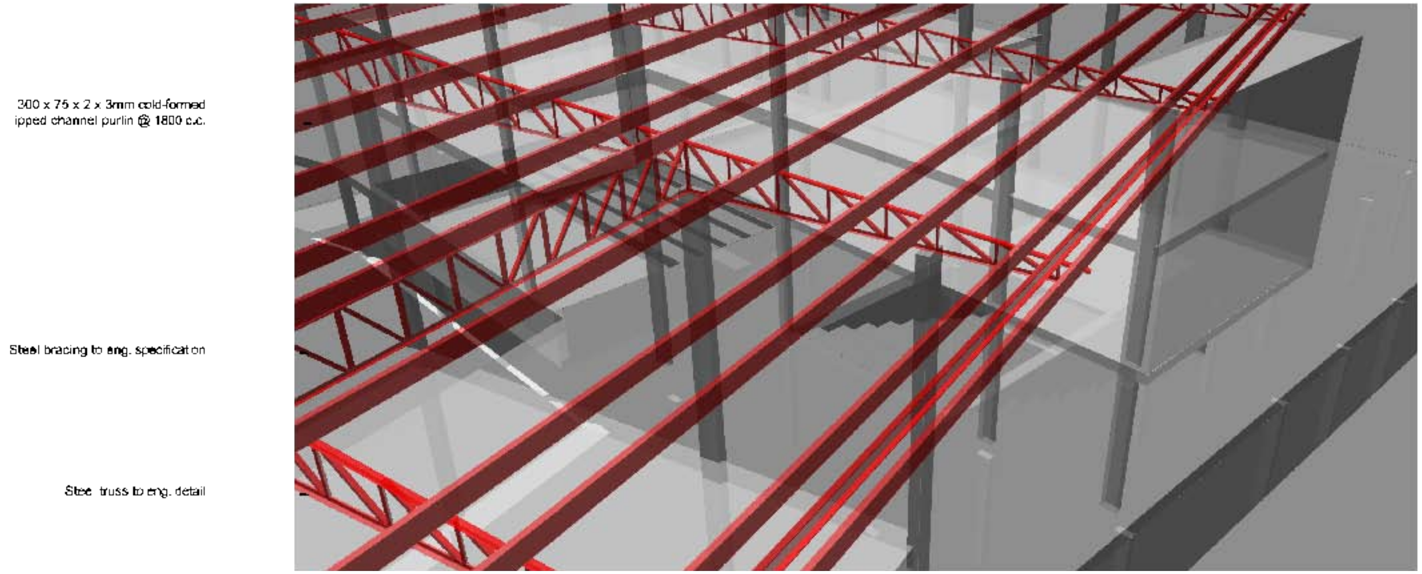


Figure 165: Structural model of the steel roof assembly.



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

A vertical service core concentrates the building's utilities along the western façade. According to Dr. Ken Yeang's principles, core functions should be located on the warmer, western side of the building to act as a thermal buffer protecting the climate controlled eastern side from the sun (Walczak, 1998). These services include an elevator, staircase and lavatories. Telephone and electricity ducts are located on each floor and connected to horizontal service spines placed underneath the walkway. Suspended floors and ceilings accommodate flexible studio spaces and house cables and ducting.

The steel roof structure includes 300mm deep purlins to span the required 8.5m length between trusses. Klip-lok roof sheeting is laid on top of the purlins.

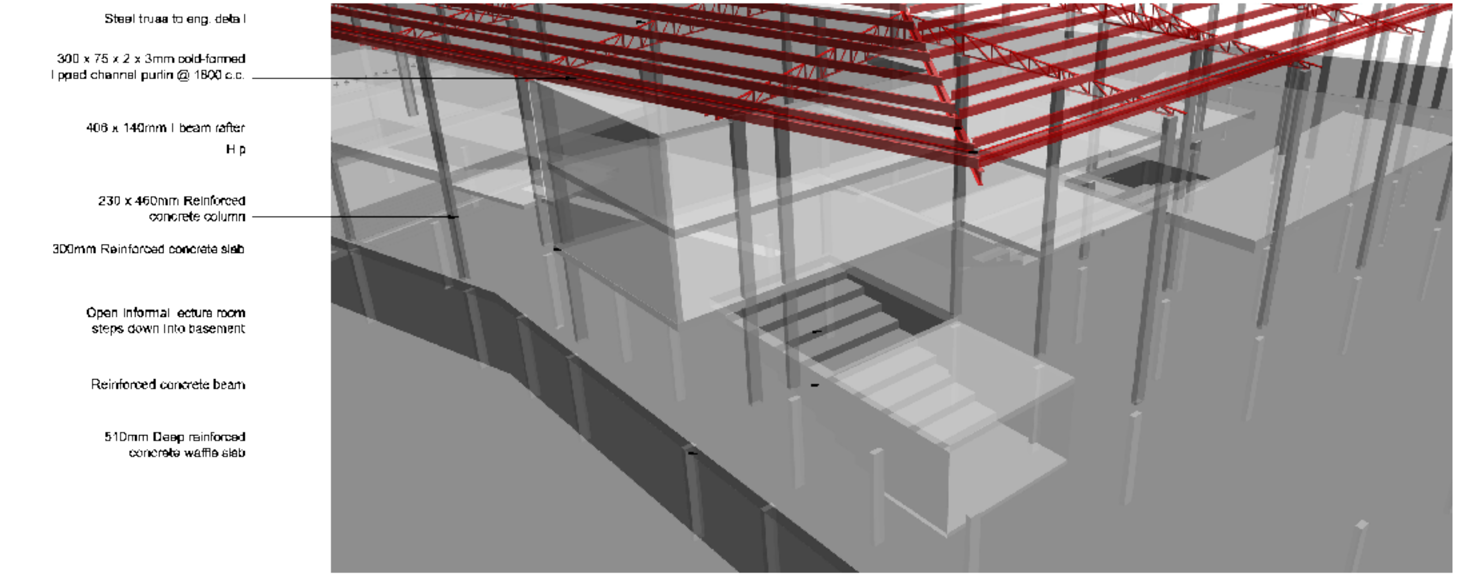


Figure 166: Structural model of the concrete frame.

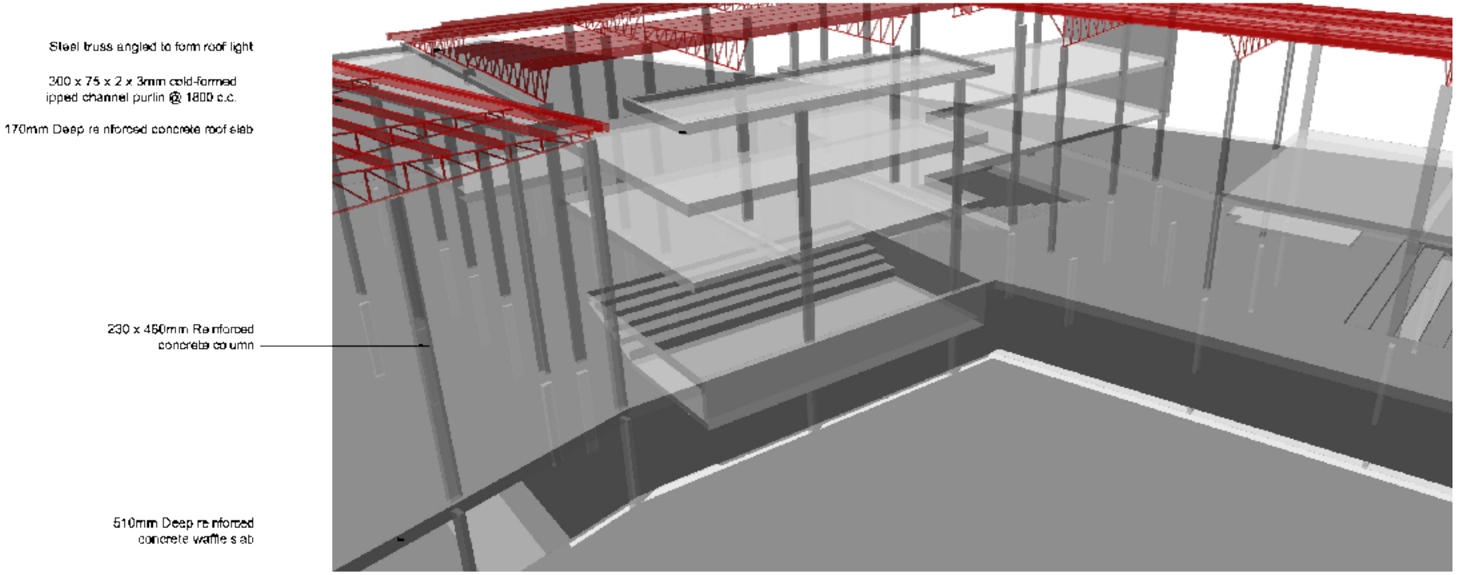


Figure 167: Structural model of the floor slabs.

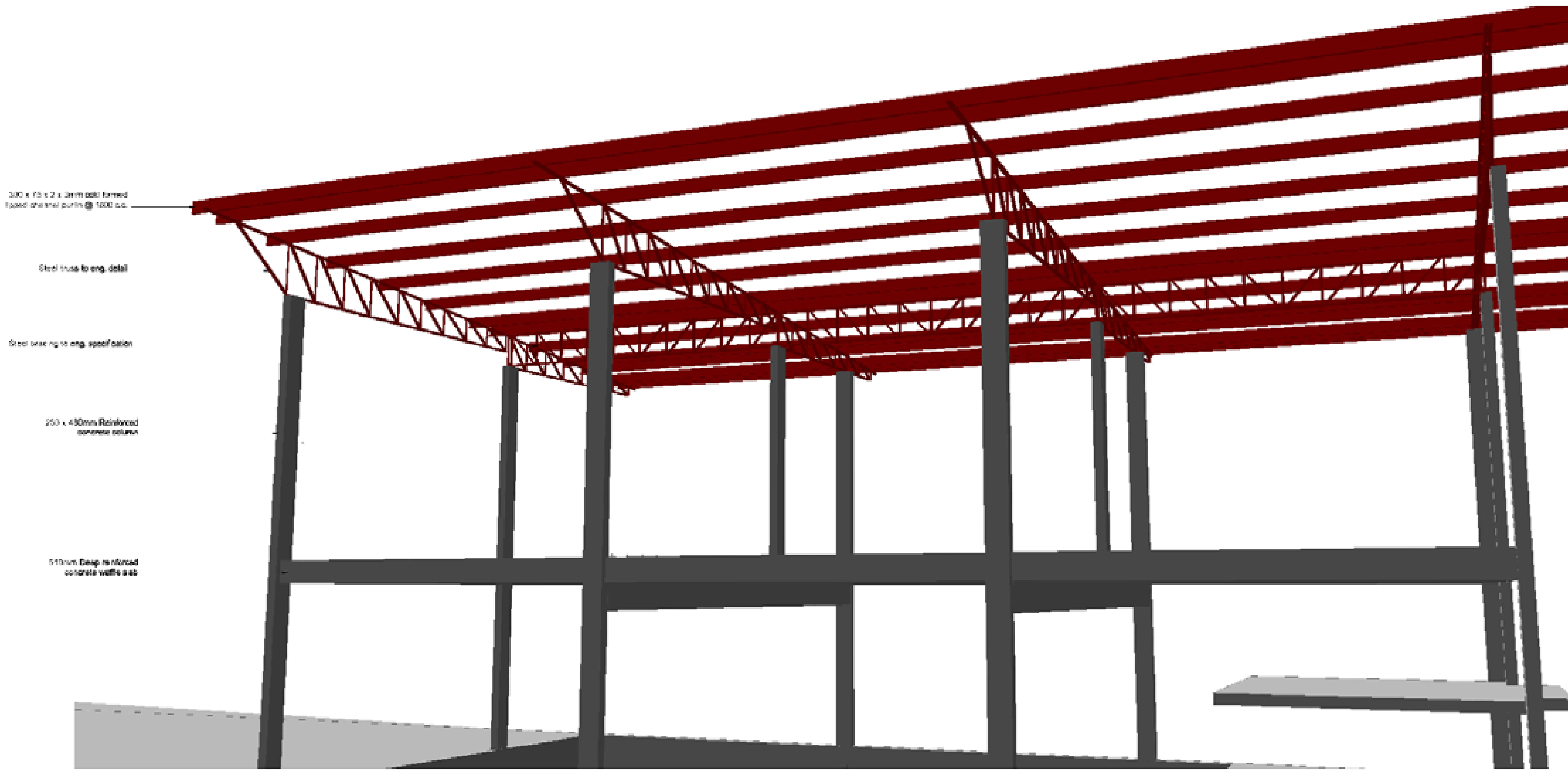


Figure 168: Structural model.

Figure 169: Eawag Forum Chriesbach.

Envelope

The northern façade is designed to be interactive. Louvres are used to assist internal glare control and regulate climatic factors including lighting, ventilation, sound insulation and energy gain. By pulling the skin away from the building a cavity is created and the skin acts as a double envelope system. Double envelopes can be defined as “multiple-leaf wall assemblies” (Kwok, 2007:43) consisting of an outer glass louvre façade, an intermediate space and an inner brick and glass façade.

In summer, open louvres provide adequate solar shading while allowing wind and natural daylight to enter the building interior. These external solar shading devices prevent solar heat gain. In winter, when the louvres are closed, the enclosed air space will heat up due to the greenhouse effect. The resultant heat can be channelled through the building, reducing additional heating requirements.

The building envelope of **Eawag Forum Chriesbach** in Switzerland is composed of vertical glass louvres. This research centre was designed by Gysin and Partner BGP to act as a synergy of systems. An automatic control system adjusts louvres, operates windows and lights, and controls the flow of warm and cool air in response to environmental conditions (Wentz, 2007:30). On summer nights, when the outdoor temperature drops, windows and louvres are opened automatically to allow warm air to exit.

Louvres adjust automatically to optimize indoor temperature and lighting conditions. A control unit tracks the path of the sun and adjusts the louvres with an electric motor to allow sunlight to enter in winter and to block it in summer. On sunny winter days the louvres remain parallel to the sun’s rays to allow maximum penetration of sunlight, while on sunny summer days the louvres turn constantly to block direct sunlight. On cold, windy or overcast days the

Figure 170: Fire escape.

Figure 171: Louvre façade.

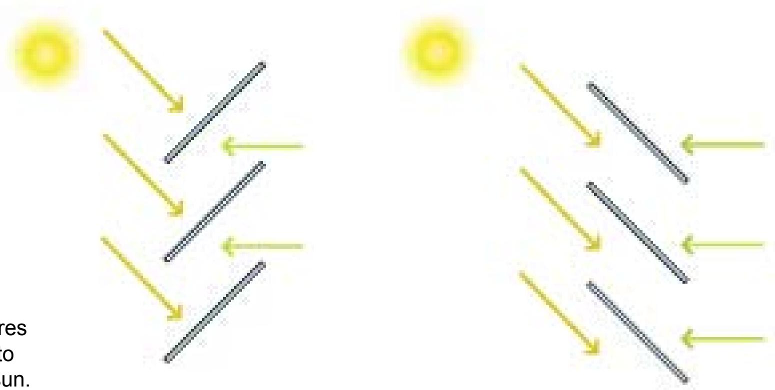


Figure 172: Louvres rotate according to the angle of the sun.

louvres remain perpendicular to the façade. As the façade goes into motion, the appearance of the building and the views to the inside change.

Each glass louvre pane is 2,8m high, 1m wide and 24mm thick. Two sheets of glass, one printed on the inside with a dotted pattern, are laminated together. Empa, the research institute for material science and technology, conducted tests using a 1:1 scale model of the façade assembly to determine the density and colour of the silk-screened pattern. A light blue pattern with 75% opacity (created by transparent voids) was selected for optimal daylighting and transparency while limiting thermal solar gain.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

A similar dot pattern was used on the ETFE skin of the Olympic Games Aquatic Centre or **Water Cube** in Beijing. Peddle Thorp Walker Architects (PTW) designed the building as a greenhouse. Diffused light enters through the main structure into an air cavity. The ETFE (ethylene-tetra-fluoro-ethylene) skin allows high levels of natural daylight to enter the building. Variations in the shading of the envelope are achieved by patterning the various layers of the façade with a translucent painted 'frit' (Wealth Creation, 2007). The pattern and position of these translucent elements respond to the functions adjacent to the façade.

Figure 173: Installation of ETFE panels.

Figure 174: Water Cube façade prototype.

Figure 175: Water Cube.

Figure 176: Broadfield House Glass Museum.

The **Broadfield House Glass Museum** in Dudley, by Design Antenna, is an exploration of modern glass technology with an all-transparent structure. The French company Saint Gobain developed “Neutral KN 169”, a special coated glass with a microscopic deposit of silver layered into its surface to inhibit solar gain (Richards, 2006:67). The glazing remains highly transparent allowing 61% natural daylight and only 45% solar energy to penetrate the façade. The roof panels were screen printed with a white fritted grid pattern. The density of this pattern varies to reduce the solar energy entering the building to less than 37%, creating an U value of 1.7w/m².

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Figure 177: Green vertical louvres.

Hermann, Valentiny and Partners designed the **Commerzbank** building in Luxembourg in association with Colt Shadowglass. Strict criteria of visual permeability and natural daylight fashioned the building skin. Concrete framed glass louvres encounter the urban environment with openness and transparency, yet ensure security. The louvres are composed of 8mm green and 15mm clear glass laminated together (Colt Germany, 2008). An electric motor integrated with a sun tracking system controls the movement of the louvres.

From an investigation of the above projects a skin, composed of vertical glass louvres, was designed for the northern façade of the proposed building. A light blue foil with a transparent dotted pattern, with 75% transparency, is laid on top or laminated into the louvre to ensure that the amount of solar radiation entering the building is regulated.

Figure 178: Commerzbank.

Sun tracking louvres

Colt International has developed an intelligent solar shading control system. The Colt ICS 4-Link processor continuously calculates the position of the sun and receives internal temperature and lighting data from sensors (Gardner, 2008). The system adjusts the louvres accordingly to create optimal environmental conditions. Therefore, the building reacts to its immediate weather conditions. The building management system also allows manual user control.

The building skin creates a climatically responsive layer. From certain angles the louvres allow views and reveal people, the details of life and the process of film making. The view is fragmented, simultaneously focusing close by or further away, or composing a spatial sequence as a series of partial glimpses. The skin becomes articulated and acts as a mediator between inside and out. Tension is created between opacity and transparency. The building constantly changes according to the point of observation, the time of day, the seasons and the weather.

Figure 179: Colt processor.

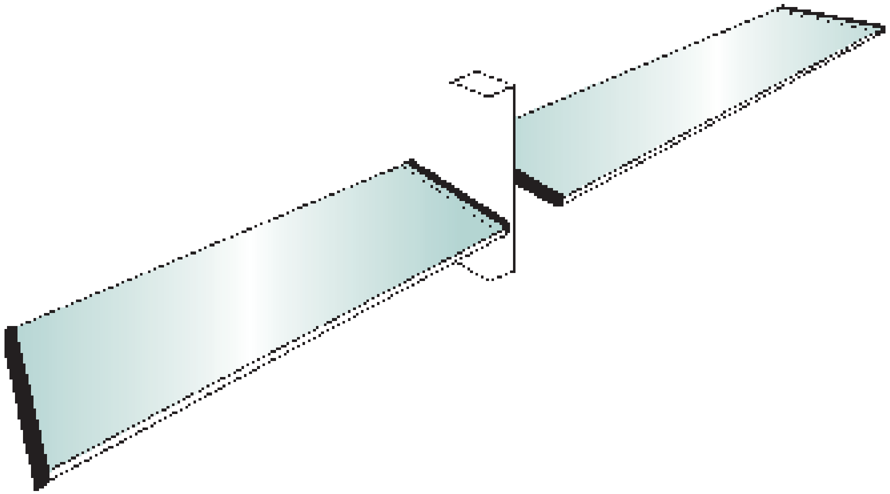


Figure 180: Colt Carrier System 5, horizontal and vertical application possible.

building systems

Ventilation

Passive ventilation is encouraged where possible. Along the northern façade a heating and cooling strategy is proposed.

In summer, the building management system rotates the glass louvres to provide optimum solar shading. The prevailing wind direction in Pretoria during the summer months is north-west. Deciduous trees along Lynnwood Road offer shade to cool the paved surfaces. A water pond provides evaporative cooling to further cool the air before it reaches the building. Cool air moves through the open louvres and ventilation ducts to the building interior. Cross ventilation is encouraged by placing windows on the windward and leeward side. Warm and cold air ducts are located in wall and ceiling cavities to regulate air movement through the building. During the early morning and at night when the outside temperature drops, the building management system automatically opens all louvres to flush hot air out of the structure.

The water pond is supplied by on-site water collection. Overflow water flows into a basement storage tank through a series of underground pipes. The temperature of the subsoil remains cool during warmer days, cooling the water in the pipes. An evaporative cooling unit uses this water to change warm, dry air to cool, moist air. Cold air is distributed in cold-air ducts and introduced at floor level, while hot air is removed at ceiling level. Whirlybird ventilators assist in creating suction to extract stale air from warm-air ducts.

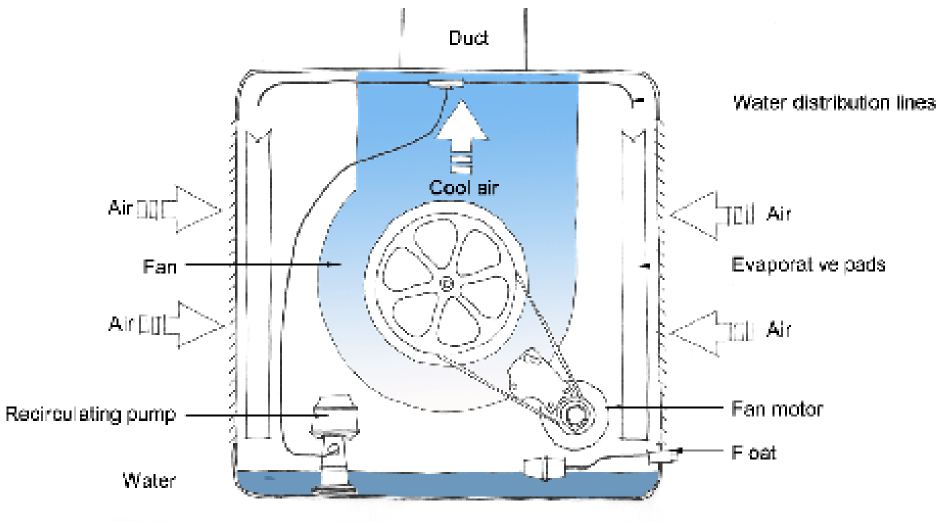


Figure 181: Evaporative cooling unit.

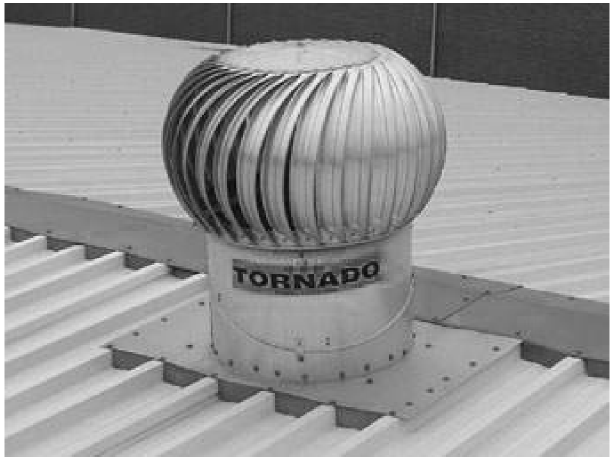
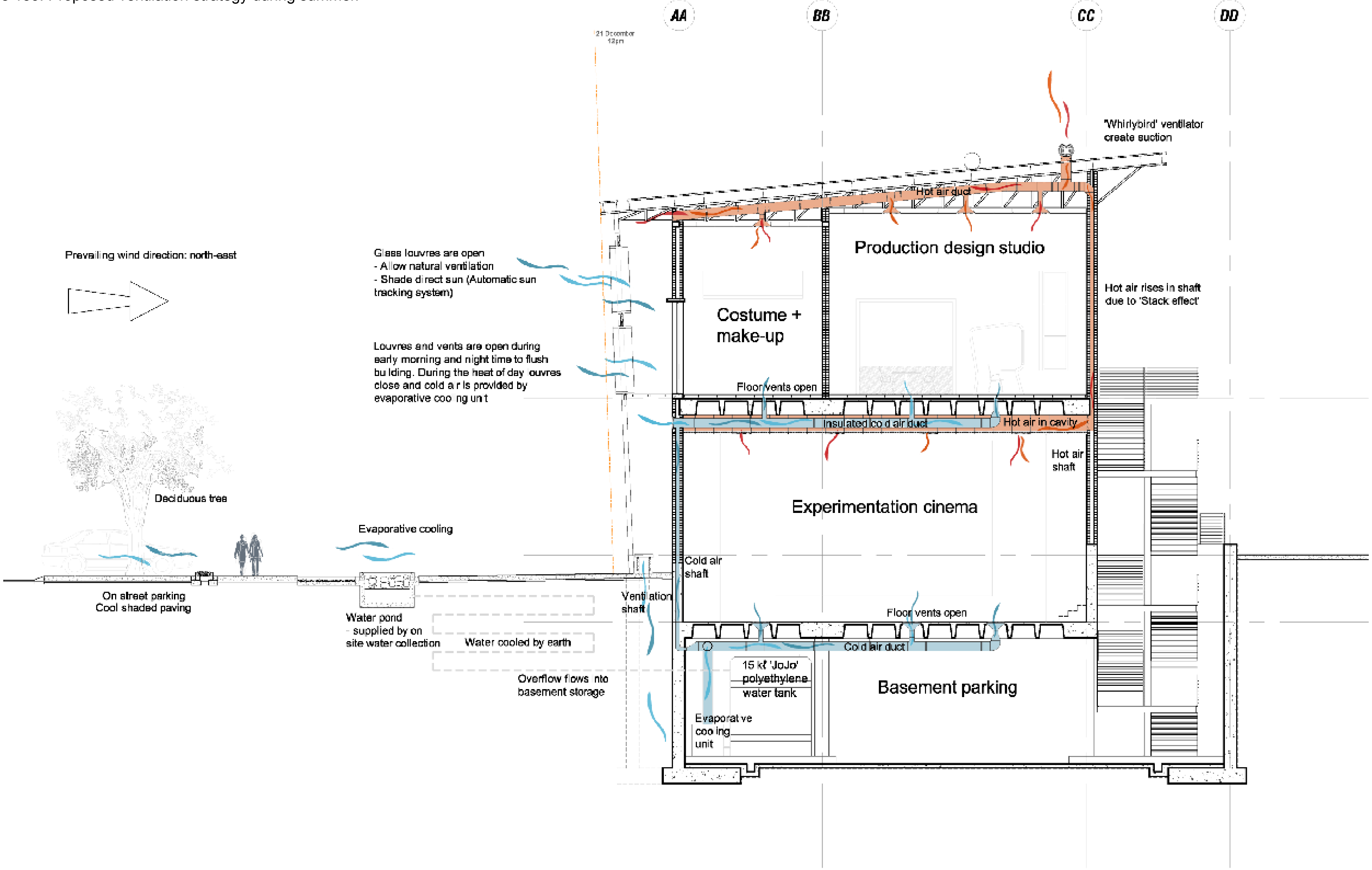


Figure 182: Whirlybird ventilator.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Figure 183: Proposed ventilation strategy during summer.



In winter, glass louvres are closed and solar heat gain is allowed. The air space behind the louvres heats up due to the Greenhouse Effect. Heat can then be channelled through the building. Additional hot-water radiators, containing water heated by solar water heaters, introduce heat at floor level. Extraction of stale air will continue through the hot-air ducts located in the ceiling cavity.

A supplementary mechanical ventilation system, operated by a basement plant room, is provided to create comfortable environmental conditions for the cinema, lecture rooms and sound recording rooms which can not be ventilated naturally.

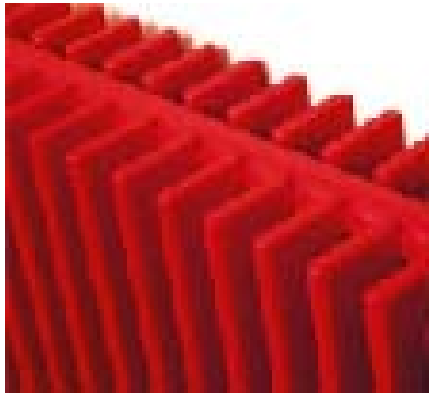
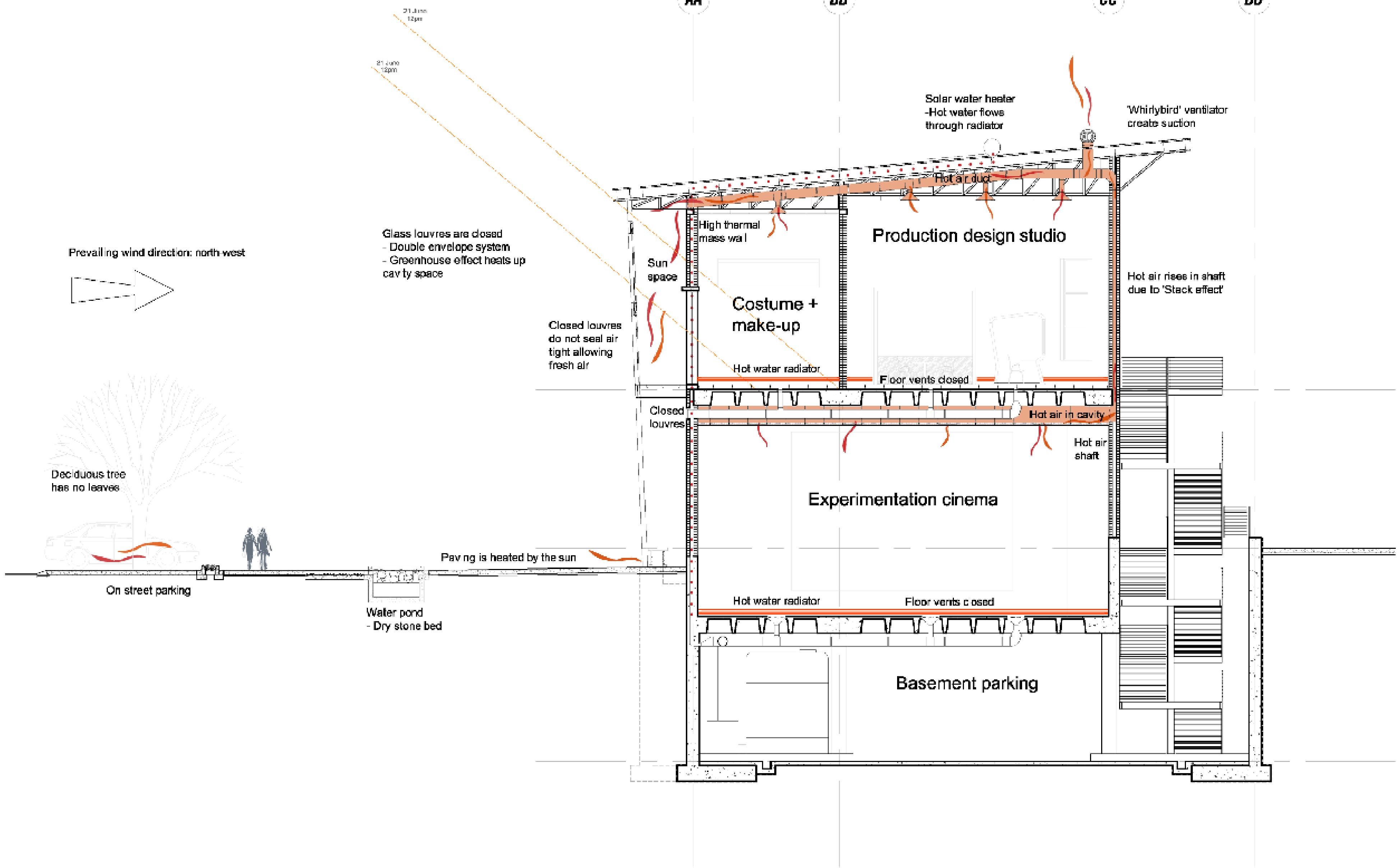


Figure 184: Hot water radiator.

Figure 185: Solar water heater.

Figure 186: Proposed heating strategy during winter.



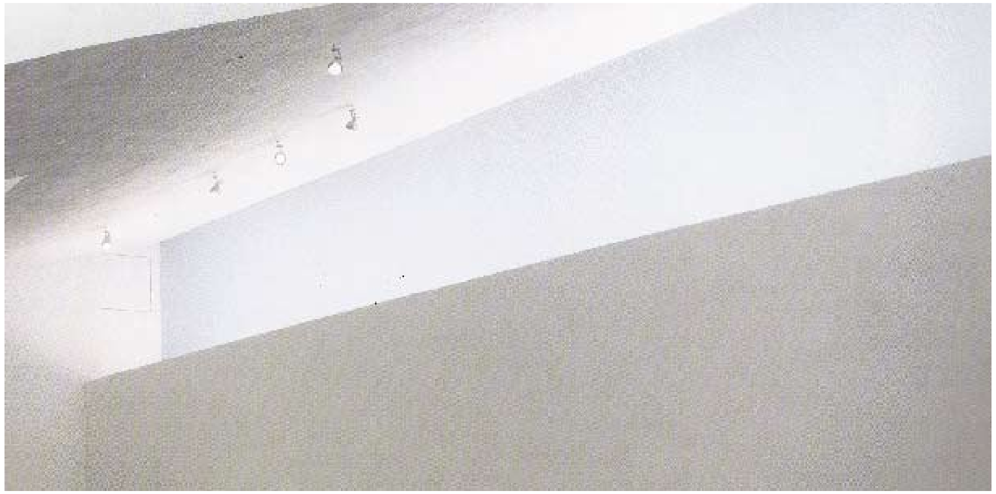
Natural daylight

As stated in the NBR requirements for natural daylight, the total area of openings should not be less than 10% of the total floor area of the room (SABS 0400:1999, 1996:102). Natural daylight is calculated accordingly for every room (see Appendix C). Light shelves, sky lights and light shafts assist in maintaining sufficient daylight in interior spaces. Light shelves are positioned to ensure uniform distribution of daylight in interior spaces. On entering the building, light bounces off the reflective shelf surface and then off the ceiling. High windows allow daylight to infiltrate deeper into the building (Kwok, 2007:81-82). In certain spaces, including the lecture hall, a daylight diffuser is placed inside the room, below a light shelf. The diffuser illuminates the ceiling and allows soft diffused light into the space below.

The **Velocity Films** office building in Johannesburg, designed by Noero Wolff Architects, is organised along a double-volume internal street. The roof form was shaped by the path of the sun in order to maximise solar gain (Noero Wolff Architects, n.d.). Skylights are placed along the length of the street. Offices facing the internal street contain windows with light shelves that allow light to enter.

Figure 187: Velocity Films.

Figure 188: Internal light shelf.



Another excellent example where this technique is used is the **Kiasma Museum of Contemporary Art** in Helsinki. Steven Holl used light shelves and skylights with translucent glass to create evenly distributed light throughout the room. The experience of light is controlled (Richards, 2006:42).

Atelier Peter Zumthor designed the **Kunsthaus Bregenz** in Austria with a ceiling space of 2m deep. This void above the ceiling acts as a plenum for air and light. Diffused light pours in through the frosted skin and down via the frosted glass ceiling (Richards, 2006:24).

Figure 189: Kiasma Museum of Contemporary Art.

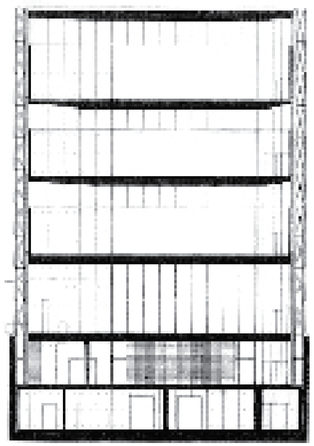


Figure 190: Kunsthaus Bregenz.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Where glass is used on the western façade of the proposed building, translucent Nanogel® insulation is applied. The translucent appearance of the glass allows high quality diffused light to illuminate the interior while inhibiting solar heat gain. Nanogel® is a Cabot Aerogel insulating material containing 95% air and 5% solid content (Cabot Corp, 2008). The small pore size of Nanogel® contributes to its good thermal insulating properties.

Figure 191: Nanogel® used in glass roof.

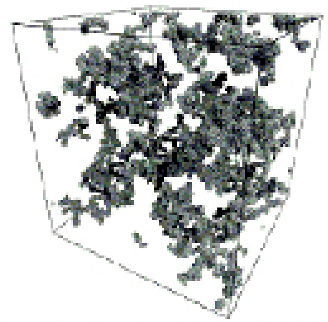


Figure 192: Nanogel® particles.

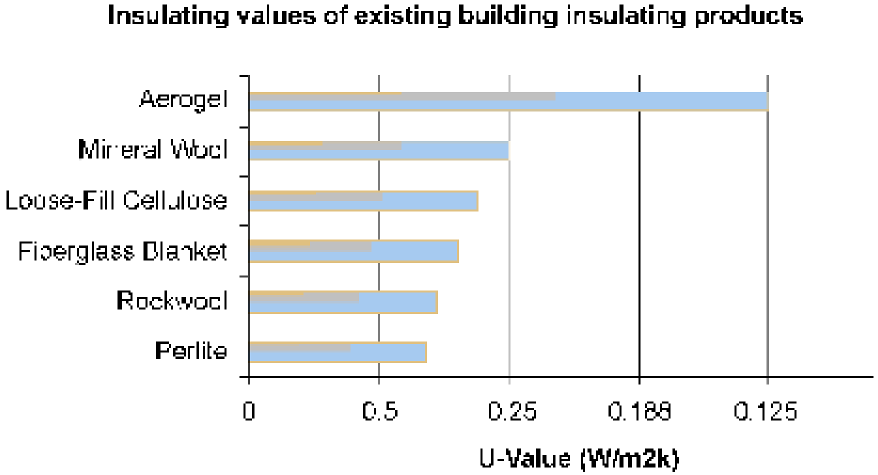


Figure 193: Comparison between Nanogel® and other insulating products.

Nanogel thickness	Light transmission	Solar heat gain coefficient	U-Value
13mm	73%	0.73	0.25
25mm	63%	0.63	0.125
31mm	49%	0.49	0.1
38mm	39%	0.39	0.08
50mm	28%	0.28	0.06
64mm	21%	0.21	0.05

Figure 194: Nanogel® thickness vs solar gain.

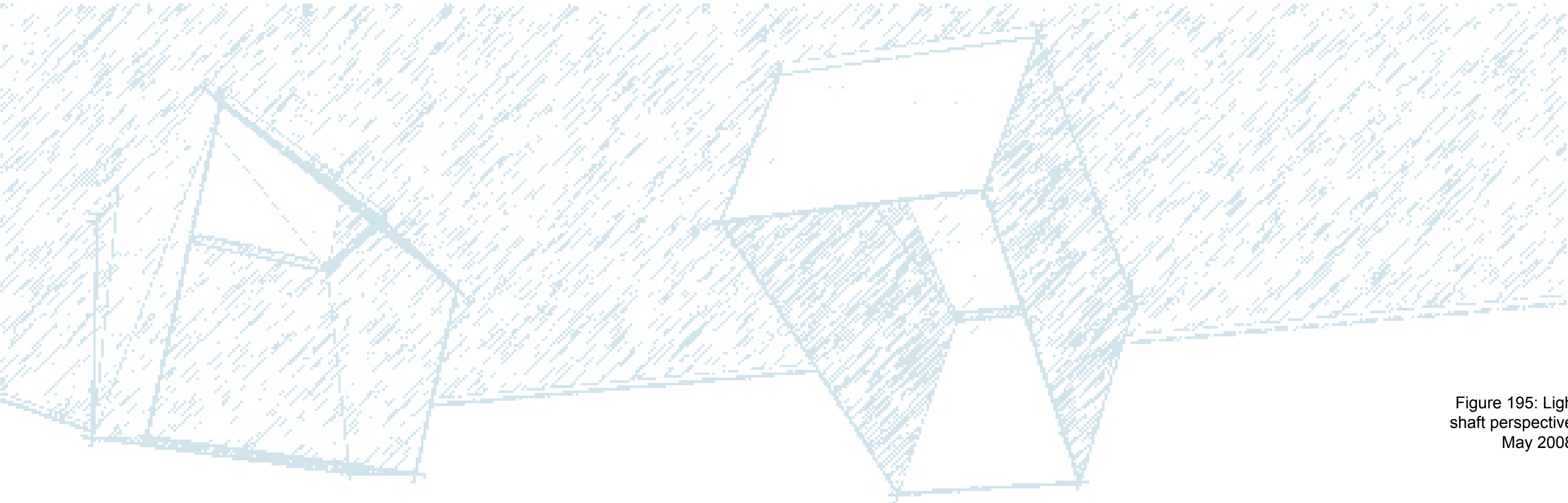


Figure 195: Light shaft perspective, May 2008.

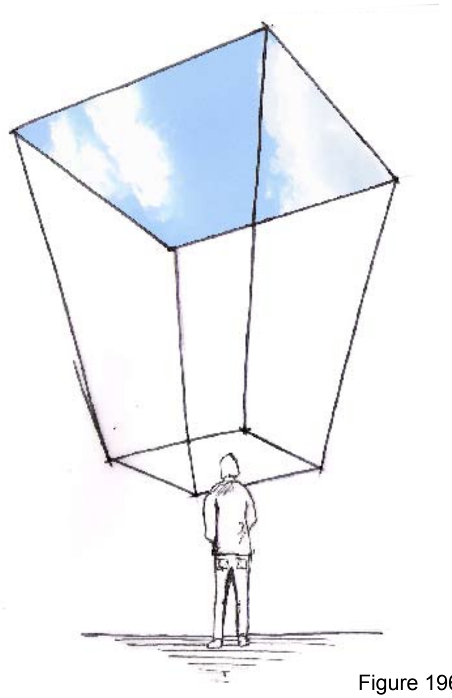


Figure 196: Concept sketch of a sky view, April 2008.

Water harvesting

A water strategy for the entire site was developed in conjunction with landscape architecture student Elmie Erasmus. The hydrological system consists of three parts:

- The wetland on the eastern corner of the site.
- A formal open water system running in an east-west direction for the length of the site.
- Infiltration trenches in Lynnwood Road.

Water from the existing storm water channel, located on the southern border of the site, is channelled into a proposed wetland system. The wetland is primarily designed to illustrate the cleaning of storm water run-off in an urban environment.

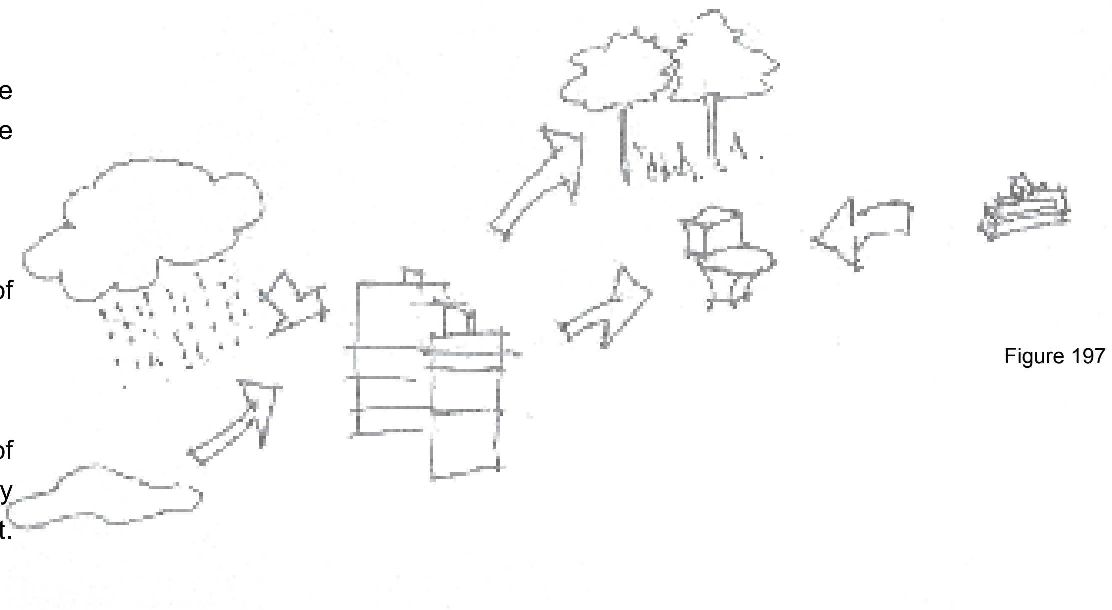


Figure 197

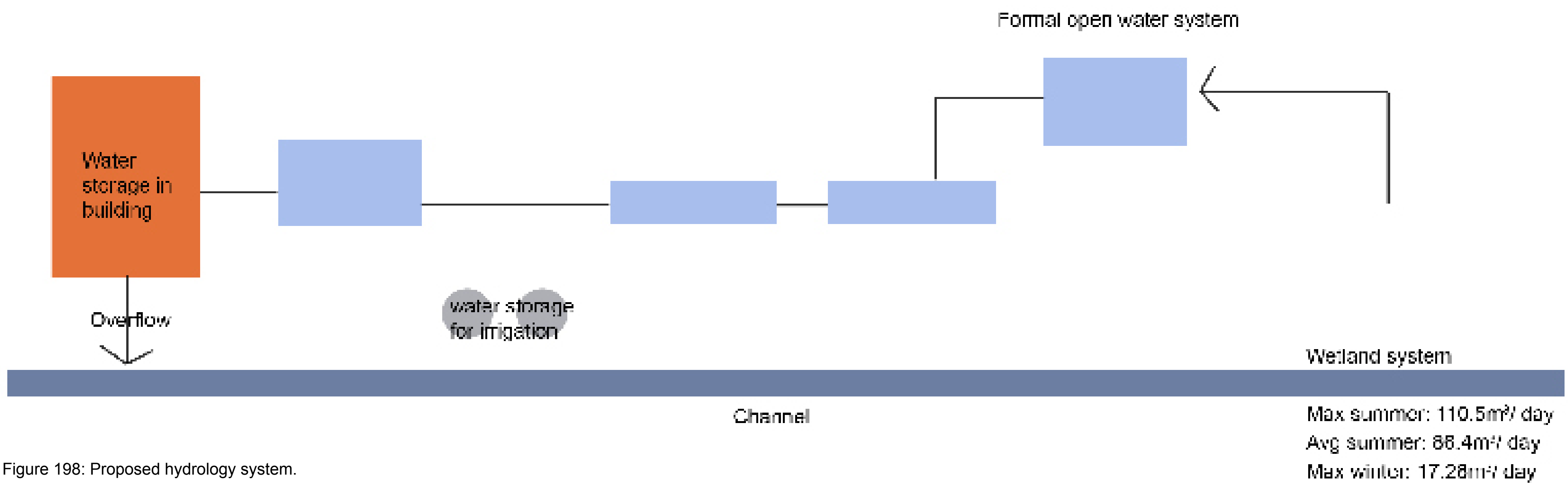


Figure 198: Proposed hydrology system.

Water output from the wetland flows through the site via a formal open water system, introducing water utilisation principles at various points. Subsequently, the water is piped into the basement of the proposed building for storage. This grey water is used for the flushing of toilets and for on site irrigation. No additional harvesting of roof water is necessary since the wetland produces enough water throughout the year to provide for the building's water demands (see Appendix D).

Storm water run-off from Lynnwood Road is distributed between a series of infiltration trenches. Treated water is then collected in a water pond which forms part of the natural ventilation system. Overflow form the pond is piped to the building's basement.

Figure 199: Networked sidewalk storm water system, Portland Bureau of Environmental Services.

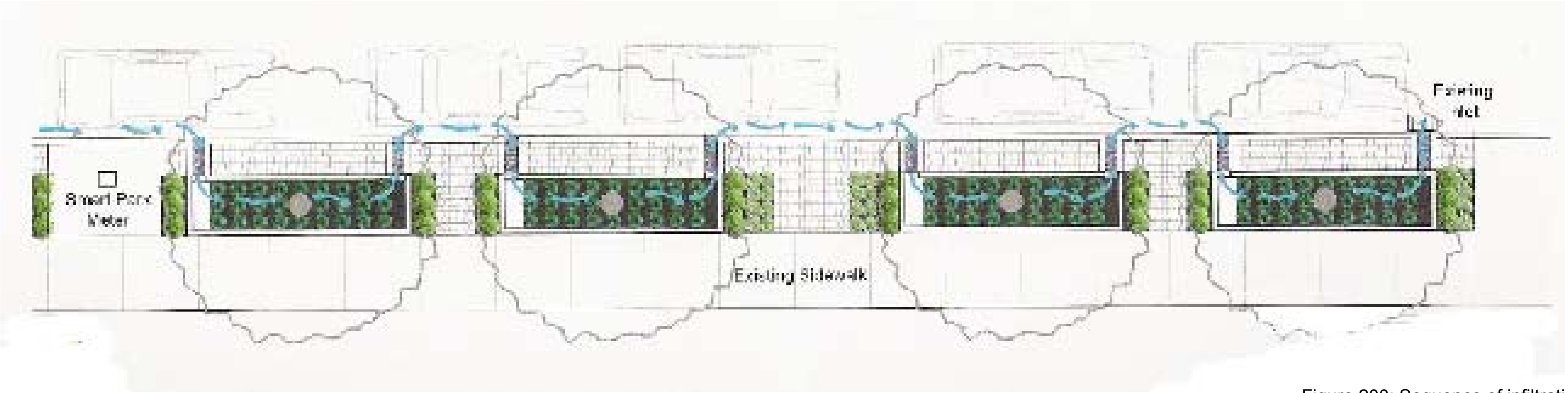


Figure 200: Sequence of infiltration trenches forms part of the streetscape.

The vertical garden

Site and contextual forces are introduced to the building skin. Along the eastern façade the landscape continues from the horizontal plane onto the vertical, blurring the boundaries between landscape architecture and built form.

Green Green Screen in Tokyo by Klein Dytham Architecture is a living, growing green wall. A mix of grass, creeper plants and graphic screens forms a long hoarding wall which surrounds a mixed-use development. Felt pockets, attached to an aluminium frame, are filled with earth to provide a growth medium for plants. A hosepipe along the top drips water into the pockets, keeping the plants moist, and a gutter along the bottom drains water from the pavement (Gaventa, 2006:172). Curiosity is aroused and people passing by are tempted to touch the plants. Additional greenery is introduced to the city environment, transforming the edge of the street.

Figure 201: Green Green Screen.

Figure 202: Musée du Quai Branly.

Another precedent for the use of a green wall is Jean Nouvel's **Musée du Quai Branly** in Paris. A living wall forms part of the exterior of the museum. Approximately fifteen thousand plants of 150 different species form part of the 800m^2 wall. Two layers of polyamide felt are hooked onto slabs of expanded PVC and anchored to a metal structure. The felt provides a cushion of air to act as insulation, and a soil base in which the roots of the plants can grow (Badia, 2007).

The use of veld grass forms part of the vegetation strategy adjacent to the eastern façade of the proposed building. Therefore, the vertical garden contains similar grass species, planted in galvanised steel channels. The grass is cut annually to reduce the risk of a fire hazard. The steel channels are mounted onto a galvanised steel frame which contains an irrigation pipe at the top, and is perforated at the bottom for drainage.

Figure 203: Detail of vertical garden.

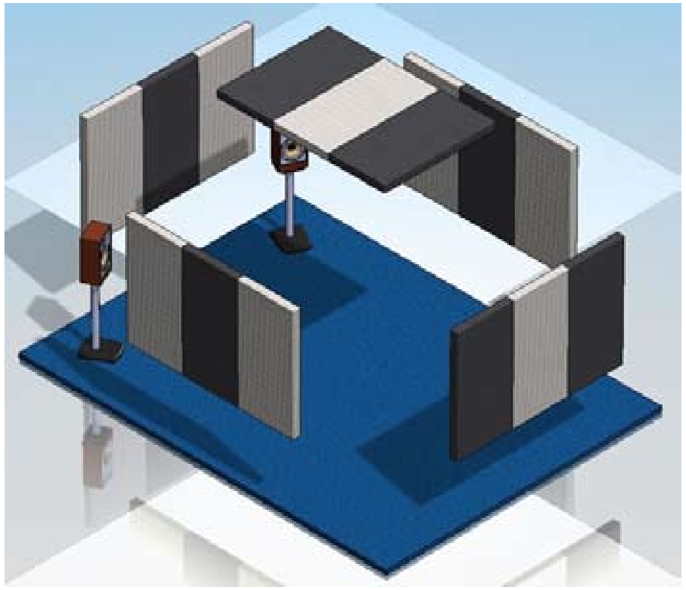
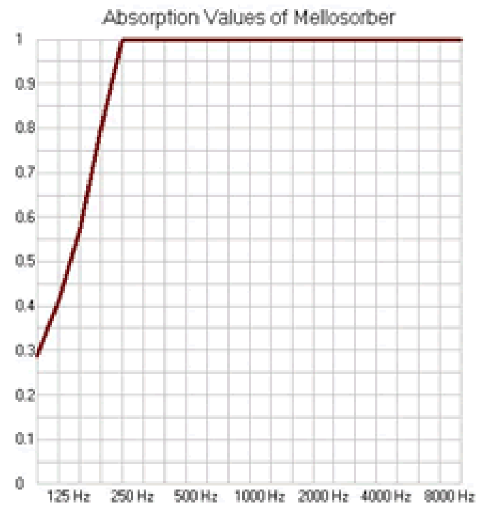


Figure 204: Mellosorber acoustic panels.



acoustics

The acoustic investigation strategy involves isolation, absorption and speech propagation for critical spaces throughout the building. These spaces include the sound recording, voice booth, dubbing, cinema, lecture and open lecture rooms.

Absorption

Adequate sound absorption is necessary for reverberation control, echo control and internal noise reduction. Room absorption is calculated and designed to meet the preferred reverberation time required by each function (see Appendix E). Egan (1988:170) explains that a "long reverberation time is desirable for music so that successive notes blend together; however, for speech the reverberation time should be short so that persistence of one syllable does not blur or mask subsequent syllables". Where necessary, Mellosorber acoustic panels, developed by the South African company Subsonic Acoustics, are installed to achieve adequate absorption.

In modern cinemas with good quality surround sound, reflective surfaces are unnecessary, therefore the maximum practical room absorption should be achieved. Proposed seating is well upholstered and all surface finishes are absorbent. According to Lord (1986:81) good absorptive walls, floors and ceilings will "permit clarity of sound and soak up local popcorn noises". Sound lobbies with absorbing finishes are provided at each entrance door.

In the lecture rooms 50% of the ceilings are treated with absorptive panels to reduce reverberation times, while the central areas remain reflective to help distribute sound from the lecturer to the back of the room. To prevent standing waves, the ceilings are angled towards the classrooms. The rear walls contain sound absorbing Mellosorber panels to avoid echoes. Viewing windows in rear walls can be closed by means of Rauvolet roller shutters. Rauvolet Acoustic Line is a perforated metal shutter containing absorptive material. An NRC number of 0.8 is achieved by this product (Rehau, 2007).

The walls of the voice booths are designed to be non-parallel to prevent the formation of standing waves.

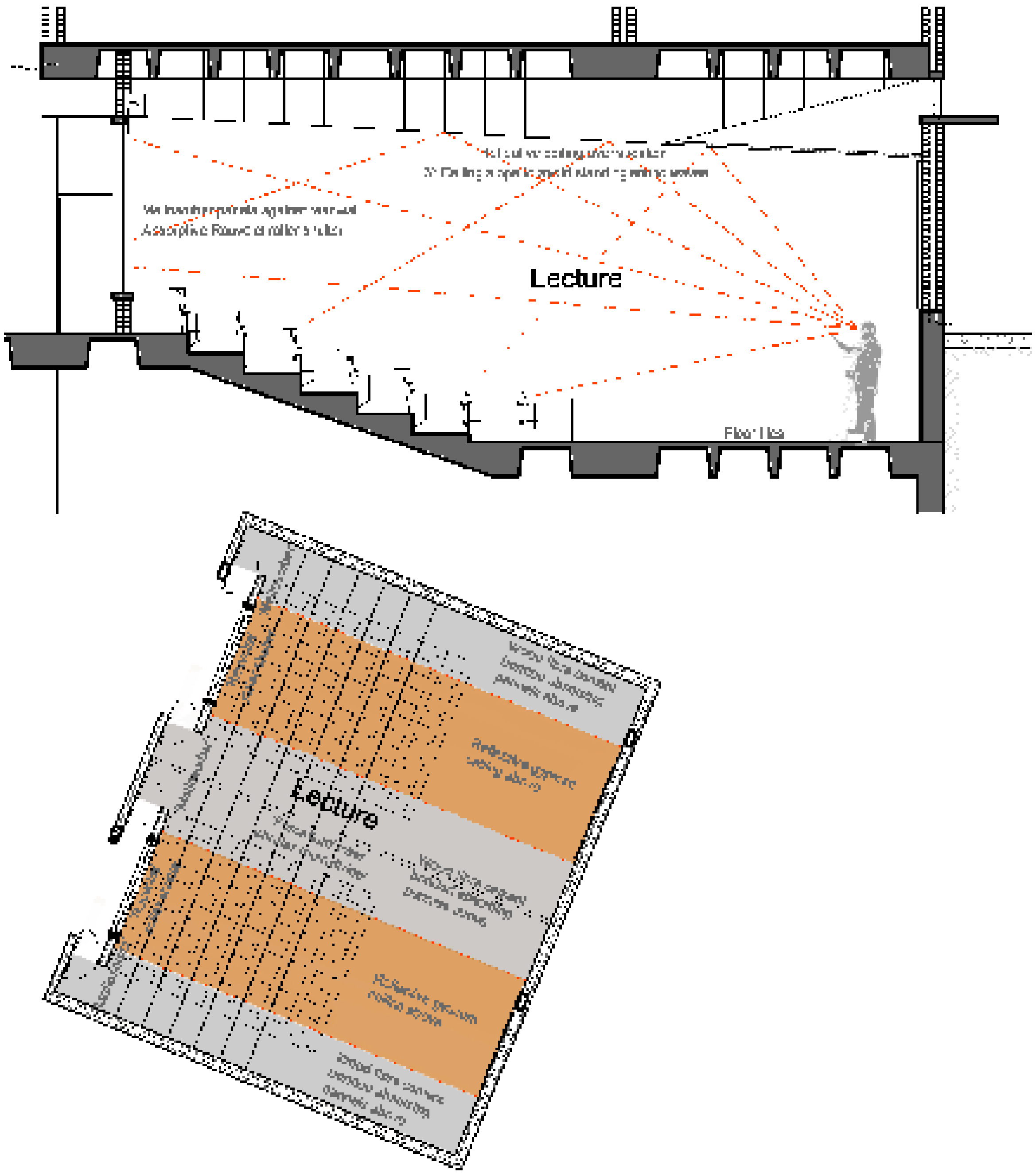


Figure 205: Sound absorption and reflection in lecture room.

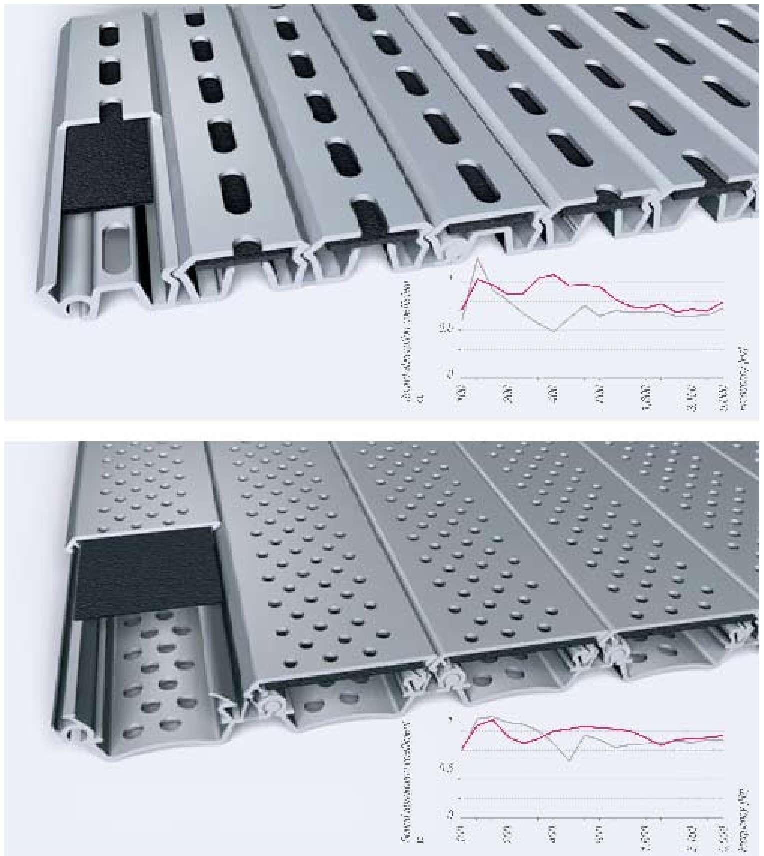


Figure 206: Rauvolet Acoustic Line.

Voice booth isolation

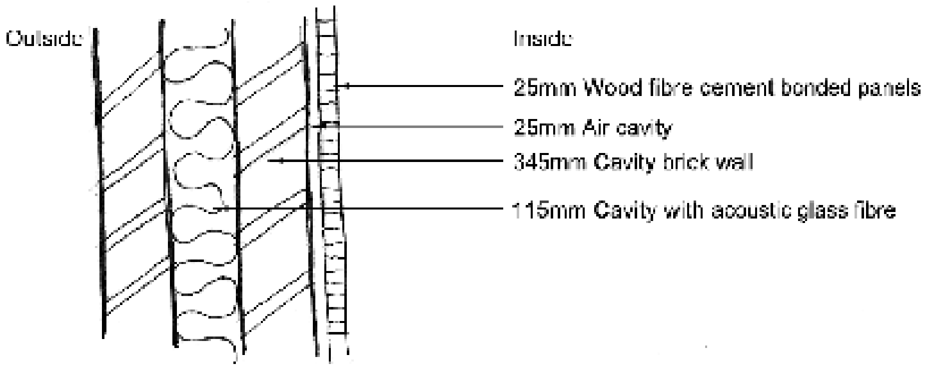


Figure 207: Section voice booth through walls.

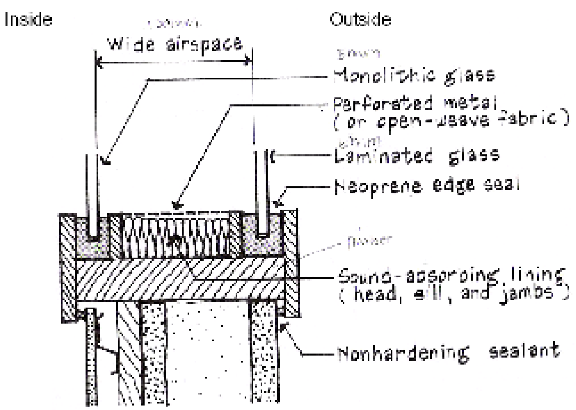


Figure 208: Section through double pane windows.

Isolation

As the site is located next to a busy road, traffic noise must be investigated. The traffic noise level "depends on the density and speed of vehicles" (Lord & Templeton, 1986:19). The faster the traffic flows, the more noise it creates. Traffic slows down at the site due to the traffic light located at the junction. Because of the slower traffic rate the site is not as noisy as the current architecture building further along Lynnwood Road, where traffic is flowing much faster. The calculated traffic noise level at the site is 65dB (see Appendix F).

The courtyard faces away from the traffic and is therefore shielded from traffic noise. When the glass louvres along Lynnwood Road are closed, the double envelope system provides excellent sound isolation for the building. When the louvres are opened they can be angled to achieve a compromise between air circulation, shading and noise reflection. Even in their open state will the louvres behave like sound diffusers.

Isolation calculations are done for the different necessary functions in the building (see Appendix G). Sound recording rooms require the best possible

Figure 209: Section through voice booth floor.

Figure 210: Section through voice booth ceiling.

isolation from external noise. These spaces are designed as a 'box in a box' by separating and isolating the walls, floors and ceilings from the building structure. The air cavity created between the two brick layers is filled with acoustic glass fibre. In the cinema however, double cavity walls with acoustic glass fibre provide sound isolation to prevent motion picture noise from reaching the rest of the building.

To ensure acoustic isolation and noise reduction, a dedicated air-conditioning duct is supplied for the sound recording rooms. Appropriate noise reduction devices are placed in the air duct. These include sound-attenuating mufflers, silencers, diffusers, filters and lining of the inside of the duct with acoustic glass fibre (Egan, 1988:293; Lord 1986:30).

An acoustic roller shutter is used to create a separating wall between the two lecture rooms. Flexibility of space allows variations in classroom size according to the daily needs of the department. Force Shield roller shutters were designed to keep traffic noise out of European apartments and has an Ia-Value of 39dB (Rollashield, n.d.). By using double Force Shield roller shutters with a 50mm air cavity, a sufficient Ia-Value of 44dB is achieved.

Cinema isolation

Figure 211: Section through cinema ceiling.

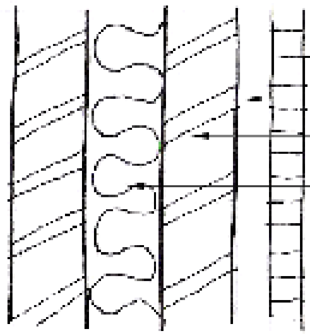


Figure 212: Section through cinema walls.

Figure 213: Force Shield roller shutter.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

proposed materials

The selection of materials is influenced by various components on site. The use of brick and concrete respects the surrounding historic buildings while introducing permanence. Steel and glass represents the new and creates a contrast. Thus the contrast between tangible and intangible, solid and void is emphasized.

Concrete

All visible concrete is to be fair-faced concrete, cast in situ with smooth formwork. The formwork creates a negative imprint and essentially determines the texture of the surface (Peck, 2006:88). A smooth, non-absorbent formwork panel is proposed. The smooth skin of the concrete box on the northern façade contrasts with the textured steel and glass skin. The concrete box breaks free of the façade, creating a large frame within which the library is visible. A consistent arrangement of the formwork panels during construction ensures that the formwork tie holes are regularly spaced over the entire façade wall. Expansion joints should coincide with formwork joints. The formwork joints are subtle repeats of the rhythm of the glass-louvered façade.

Brick

Red face brick is used to relate to the adjacent historic buildings. Brick creates a solid, tangible envelope. Bricks are to be laid in stretcher bond with flush joints.

Figure 214: Crematorium Berlin, Axel Schultes Architekten.

Figure 216: Fair-faced concrete.

Figure 215: Parish Centre, Thalmassing, Meck Architekten.

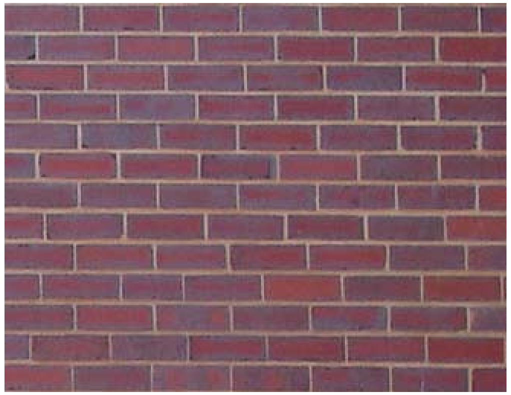


Figure 217: Red brick.

Steel

Steel is introduced in the roof structure and as structural members of the glass façade. Steel stairs and walkways include galvanised steel chequered plate steps to establish a lightweight industrial appearance. As an alternative to "vastrapplaat" or chequered plate sheet metal, a fine rib pattern is used.

Glass

Glass represents "the void" or the intangible aspect of the design. Transparent and translucent types of glass are used respectively, according to the orientation and climatic demands of the building. Movement behind translucent glass generates shadows, animating the exterior surfaces. Where projections are screened onto the glass, these shadows interfere with the motion picture and the user becomes entwined with the images. On the northern façade light blue glass with a transparent dotted pattern is applied to the vertical glass louvres to reduce solar heat gain. The laminated glass louvres are 10mm thick to withstand wind pressure. On the solid façades small windows are placed at significant points to frame specific views to the outside. For example, a slender horizontal slice of city is viewed through the western stairway wall. These windows are framed by concrete elements, incorporating window sills and lintels. In the interior, simple glass balustrades and glass partitions in meeting rooms suggest transparency of function. Safety glass is to be used on all balustrades.

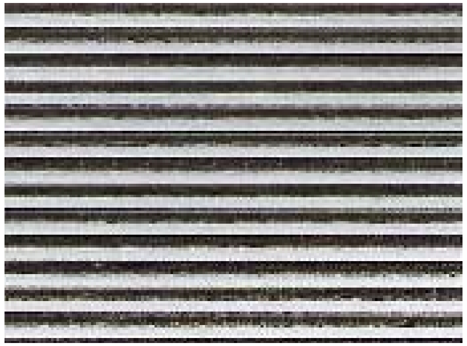


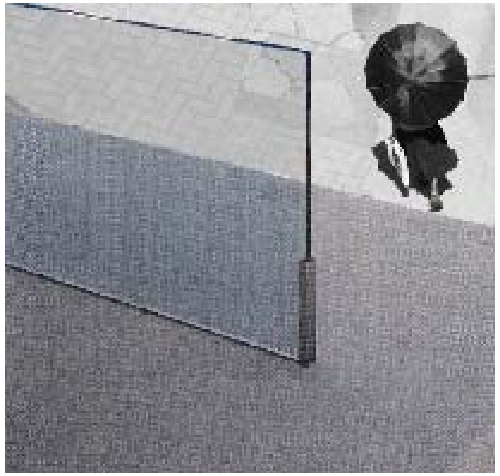
Figure 219: Ribbed sheet metal.

Figure 218: "Vastrapplaat".

Figure 220: Glass louvres design.

Figure 221: Transparent dot pattern of the blue film.

Figure 222: Glass balustrade design.



technology

HoloPro™ transparent surface projections

The HoloPro™ Company specialises in the manufacture of transparent projection surfaces capable of showing video projections with daylight brightness (Ritter, 2007:36). HoloPro™ allows rear or front projection onto a glass surface under any light conditions while maintaining transparency (Gatehouse Design, 2008). A sharp image with high contrast is generated. The image or motion picture becomes a component of the space and the transparency of the projection surface allows innovative presentation possibilities.

The patented HoloPro™ technology contains holographic elements beamed with a laser onto a highly transparent film. The film is then embedded between two layers of glass (Pronova, n.d.). A beam of light from the projector hits the glass at a certain angle and the light is then redirected to the viewer.

HoloPro™ comes in an interactive touch-screen format which allows the viewer to interact with the information through computer software. Therefore the HoloPro™ film applied to the glass partition walls of meeting rooms allows multimedia presentations to be projected onto the glass. The room becomes part of the presentation and the image becomes part of the room.

Figure 223: HaloPro™ in exhibitions.

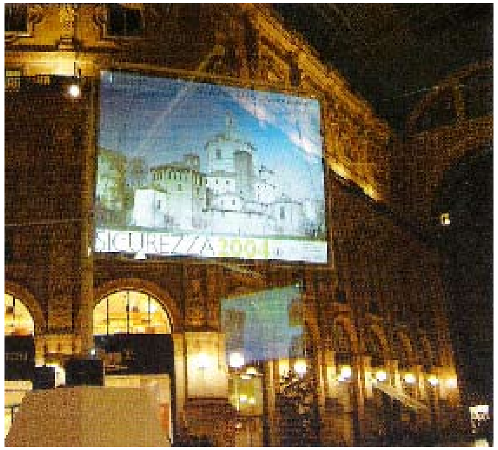


Figure 224: HaloPro™ on a building façade.

Figure 225: HaloPro™ with interactive software.

At the **Deutsche Forschungsgemeinschaft** in Bonn, Michael Bleyenberg applied a HoloPro™ façade. A fixed motif is used as a living advertising screen while the windows remain transparent.

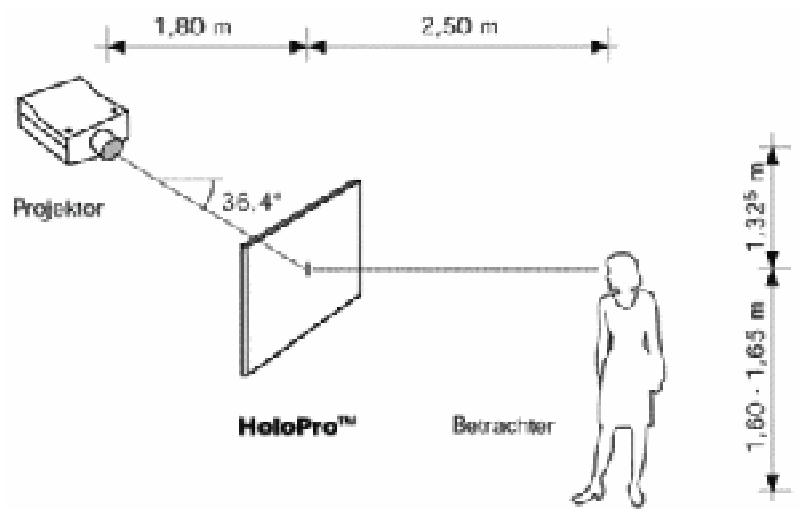


Figure 226: HaloPro™ specifications.

Figure 227

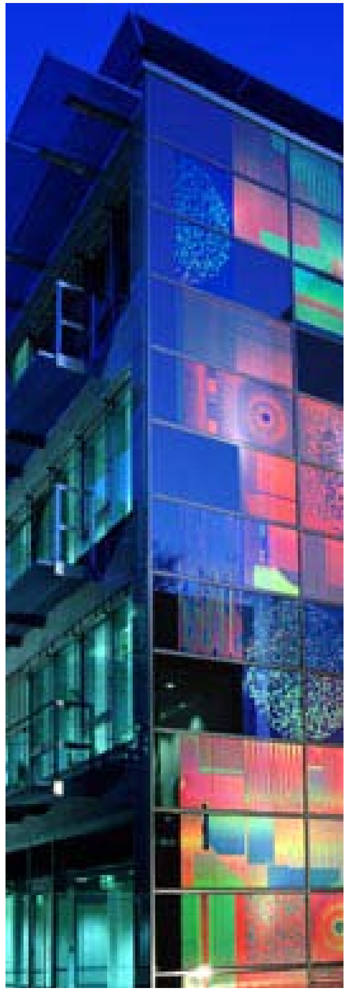


Figure 228: Deutsche Forschungsgemeinschaft.

Figure 229: Eyestep.

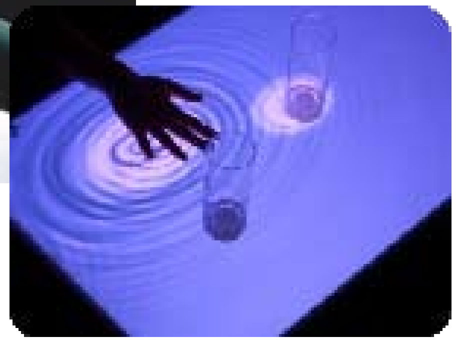


Figure 230: iSurface™.

Interactive surfaces

An interactive system, developed by Mindstorm as iSurface™, projects digital effects on walls, floors and other surfaces. Full body interaction is achieved as intuitive human motion stimulates a reaction from the wall or floor display.

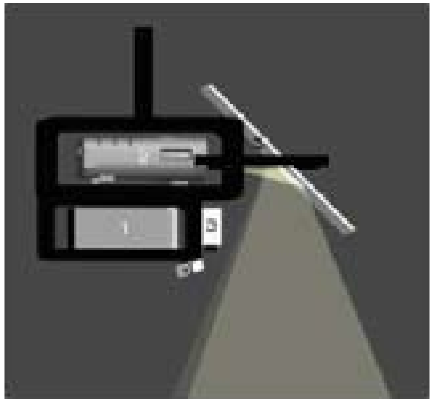
For example, a fish pond can be projected onto a floor surface. When someone walks over the water they see ripples forming, hear the sound of their footsteps and see fish swimming away from their feet. A similar application was introduced in **Brooklyn Mall**, Pretoria. The display causes people to stop and children to chase the fish around.

An infrared motion tracking kit detects motion and transmits it to a software program on a computer. The software processes the movement and changes the image accordingly (Luminvision, 2007). The interactive software can easily be adapted to display any custom image or motion picture.

Figure 231: Eyestep interactive floor.

Figure 232: iWall™.

Figure 233: Floor projection specifications.



1. Computer with software
2. Projector
3. Tracking kit camera
4. Tracking kit IR illuminator
5. First surface mirror

For floor projection the projector and tracking kit are mounted above the floor, projecting down. The computer can either be mounted with the projector or placed in another location. Both front and rear projections onto walls are possible (Mindstorm, 2007).

The digital displays throughout the proposed building interact with passers-by and stimulate user participation. When someone walks along the interactive wall, projected silhouettes of people follow them, jumping and running along the wall.

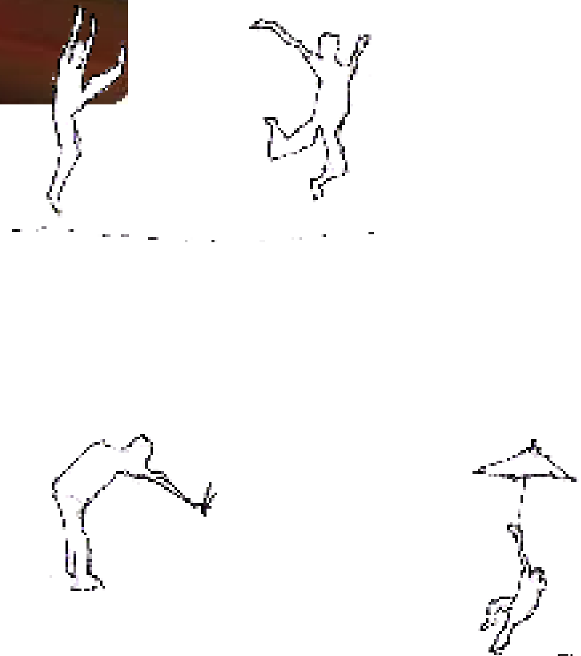


Figure 234

Figure 235: Brooklyn Mall floor, interactive fish pond.

Figure 236: Brooklyn Mall ceiling.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

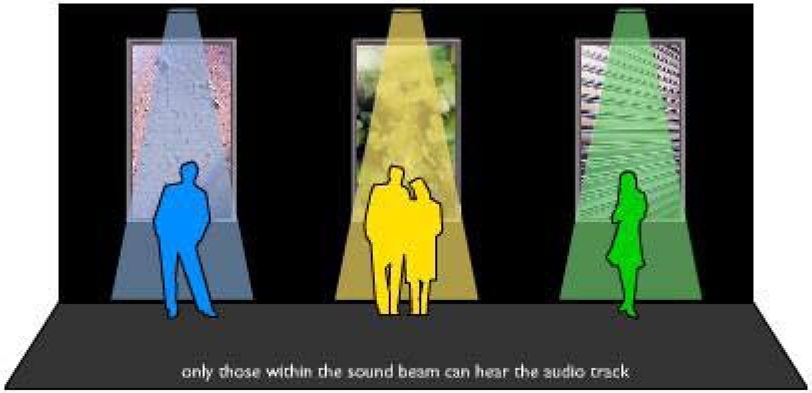
Figure 237: A & E Billboard.

Audio Spotlight®

Holosonic Research Labs developed the Audio Spotlight® system which directs sound to a specific area. By using only ultrasound, a narrow beam of sound is generated. Ultrasound contains frequencies outside the human range of hearing. However, as the ultrasound beam travels trough the air, the properties of the air cause the ultrasound to distort. The distortion generates frequencies in the audible bandwidth (Holosonic Research Labs, 2002).

Blue Blast Media revived the traditional billboard by incorporating sound, using the Audio Spotlight® system. Mounted above the **A & E Billboard** in Manhattan, the system projects an isolated sound beam onto a targeted area of the sidewalk. People who pass by the billboard hear the sound of a woman whispering, saying “Who’s there? Who’s there? It’s not your imagination” (Holosonic Research Labs, 2002). Since the sound is targeted at a specific area, environmental noise is avoided. As the passer-by enters the beam he hears the sound immediately and clearly.

Figure 238: Directed sound.



The Audio Spotlight® system can therefore be used to project beams of sound from one area in the proposed building to another. For example, sound from the cinema can be projected to the courtyard corner, while sound from the recording room can be projected to the waiting lobby. The transparency of the building's processes creates a sensory experience, stimulating both audio and visual perceptions.

Figure 239: Audio Spotlight® system.

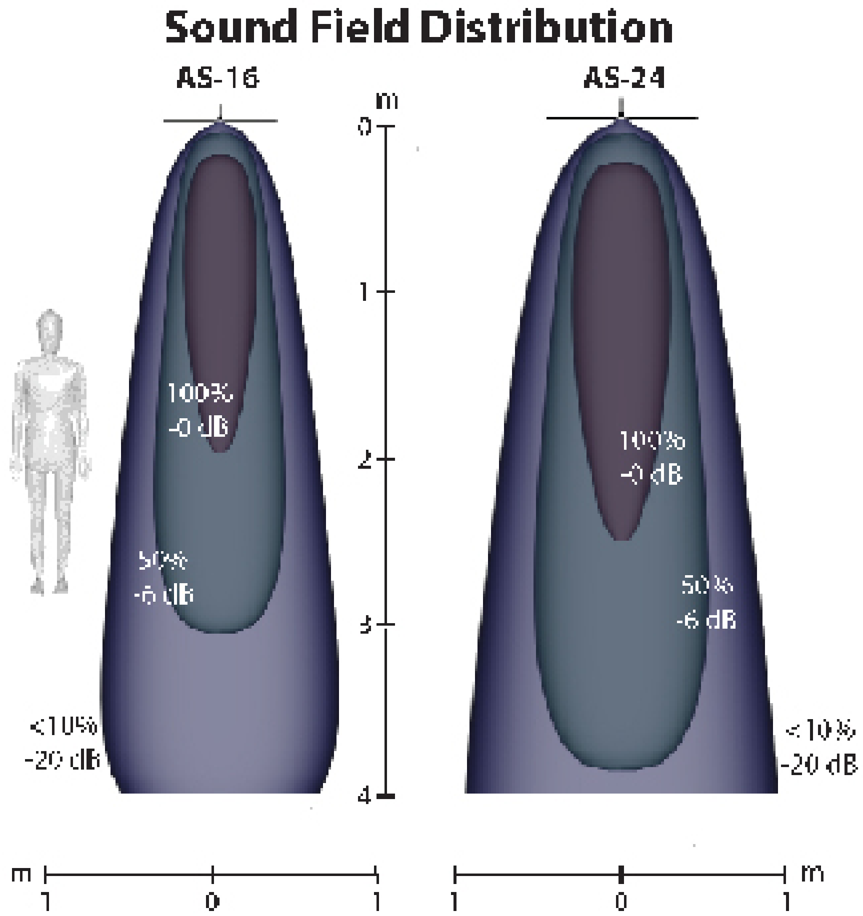


Figure 240: Audio Spotlight® specifications.