007 TECHNICAL INVESTIGATION

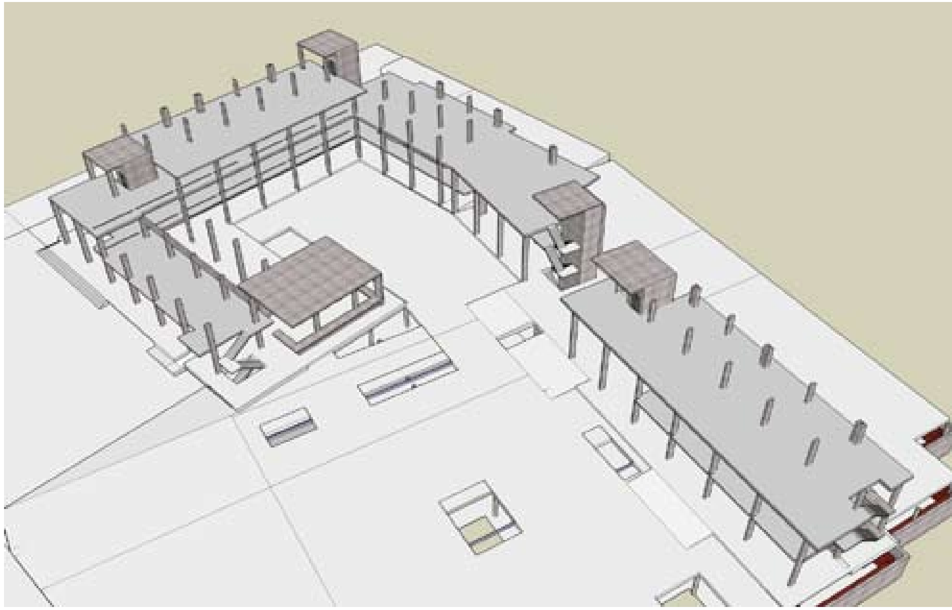


fig 7.1

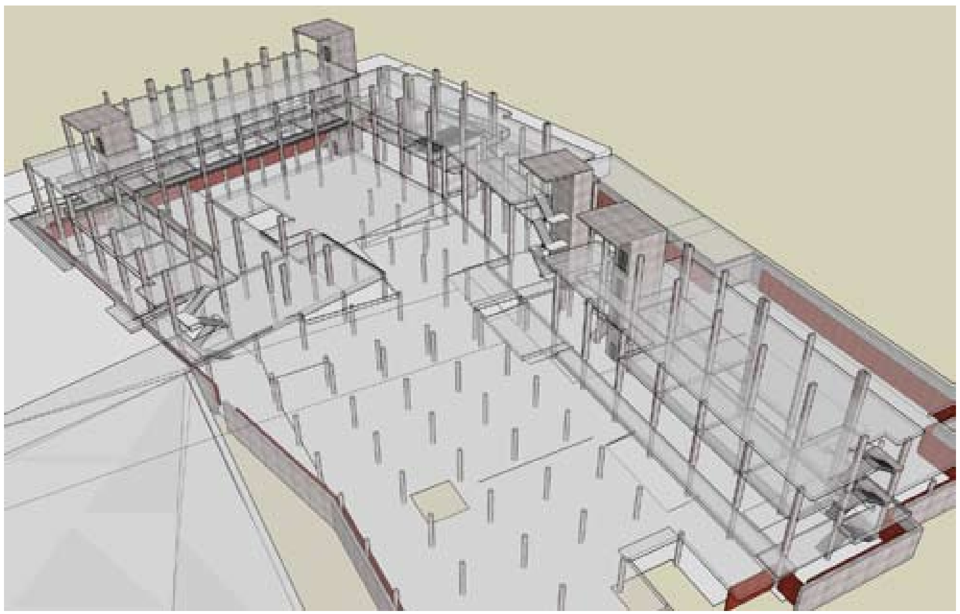


fig 7.2

fig 7.1 reinforced concrete column and slab structural system

fig 7.2 structural system showing basement

007 TECHNICAL INVESTIGATION

7.1 Revealing Structure

The building and structure are integrally related and cannot be separated. Therefore, one of the primary design concerns was that of revealing the structure, and consequently also revealing the architecture of the building. The building developed as a response to the structure and the structure accommodates the design to reach a harmonic solution.

Adolf Loos in his book 'Ornament and crime', 1908, wrote:

"*He who hides away part of the framework not only deprives architecture of its sole legitimacy, but also strips from its most beautiful ornament. He who hides a column makes a blunder, he who makes a fake column commits a crime*" (Perret, 1952:34-35).

The structural system of the building consists of a concrete column and slab construction, forming a linear weight distribution system, with infill structural steel elements, functioning as support for the roof. The intention of the structural design is to expose the primary structural members to the extent that their function can be read by the user. Therefore, the primary structural elements are treated in a distinctive manner as to set them apart from the rest of the structure and thereby clearly defining the weight distribution throughout the structure.

The structural design exploits the expressive potential of the structural elements; it becomes the ornament - through repetitive rhythm, beauty and honesty of construction. This ornament is not added on but rather incorporated into the design so that the structure falls into harmony with the building as a whole.

fig 7.3

fig 7.4

7.2 Revealing Materials

The materials used in the building are naturally rich and varied and were selected for their inherent qualities as much as their economy or utility. The materials have been left mainly untreated to reveal their true nature and to express the concept of exposure. The various materials used in the building attribute sensory qualities to certain spaces within the building, while still maintaining a common language throughout.

fig 7.3 Concert Hall, St Polten, Austria

fig 7.4 Kunsthaus, Bergenz, Austria

7.2.1 Concrete

Concrete was chosen because of its common association with structure and using it in its natural form can be seen as an expression of structure. It was also chosen for its high mass that attributes to good thermal insulation and sound isolation necessary for the auditorium.

Reinforced concrete slabs will be used for all floors and has a maximum span of 7480mm. Through consultation with an engineer, it was decided that 255mm thick slabs would be sufficient for spanning the required 6m. The floor slabs will be cast in-situ. Two-way spanning slabs will be used for most of the building, but in places where the slab has been cut away for illumination purposes, one-way spanning slabs will be used with the reinforcement acting in one direction only between two support beams, 425mm deep.

fig 7.5

fig 7.6

7.2.2 Glass

The other dominant material used in the building is glass, which originated from the concept of being able to experience the structure and spaces without any obstructions. Glass offers unobstructed views in order to maximise integration, interaction and exposure to all the processes, keeping the building as clear and visually accessible from all angles as possible, providing seamless connection between inside and out.

Special care was taken to ensure that sufficient solar shading was provided to minimise solar gain despite the large glass surfaces. A safety glass system is used for the majority of the balustrades.

fig 7.5 example of glass balustrade

fig 7.6 Broadfield House Glass Museum, Broadfield, London

fig 7.7 Stone Hill Centre, Williamstown USA, Tadao Ando

fig 7.8 design development - steel details

fig 7.9 Beyeler Foundation Museum - ventilated floor

fig 7.7

7.2.3 Steel

Hot rolled structural steel is used for all components of the assemblage. Bolted connections will mainly be used as this is the most common connector, requiring little special equipment. The precedent used for concrete, steel and glass design was the Stone Hill Centre in Williamstown by Tadao Ando.

All connections between concrete and steel have been accentuated, bringing focus to differences in treatment while successfully integrating the various properties of the materials. Steel hovers over the concrete, creating a synthesis where the two main structural materials of the building meet.

7.2.4 Finishes

Floor finishes on the heaviest trafficable areas are seamless epoxy mortar. The exhibition space floor is plywood with a seamless finish. The majority of the wall covering in the lecture room perforated plywood with absorptive material behind to attain acoustic properties.

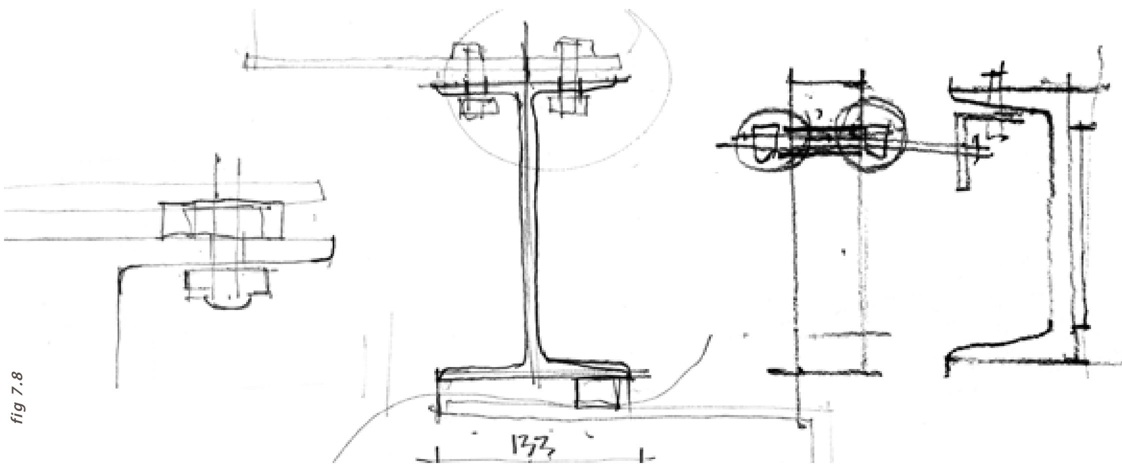


fig 7.8

fig 7.9

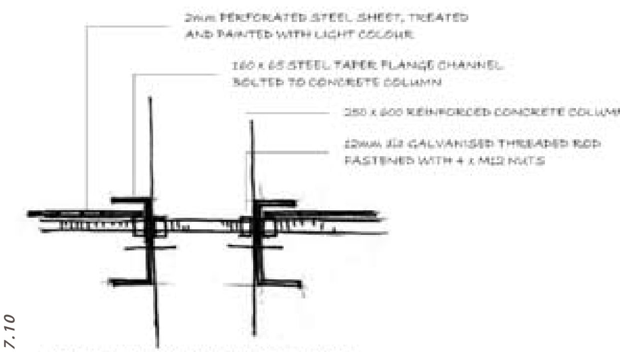
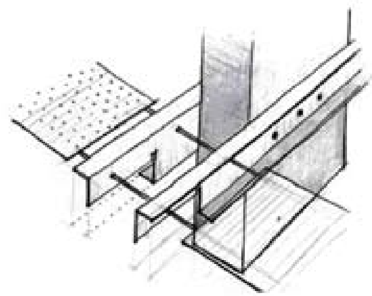


fig 7.10

ELEVATION - CHANNEL LIGHT SHELF

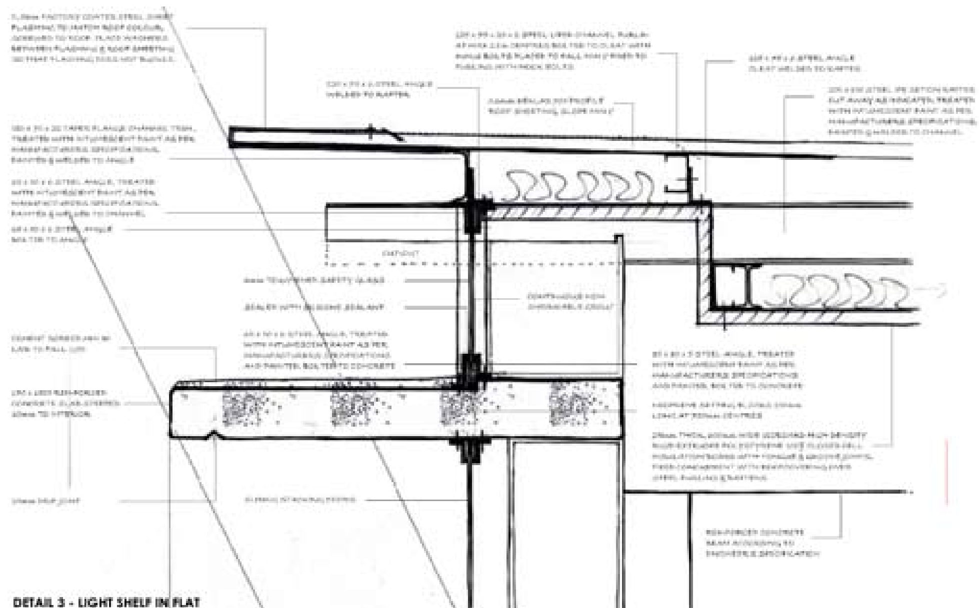


PERSPECTIVE - CHANNEL LIGHT SHELF

7.3 Revealing Detailing

Tectonic suggests a preoccupation with materiality and a championing of craft that respect the expressive potential of construction. The term tectonic has been misused by applying it to denote the undermining rather than the fusion of art and technique. Le Cuyter (2001:15) provides a formal definition of the term 'tectonic': "the word tectonic is derived from the Greek word tekton, meaning carpenter or builder. It signifies the fusion of technique with art, of construction with poetry."

The importance of the physical suggests a preoccupation with construction detail as a vehicle for expression. Selectively hiding and revealing elements draws attention to it. Shadow lines emphasises the meeting of horizontal and vertical planes.



DETAIL 3 - LIGHT SHELF IN FLAT

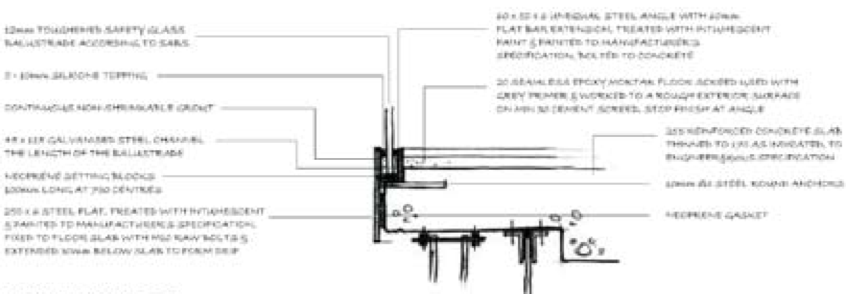


fig 7.11

DETAIL 6 - BALUSTRADE
1:20

7.4 Revealing Systems

Because of the unique shape and nature of the building, its five facades were all treated differently, depending on orientation, approach and response to the immediate surroundings, e.g. the courtyard, or public street.

fig 7.10 detail of architectural studio light shelf

fig 7.11 construction details - see chapter 8

7.4.1 Orientation

Orientation was an important determinant in the design of the facades, namely:

- Elimination of direct heat gain and solar radiation by means of overhangs and shading devices.
- Maintaining views, natural light and ventilation regardless of the shading devices.

Each component was designed to optimally exploit the northern and southern aspects of the building, thereby overcoming any constraints imposed by the orientation while making the most of the opportunities offered.

7.4.2 Ventilation

For the most part the building makes use of natural ventilation. Strip windows allow for cross ventilation and reflected natural light. However, due to the nature of the building and its functions it is not possible to rely solely on passive ventilation systems.

The formal areas of the auditorium and offices require mechanical ventilation to achieve optimum human comfort levels. When the function of a room makes the use of sound isolation essential, a mechanical system is also needed. The air-conditioning system used in the building consists of split units with the compressors and condensers located in the basement. The service shaft behind the lift has an opening to allow for sufficient air supply.

A deliberate attempt was made to reduce the demand on the mechanical ventilation system and to save energy by applying the following principles:

- High thermal mass is provided by concrete floors and walls and brick walls, taking advantage of the fly wheel effect (term used to describe the property of a material to remain at a given temperature).
- Light coloured concrete is used for exterior walls and light coloured roof sheeting, reflect solar heat instead. (Dark colours absorb solar heat)
- Ample overhangs and circulation elements form weather buffers on the north and western facades.
- Glazed surfaces on the western and eastern sides of the building are kept to a minimum to reduce solar heat gain or loss. Where glazing occurs on these facades, proper shading devices have been provided. North-facing glazed facades are also provided with effective shading. Large south-facing glass areas allow maximum soft southern light into exhibition and studio spaces without solar gain.
- Openings in the basement at the front and around all planters, as well as above the ramp permit natural cross ventilation
- Where plywood floors are used, ventilation grilles have been placed between the battens on either end allowing for ventilation.

7.4.3 Solar Control

Lighting of the building interior is mainly by means of daylight, supplemented by artificial light where necessary. The predominantly linear shape of the building allows for good natural lighting in all spaces. Daylighting strategies consider heat gain, glare, variation in light availability, and solar penetration. These are addressed through opening size and spacing, shading devices, glazing materials and surface reflectance materials.

All studios and exhibition spaces were placed on the southern sides with large double storey glass walls to provide soft southern light in these spaces. East, west and northern fenestration are controlled to permit good daylighting while limiting direct solar penetration and heat gain.

fig 7.12 light shelf and sun shading - architectural studio

fig 7.13 timber louvres - workshop

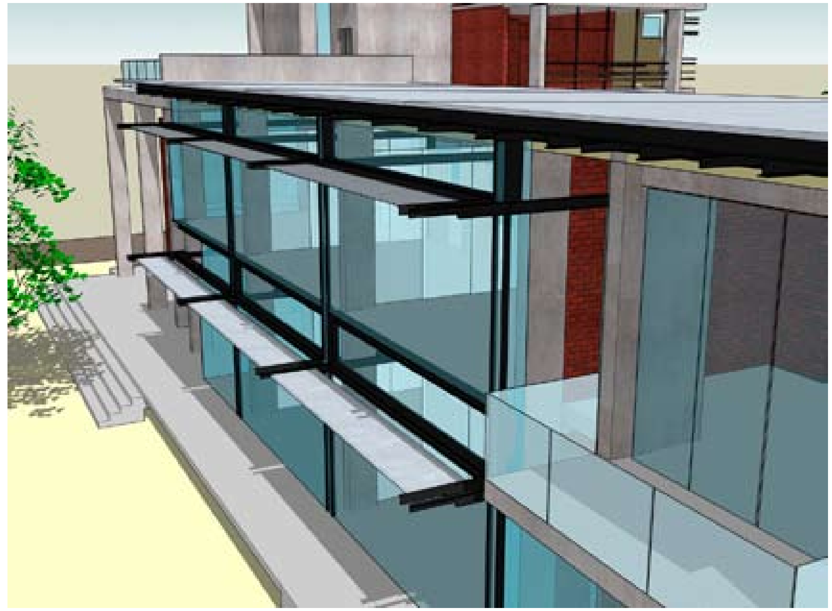


fig 7.12

fig 7.13

fig 7.14 timber louvers - offices

fig 7.15 timber louvers - 25 Daleham Mews, London

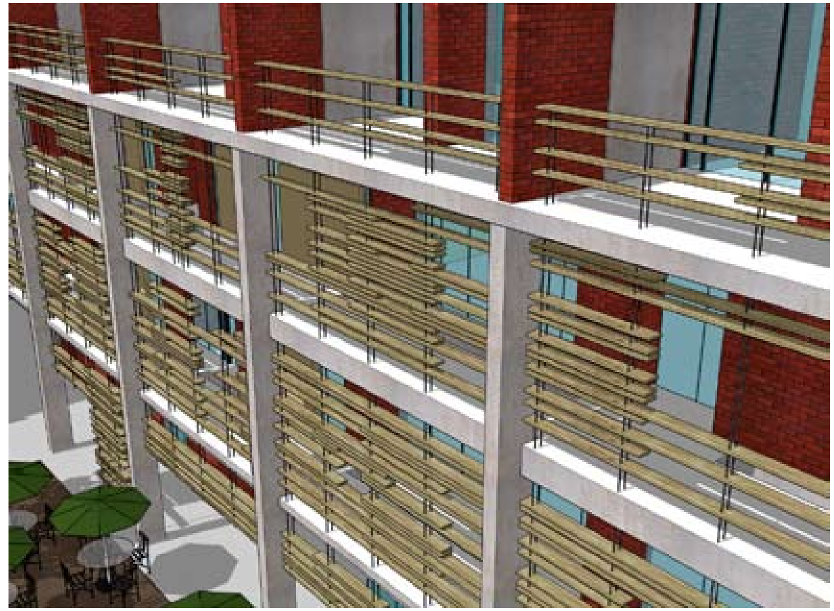


fig 7.14

fig 7.15

7.5 Revealing Services

Louis Kahn on services:

"I don't like pipes. I don't like ducts. I hate them thoroughly, but because I hate them thoroughly, I feel they have to be given their place. If I just hated them and took no care, I think they would invade the building and completely destroy it" (Frampton, 1996:217).

The design of the services provided was refined several times from the concept design to the final product. The most important decisions were made on the basis of ensuring services that functioned optimally without cluttering the spaces in between.

The services in the building were regarded as design opportunities rather than constraints. Because of the fragmented nature of the building, the service cores and shafts were used to connect the separate building elements vertically as well as on plan, forming pivot points throughout the building.

7.5.1 Site

The proposed project is situated on a 'Brownfield' site that is currently used as a parking lot. The parking area is finished with impermeable asphalt that is detrimental to biodiversity. A basement parking level has replaced and added to the existing number of parking spaces available.

7.5.2 Acoustics

The auditorium is fitted to allow for optimum acoustic performance. Standing waves between parallel walls may cause the enhancement of certain frequencies. This is undesirable, as optimum sound produces the same amount of enhancement across all frequencies. To avoid this, the auditorium has non-parallel walls along the sides so that the standing waves are not trapped. The contents of a room affects the amount of absorption and in turn the reverberation time. For this reason the auditorium has seats that act as sound absorbers for shorter reverberation (speech).

In the auditorium the speaker in front produces the sound and for this to be clearly audible in a direct sound path, all the listeners sit on stepped seats within eyesight of the speaker.

For excellent sound enhancement, the ceiling and side walls of the rooms are finished with plywood panels that reflect and disperse sound. The plywood panels have absorptive material behind them to absorb background noise.

Where the floor and ceiling are parallel where the speaker stands, flutter echoes will occur between the two surfaces. The speaker will hear himself and will therefore tone down his voice and will thus not be heard at the back of the room. This can be prevented by an additional angled sounding board suspended above the speaker to reflect sound where it is desired.

To further improve the acoustics in the auditorium, the back wall and a third of the ceiling were made absorbent. Plywood panels fitted to the rear wall have 6mm diameter perforations, to allow the sound through to be absorbed by the porous material behind the panels.

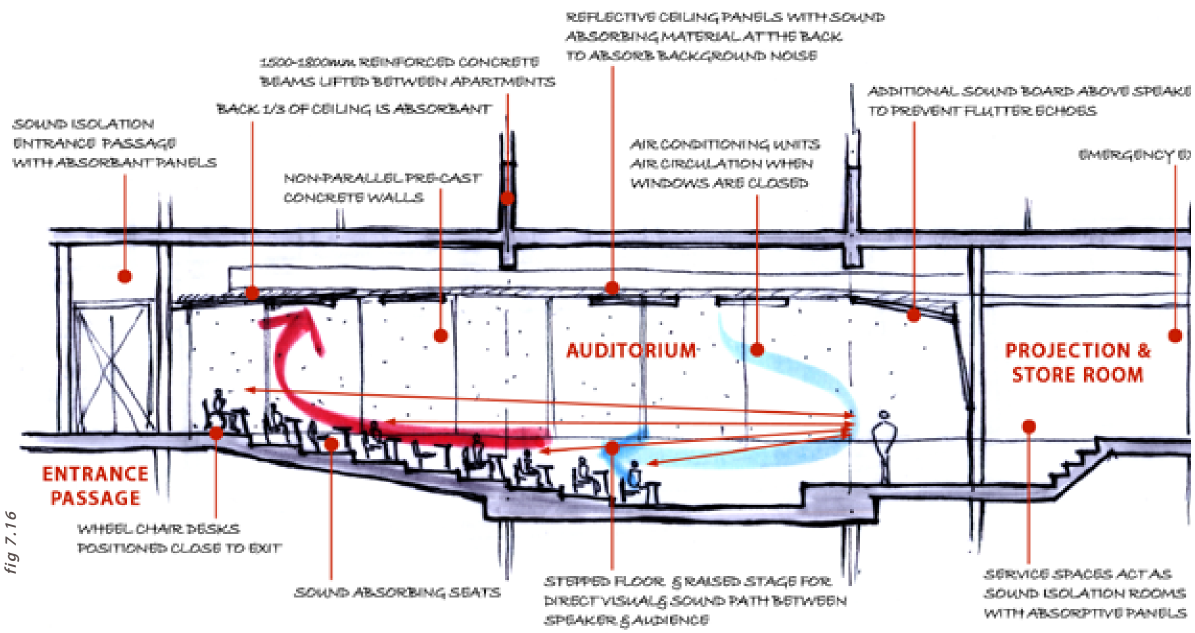


fig 7.16

fig 7.16 acoustic treatment of lecture hall

7.5.3 Rainwater Harvesting

Rainwater harvesting will be feasible, due to the large roof area of the project. The water harvested will be used for irrigation purposes only and not for human consumption. This implies that there will be no need for water treatment. Rainwater can simply be stored for use when needed, or used directly for irrigation.

The drainage surfaces on the roof consists mainly of profiled sheeting as well as some exposed concrete surfaces. All water is drained toward outlets and gutters leading to 80mm diameter mild steel galvanised down pipes placed in columns which drains into storage tanks.

The basement has openings allowing for natural ventilation and lighting and this may lead to minimal amounts of rainwater getting into the basement. This water is drained via a granolithic surface laid in a herringbone pattern with a minimum slope of 1:70 and laid to fall toward the sump indicated on plan from where it is mechanically pumped to the surface and planters.

Excess surface water is drained into the main municipal storm water management system.

Amount of collected water:

= collection area (m2) x 0.7m/year

TOTAL WATER HARVESTING AREA = (1 717m²)

MONTH	AGGREGATE RAINFALL IN mm / MONTH FOR PRETORIA	TOTAL AMOUNT OF WATER HARVESTED (kl)
January	101.3	174
February	108.8	187
March	63.8	110
April	37.5	64
May	48.4	83
June	3.8	7
July	2.3	4
August	2.3	4
September	11.3	19
October	82.5	141
November	168.8	290
December	112.5	193
TOTAL	**745.27mm**	**1276kl**

Financial gain brought about by water harvesting: 1276kl of water at a cost of R6,90 (July, 2008) per kl of water, R8804 can be saved annually.

fig 7.17

fig 7. 17 cove 6, Pezula Golf Estate, Knysna, Stefan Antoni Architects

fig 7.18 diagram showing circulation shafts and service cores

7.5.4 Ducts & Circulation Shafts

Sewage will be collected at one point along the perimeter of the building and connected to the municipal line in the north-east corner of the site. Wet core services have as far as possible been kept to a minimum. The main soil pipes are fixed to the soffit of the coffer slab in the basement and run horizontally from the ducts to the main pipeline.

See appendix 10.4.7 for Sewage lines and municipal connections.

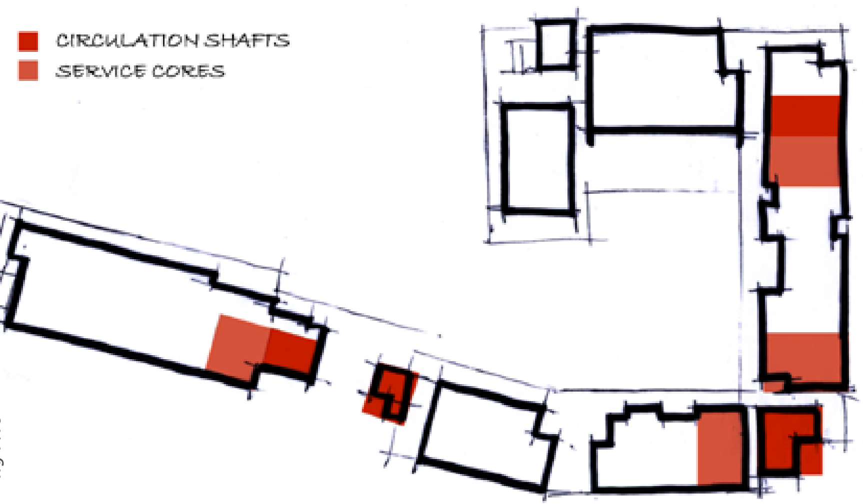


fig 7.18

7.5.5 Fire

A rational fire design will have to be done by a professional. The entire building will comply with the Standard Building Regulations, with a suitable sprinkler system and fire fighting devices in place.

According to SABS 0400 TT7, structural elements in a 3-10 storey building must have the following resistance:

OCCUPANCY	CLASS OF OCCUPANCY	FIRE RESISTANCE (minutes)
Workshops	B2	120
Offices	G1	60
Restaurant	A1	120
Book Shop	F2	120
Auditoria	A3	90
Parking Garage	J4	60
Exhibition Hall	C1	120
Residential	H3	60

Structural steel will require a fire resistant coating. This will consist of a primer, an intumescent base coat, and a decorative top coat.

According to SABS 0040 section TT16.4, the travel distance measured to the nearest emergency escape access door must not to be more than 45m from any point in the building. The greatest distance to travel in the building to a fire escape is 28m and therefore complies with the regulations.

According to SABS 0040 TT17.1 a lecture room that has s population of more than 50 persons should have a minimum of 2 exit doors. The auditorium has 2 emergency exit doors as well as the main entrance doors and therefore complies with the regulations.

7.5.6 Facilities for the Disabled

According to SABS 0040 section S, all facilities should be fully accessible to persons with disabilities. Accordingly the building has been designed to be fully accessible to persons in wheelchairs. Ramps and lifts have been provided, as well as toilets for the disabled in all bathrooms.

According to SABS 0040 section SS8, at least 1 parking space per 200 provided must be suitable for parking of vehicles used by disabled persons and must be located as near as possible to the building access points. Of the 124 parking spaces provided, 5 are disabled spaces and placed as close to the lift shafts as possible. Ramps lead up to the lift platforms.