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8.0 Technical Study

7.1 Introduction

The following text is supplementary to the set of drawings, to motivate decisions made on a technical level. The chapter aims to deal with the most important technical issues raised through the design process.

Considering that the construction industry is the largest consumer of materials, designers need to make decisions that do not impact adversely on the environment. Designers are in the position to make the public aware of the situation and lead by example, through the use of appropriate materials.

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The hot, humid climate experienced in Durban, as discussed in the context chapter, requires a climate based design process where climate response concepts are a major generator of the architecture.

Climate Responsive Design >>

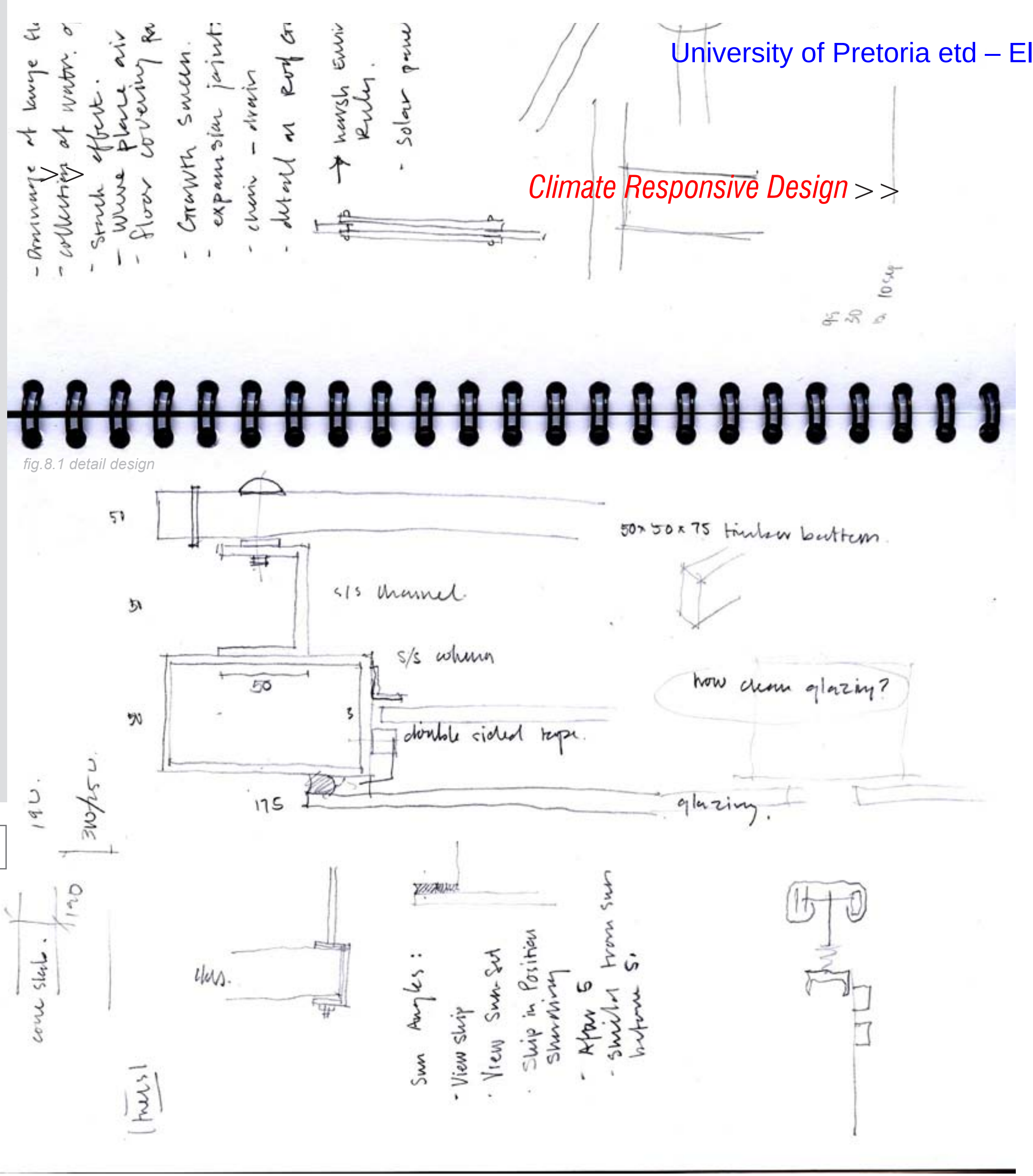


fig.8.1 detail design

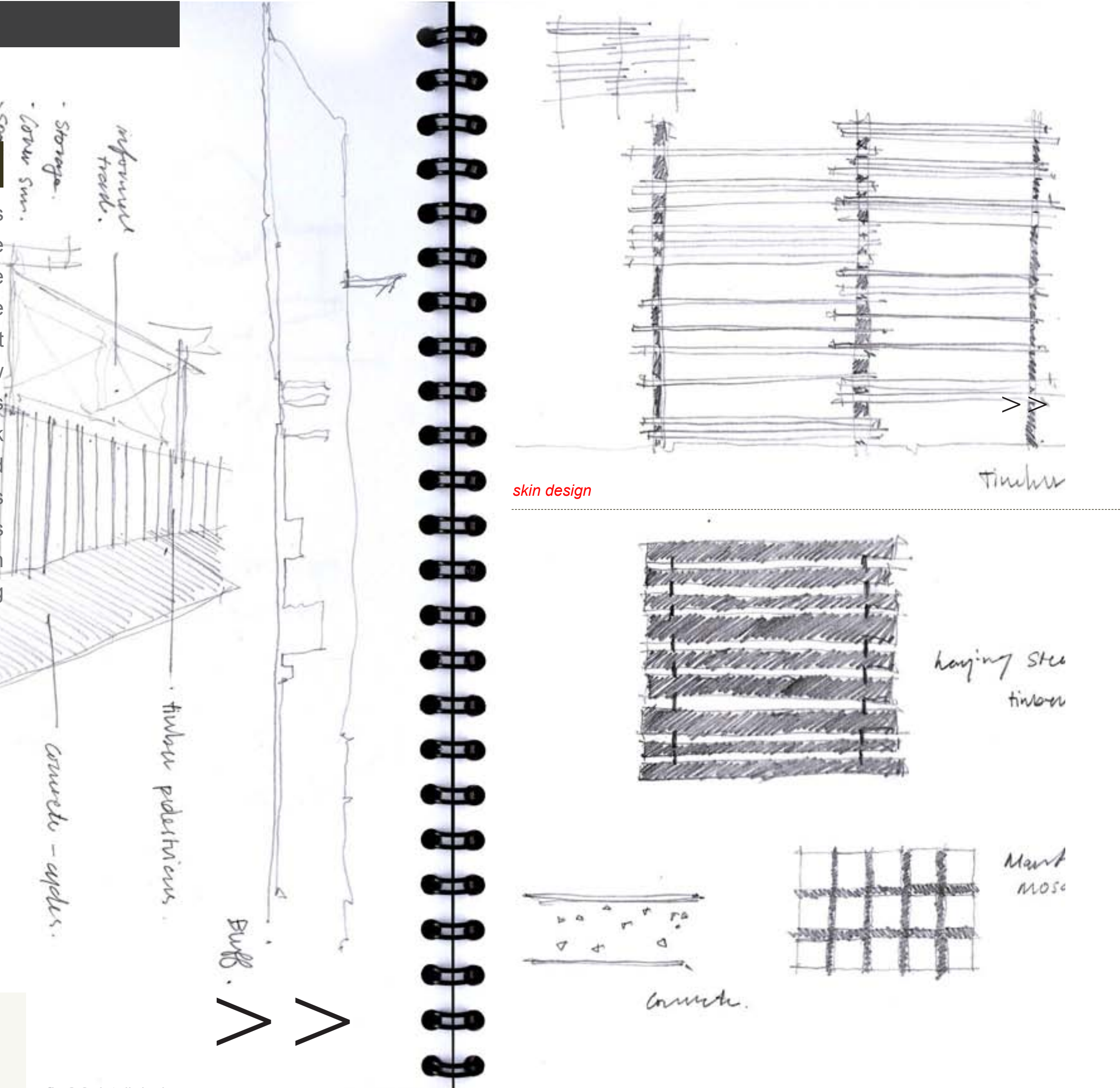
Orientation

The building is aligned to the water edge and ship edge allowing for movement between the two. The result is that the longer facades are exposed to north-east and the south-west.

An advantage of the orientation of the building is that it receives the prevailing summer and winter winds along its longer facades aiding natural ventilation. The situation of the building on the waters edge increases its exposure to these winds as there are no obstructions to block the wind as would be experienced in a city block.

Form

The narrow plan shape allows for effective cross-ventilation due to the natural wind direction. The South Western façade can be opened to allow air movement through the building. The narrow plan also allows for high levels of natural light, avoiding dark areas that encourage mould growth. Natural light decreases the dependency on electric lights which have an adverse effect on the internal heating of the building and energy consumption.



skin design

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fig.8.2 detail design

Structure

The primary structure of the building is a reinforced concrete structure, consisting of columns and beams. This structure is stiffened by slabs, the lift shaft and service cores. This creates a skeletal structure allowing flexibility to the skin that can be modified to accommodate varying internal functional conditions and exterior environmental conditions.

A secondary structure of stainless steel is used on the east and west facades to support the timber batten skin. This structure clips onto the primary structure. A light stainless steel structure is also used to construct the waiting shelter.

The walkway is constructed of concrete columns and load-bearing concrete walls supporting timber beams and battens. These timber beams are placed within openings in the concrete and packed with mortar.

Skin

Saligna timber battens are used throughout the building as a skin, allowing air movement and vision through it. The timber batten screens are used predominantly to screen the building from sun on the eastern and western facades.

Concrete walls with perforations also allow for air movement and visibility.

These semi-transparent skins promote visibility into adjacent spaces, emphasising the circulation routes through the building by making them visible from many spaces.

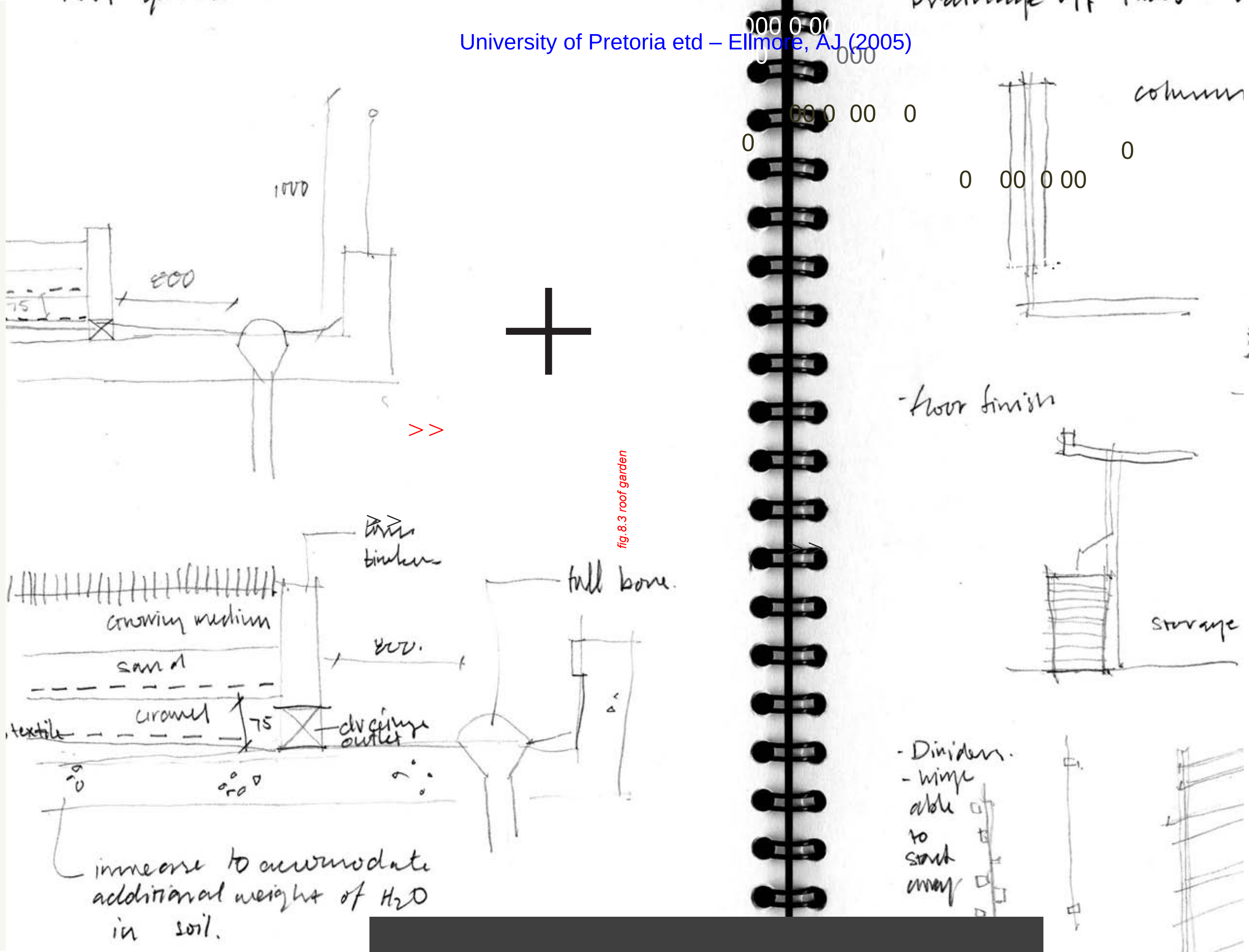

fig.8.3 roof garden

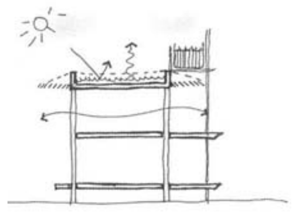

fig.8.4 roof garden

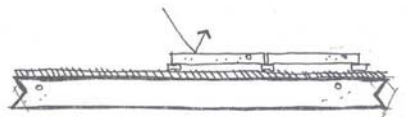

fig.8.5 accessible roof

Roof Design

The primary function of the roof is to protect against precipitation and solar gain. A flat concrete roof is proposed to facilitate pedestrian traffic and viewing platforms.

Due to the scale of the cruise ships the building and surrounding landscape will often be viewed from above. A roof garden is therefore introduced. The roof garden has the added advantage of providing a massive material to insulate the building. The high specific heat of the earth means that it will act as an insulator, and remain at the lower levels of air temperature thus keeping the roof cool. (Hyde, 2000, p. 147)

To provide for a level, accessible viewing platform concrete tiles on plastic spacers placed on the concrete roof slab are used. By placing insulation above the waterproof membrane an inverted roof is created. The insulating layer protects the waterproofing layer and also reduces heat gain to the slab. The light colour of the concrete tiles and slab will also reflect the sunlight.

Ventilation

Buildings in Durban require good ventilation due to the high humidity levels. The building makes use of a combination of both passive and mechanical ventilation methods. The zones that have no contribution from the external environment are called active zones and require air-conditioning and mechanical ventilation. The aim of the design is to make the passive zones as large as possible and to reduce the number of active zones, and by so doing, conserve energy.

Passive Ventilation

According to Hyde [2000, p.74] the design factors affecting ventilation are as follows:
- Reduction of plan depth and increase openness of section to facilitate cross-flow and vertical flow of air.
- Optimum orientation of rooms to the prevailing breeze and the linkage between leeward and windward side to utilize pressure differences.
- Maximize the skin opacity through the number of openings.
- Reduction of internal obstructions.
- Site selection and building situation to increase exposure to airflow effects.

The width of the building is 12m, allowing for effective cross ventilation. Planes, at right-angles to the flow of air, have been punctured to allow air movement through them. The use of high ceilings also promotes cross-ventilation.

Mechanical Ventilation

Mechanical ventilation requires an insulating, defensive skin to reduce energy consumption and retain the cool air. This skin of large amounts of mass and solar glass create a barrier to the exterior and the connection to the natural climate is lost. A further consequence of this is that the visitor is separated from the place they have come to experience, clearly defeating the purpose of the building (Hyde 2000, p. 9)

The kitchen will be mechanically ventilated, and a extractor will take the heat out the building.

Air-Conditioning

The harbour office, wine cellar, staff room and kitchen office will all be cooled using separate split air-conditioning units. This allows for each room to be controlled separately allowing individual control. The upper level of the restaurant has a layer of glazing to insulate the space, and retain the cool air from the air-conditioner. Automatic sliding doors are also provided between air-con and non-air-con zones, to retain the cool air. Both this upper restaurant level and the customs and luggage hall will be air-conditioned using two separate plants that will be situated on the roof slab above. These plants will be hidden using timber batten screens as they need to be ventilated.

The air-conditioning plants cooling the customs hall will be on a economy cycle, saving energy. When the air being released out of the plant is cooler than the external air temperature it will be directed through the lower level of the restaurant to cool it. This will work well in the evenings, pre-cooling the surfaces for the morning.

The building was analysed using a computer program, the results indicated that by using natural ventilation in the lower restaurant areas the maximum temperature, on the maximum temperature day with the maximum volume of people in the restaurant would be 28*C. This is seen as acceptable [Kohler, 2005]

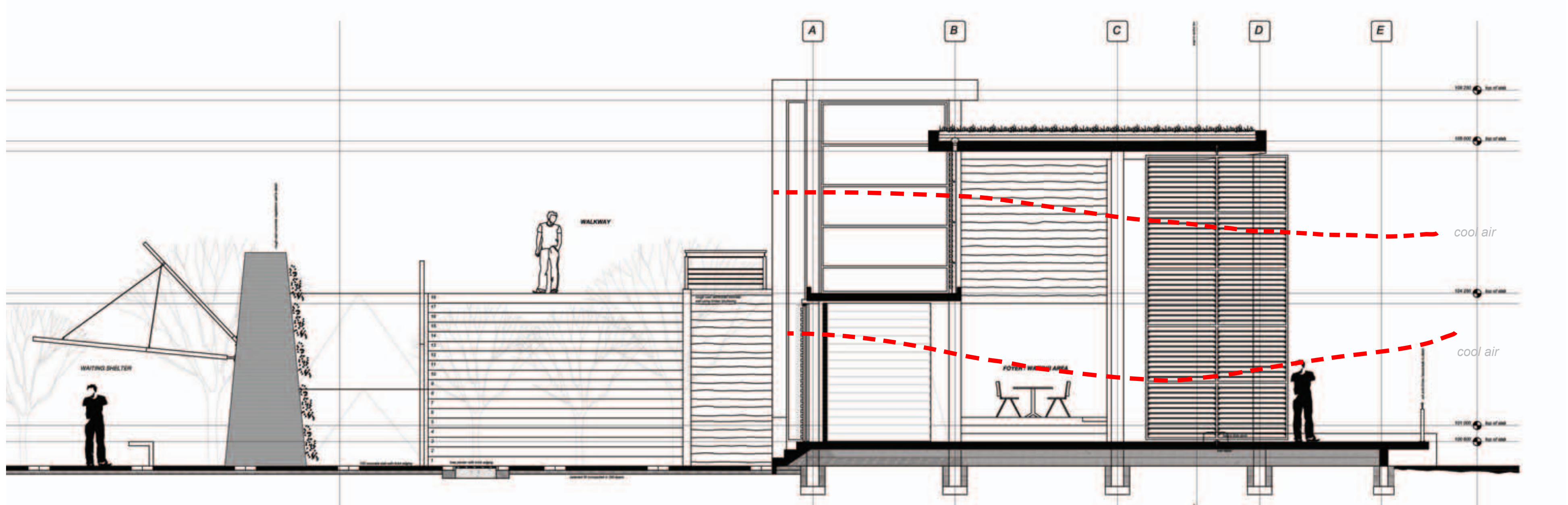

fig.8.6 building section showing cross ventilation

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Floor Surfaces

Granite floor tiles, finished to have a non-slip surface are used in internal public spaces. Floor surfaces are used to indicate the important movement routes through the building. Routes for passengers boarding or disembarking a ship are indicated using a change in the composition and geometry of the tiles.

Concrete with brick trim is used for high traffic external spaces. Granite crush will be used in spaces with less traffic flow. Pre-cast concrete slabs placed in the gravel will allow for easier movement.

Harsh Coastal Environment

The harsh coastal environment has a large influence on the material palette. As mentioned concrete, timber and stainless steel are used due to their high resistance properties. The use of these materials needs to be in such a way as to allow for easy maintenance and replacement of components. Details should be so designed as to prevent the collection of water, that would otherwise cause rusting.

Inclusive Environment

The building allows for access to people in wheel chairs. Ramps allow for movement through the building and a disabled persons WC is provided. Provision has been made for a travelator to be installed at a later stage if required. A lift is also provided.

Transformability

The different size of cruise ships results in diverse requirements in the building. Entrances need to be provided on the dock level for smaller ships, as well as an entrance on first floor to accommodate a gang-plank or a loading bridge similar to those used at an airport.

The scale of the ships can be likened to moving architecture, and the project needs to allow for the situation when a ship is in dock and when one is not.

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Cruise ship environment

Due to the buildings fun

At present the ships that frequent Durban are smaller ships that accommodate approximately 700 passengers including crew. The largest ships can accommodate up to 3 000 passengers, however these ships do not visit Durban often, only every four or five years. When these ships do dock it is highly unlikely that all passengers will disembark the ship, small groups of passengers will disembark to go on organised tours at different times [Beukes, 2005]. At present the decision has therefore been made to design the terminal to cater for the smaller ships, as it would not be feasible to design the building to cater for 3 000 passengers that may visit every four years. It will however be possible to accommodate larger ships due to the nature in which passengers disembark or board the ship. Passengers are provided with coloured stickers and disembark in groups of 40 people. Groups simply have to wait their turn, and can continue relaxing on the ship until their group is called. Once the luggage is off it usually takes approximately an hour to disembark 700 passengers [Beukes, 2005].

The difference in size of the cruise ships results in diverse requirements in the building. Passengers may need to enter the building from dock level or they may enter the building on first level. Two entrances have therefore been provided.

In terms of site selection the major requirement is space for a turning circle of 400m

Service Requirements:
The major requirement is for sufficient space along-side the ship to allow access for a truck to deliver food and beverages to the ship and to remove waste and luggage from the ship. This space is also required to fasten the ship to the dock.

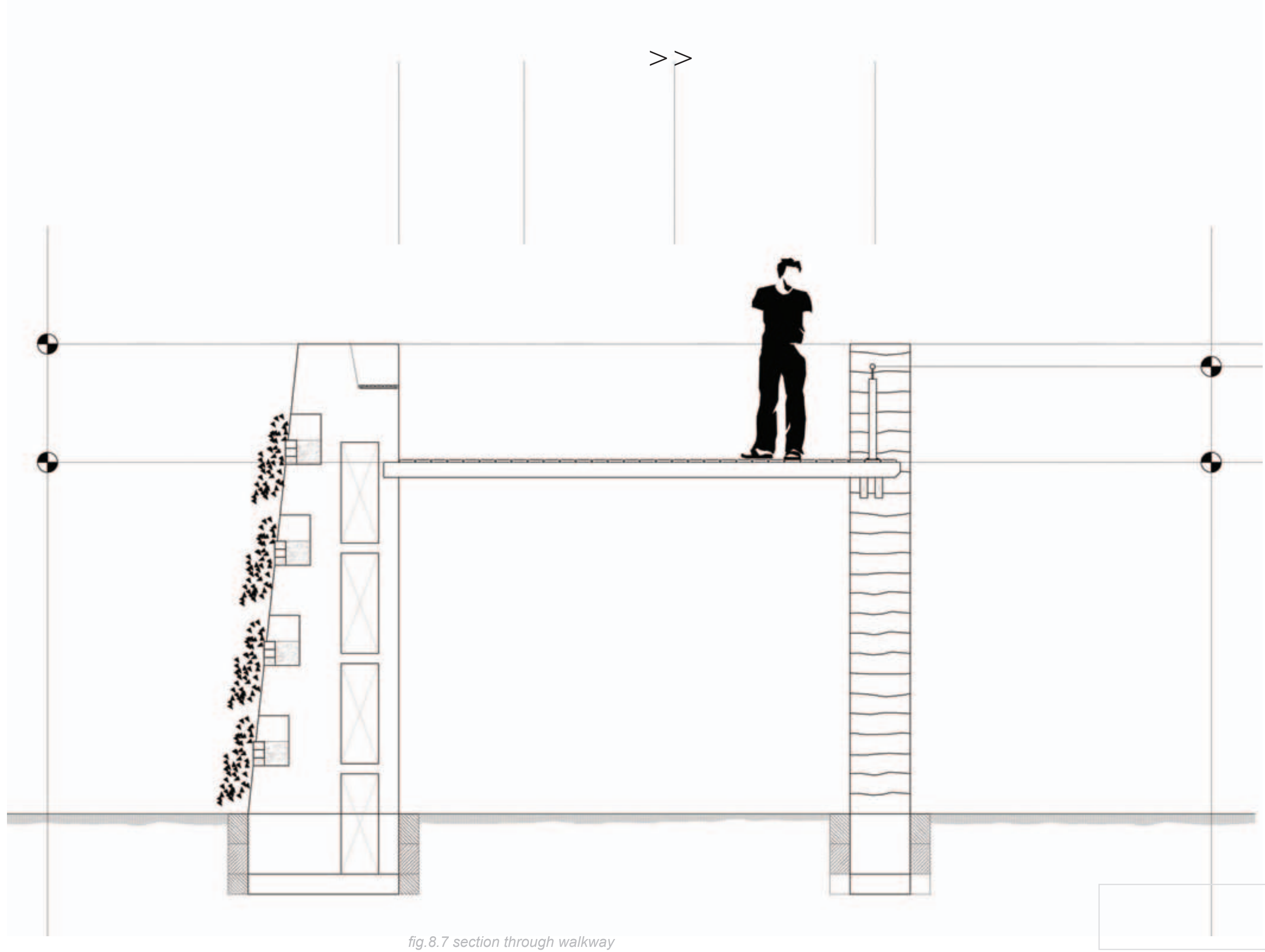

fig.8.7 section through walkway

Path

The walkway provides an alternative means of transport for people living in the CBD and working at the Point Development or vica-versa. It also provides a safe route for cyclists, joggers and walkers, with views of the city, harbour and The Bluff. With a one way distance of 1.6km it is an appropriate distance for pedestrians.

A spine for future development along the waterfront is developed. Functions can be "clipped" on or can "grow off" the walkway structure. This is in line with the city's plans to reclaim the waters edge and future plans to relocate the harbour.

The journey from point A to point B becomes a journey where the user is provided with information about their context. Information boards provide information on the history and cultures of Durban. The history of Durban could be provided in timeline format starting at the Da Gama Clock, the first person to arrive at Durban by ship. Information is provided about the Mangroves and environment issues, creating awareness. The walkway is routed in such a way as to emphasise the surrounding views of the harbour, the city and The Bluff.

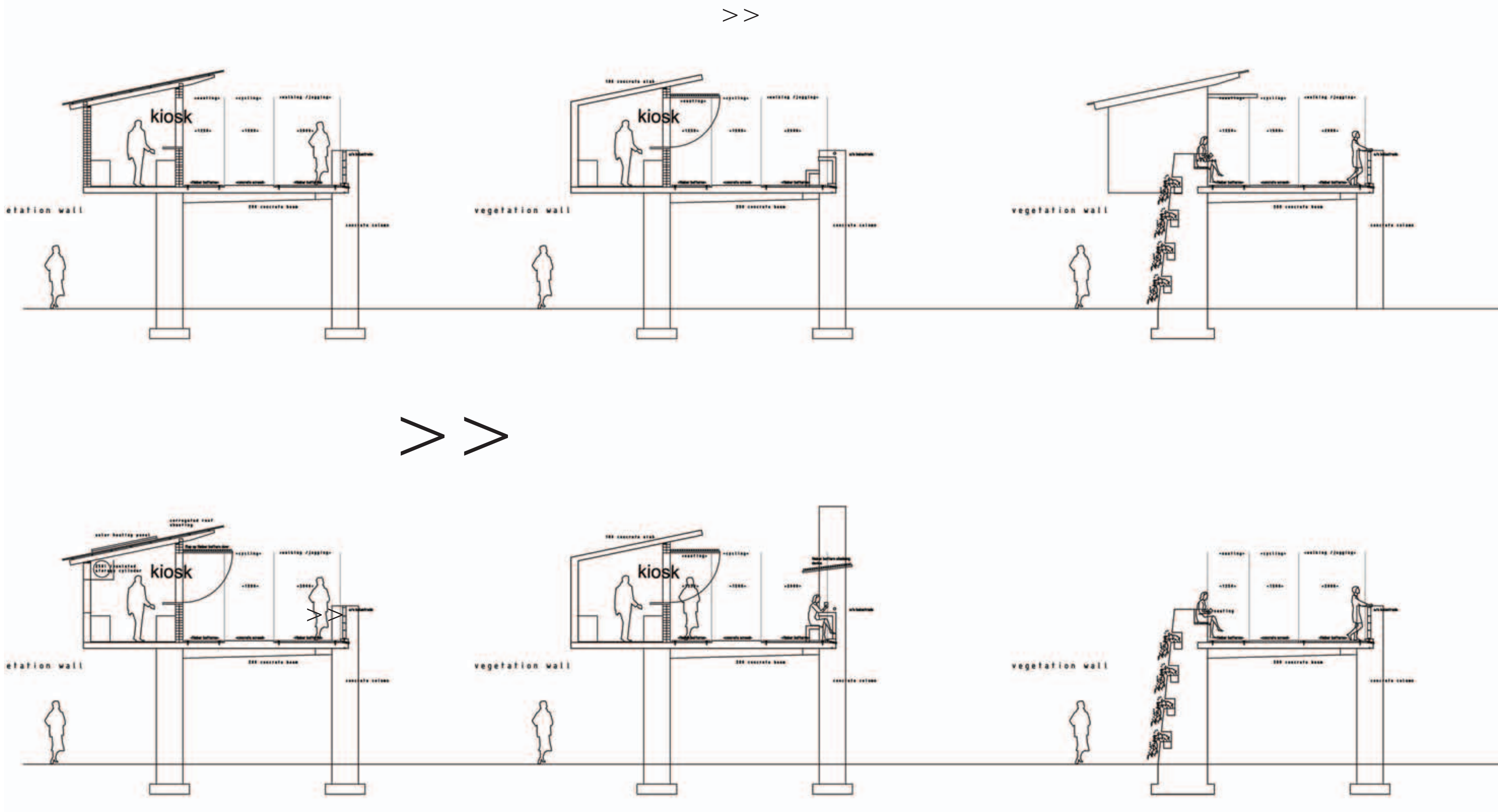

fig.8.8 design sections through walkway

materials

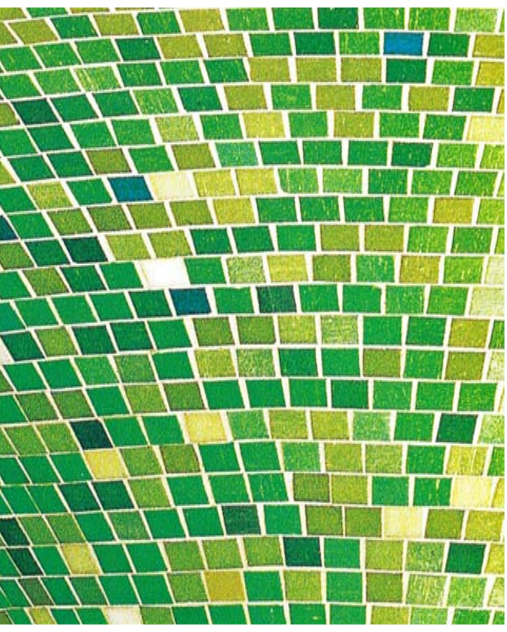
fig.8.14

Timber

Timber is traditionally associated with marine environments due to its resistant properties once treated. The use of timber once again refers back to the landscape and surrounding environment of Durban and a link between man and the natural environment. Saligna, a softwood, which is medium red to dark red in colour, with a straight and even grain is to be predominately used.

Sligna timber battens are used to create sun screens, as well as the pivot doors. These battens are supported using a stainless steel frame. The battens are to be treated accordingly.

Timber is used for the construction of the walkway. If due to future demands the construction can be dismantled and recycled as building material or burned as fuel.

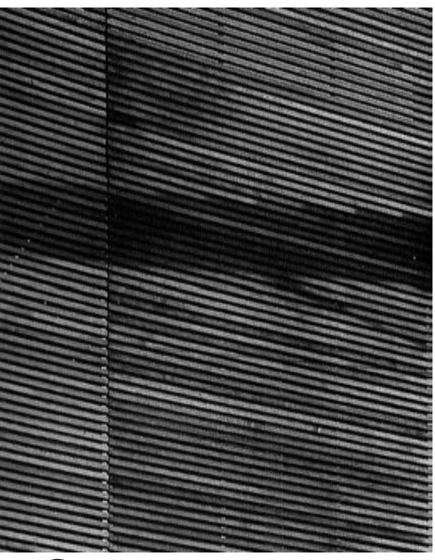
fig.8.13

Mosaic

Mosaics are used as internal decoration. Green mosaics are to be used to refer to the landscape. Artisans from the neighbouring BAT Centre are to be employed, providing a sense of identity to the building and involving the community to instil the idea that the building belongs to the Durban public.

Stainless Steel

Due to the harsh coastal environment, grade 320 stainless steel is to be used through-out the project. This decision is based on the long term benefits of this material in a marine environment.

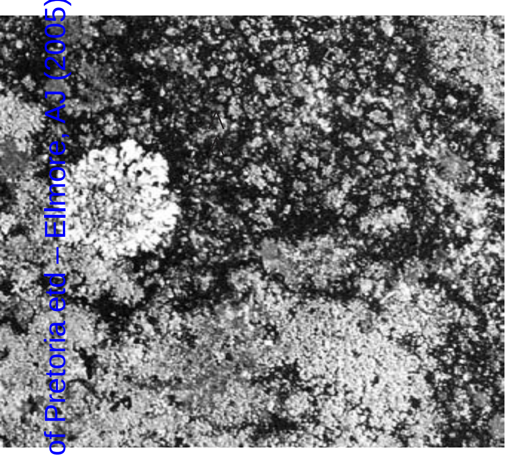
fig.8.12

Granite Crush

Durban Harbour exports vast quantities of granite blocks. Granite crush from the quarries can be transported with these granite blocks. This crush shall be used as an external floor covering. As mentioned the project will be viewed from above when aboard a cruise ship, therefore the overall landscape becomes important. The granite crush will complete the sculptural effect of the walkway.

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fig.8.11

Concrete

Concrete is the material used for both the structure and solid envelope construction. All concrete will be off-shutter, with finishes varying from smooth to rough. Steel shuttering will be used to create the smooth surface, while timber shuttering will be used to create the rough finish. The timber shuttering will be burnt with a blow torch first to enhance the timber grain into the concrete finish. The timber grain in the concrete will refer back to the natural landscape and environment of Durban.

The direct finished concrete floors, which are power floated and smoothed with a steel trowel before setting.

A white concrete mix will be used throughout the project, this will enforce the contrast between the existing harsh harbour environment and the new spine layer placed on it.

Glazing

Standard float glass is used in the passive ventilated zones. However the glazing in the air-conditioned zones will use an insulating glass, to retain the cool air within the space. All glazing to be installed according to Part N of the SABS 0400.

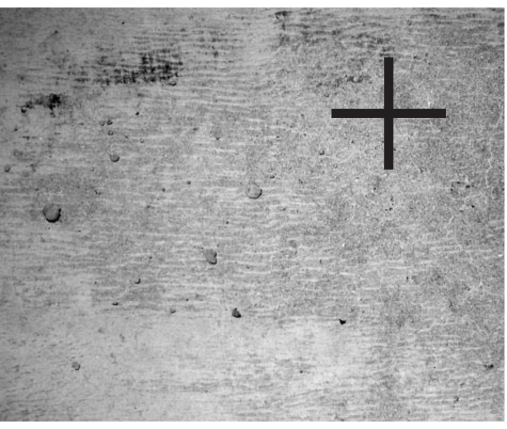
fig.8.10


fig.8.9

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Fire

The guidelines for fire management as dictated by The National Building Regulations [Part T of SABS 0400]

-Life safety and provision for escape.
-Minimize the spread of fire both within the structure itself as well as from building to building.
-Provision for structural stability within a prescribed time.
-Detection and prevention of the spread of smoke and heat.
-Provision for detection devices, control and extinguishing equipment.
-Limiting the destruction of property.

Escape routes will not exceed 15m in one direction. The total length of the escape route plus the emergency route to a safe point outside the building does not exceed 45m. Fire hose reels are supplied at intervals of 30m.

Fire detection equipment should form part of the 'building management system'. A sprinkler system will be installed in the ramp area, and smoke detectors in all rooms. The building is a smoke-free building therefore smokers will need to make use of external spaces.

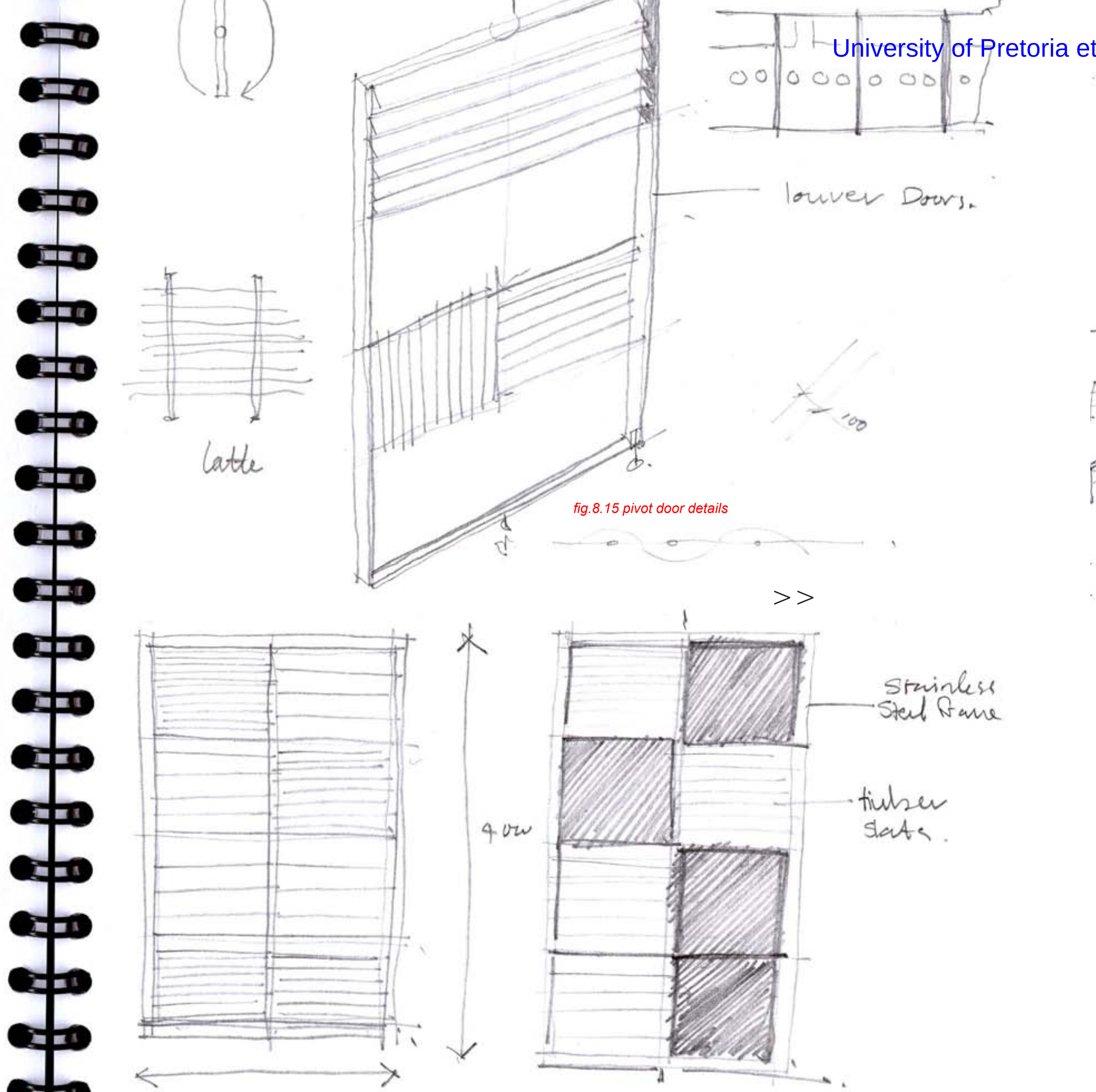

fig.8.15 pivot door details

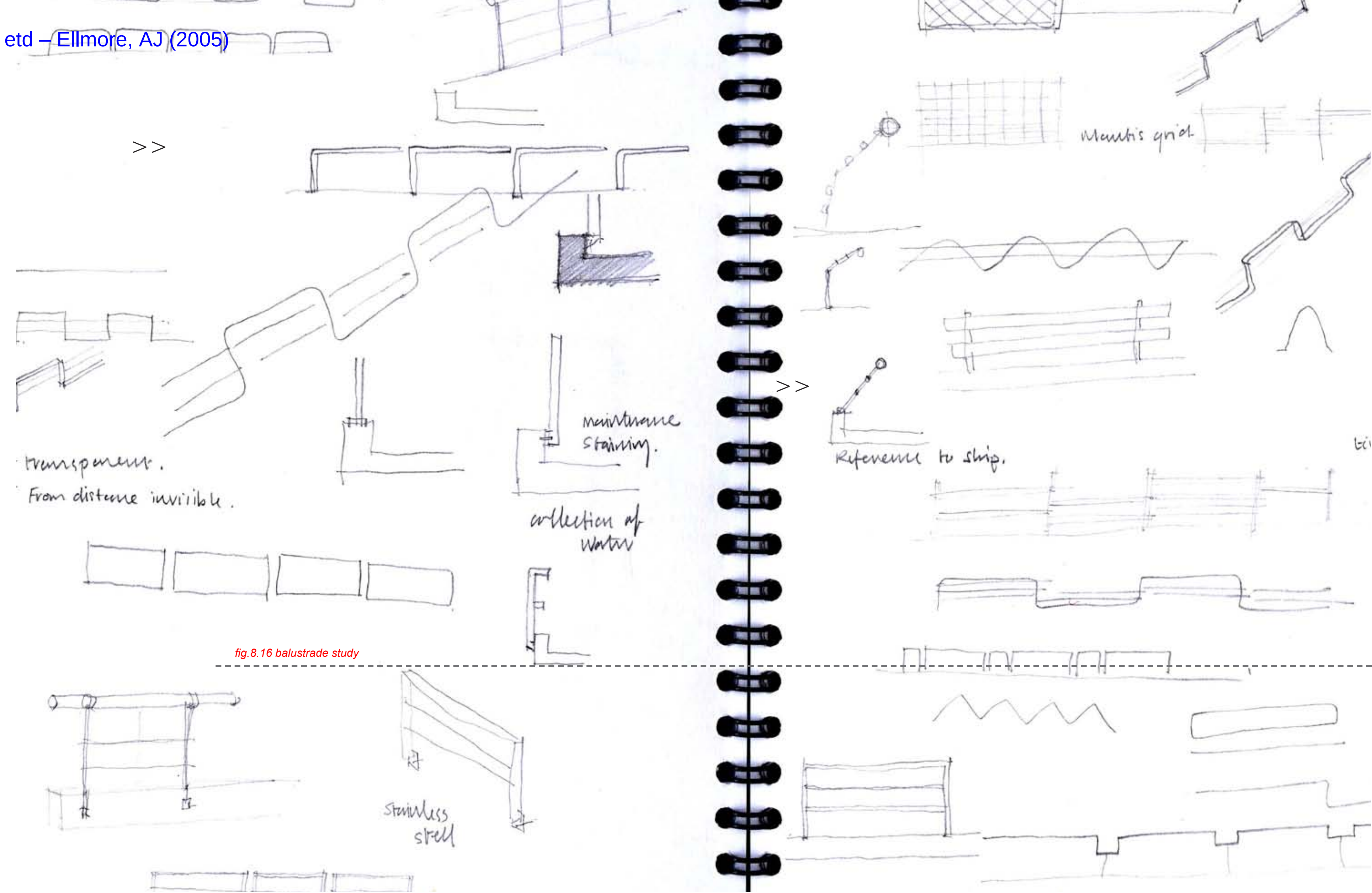

fig.8.16 balustrade study

Lighting

The presence of the building and the pathway through the harbour at night can be enforced through lighting. Due to the darkness of the bay at night, the contrast of the illuminated walkway will be striking. Lighting will be provided at intervals along the pathway, providing security. Viewed from a cruise liner at night these lights will emphasise the link of the cruise terminal to the urban fabric of the city. These light poles at intervals should have their own solar power source, and should be designed in such a way as to provide shading during the day. These light structures could be read as trees within the landscape.

This provides a public space that can be used through-out the day and night.

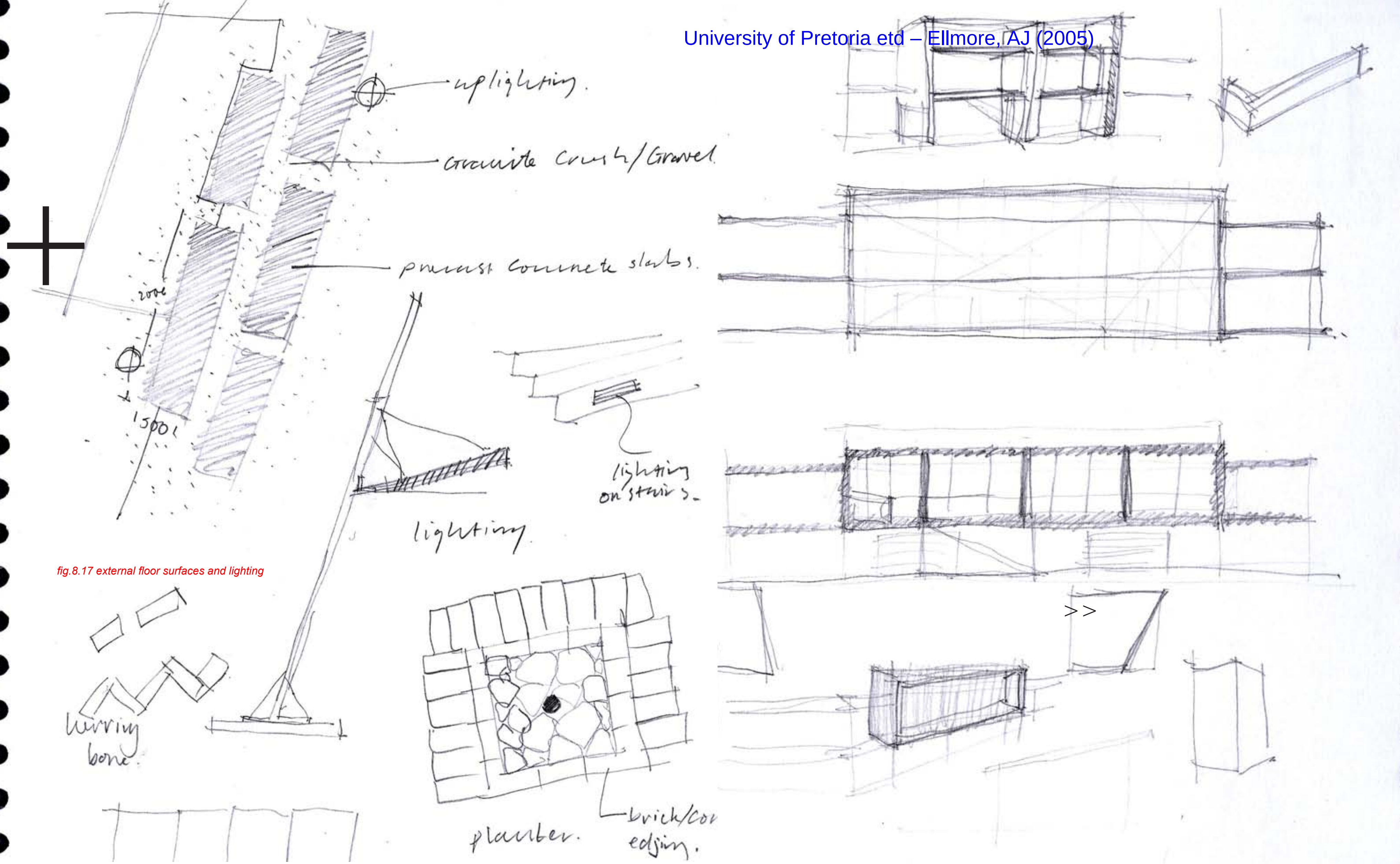

fig.8.17 external floor surfaces and lighting

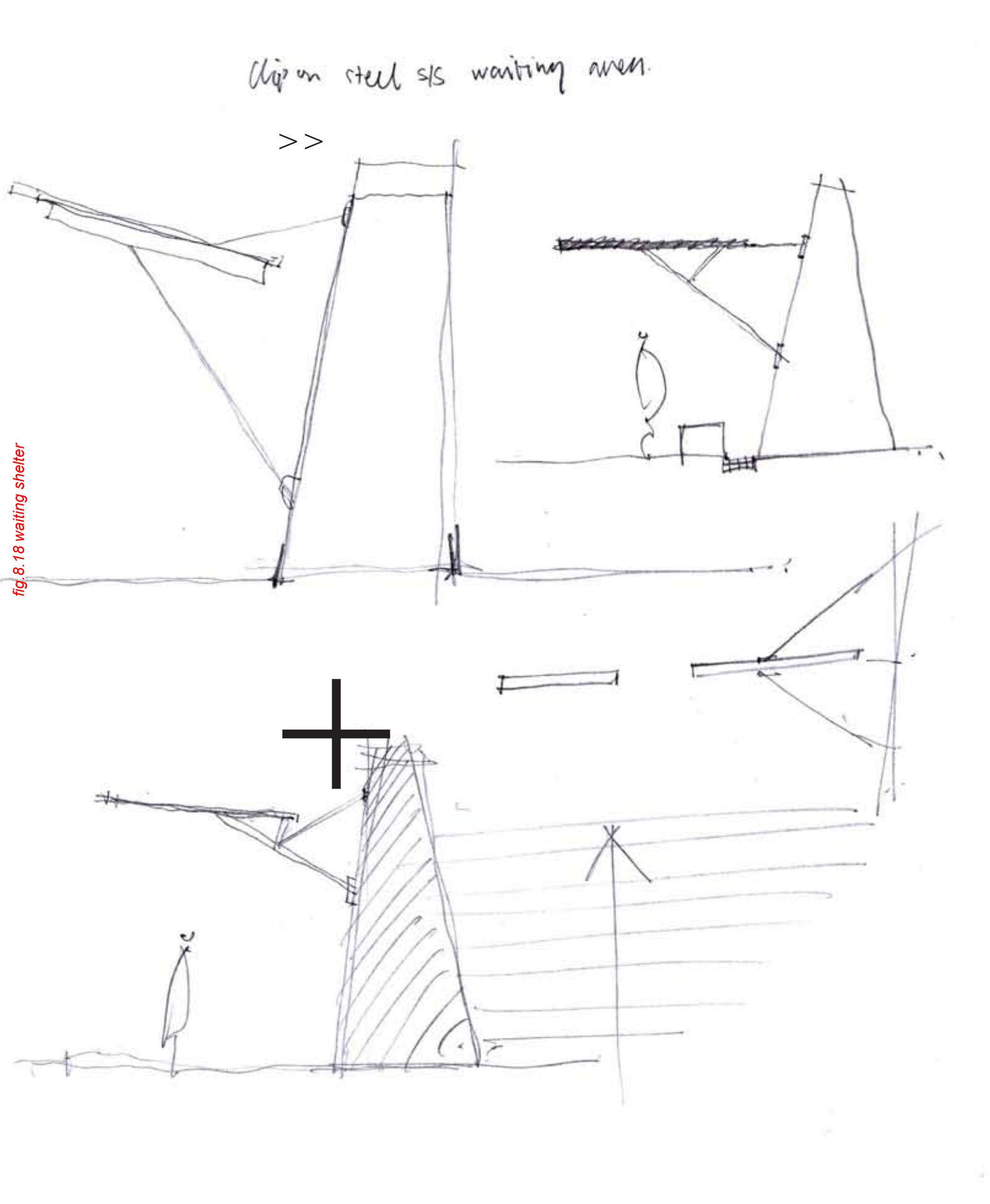

fig.8.18 waiting shelter

Mangroves and wetland

Cato Creek, the river that created the Bay of Natal, is presently concreted over making it invisible to the general public. The design proposes the river be opened up and an artificial wetland and mangrove forest be built. Mangroves flourished in the area when early settlers arrived.

Mangroves provide a nursery area for aquatic organisms and a refuge for a variety of bird species. Other advantages include: stabilizing shorelines; reducing wave and wind energy; supporting coastal fisheries; medicinal products and eco-tourism. People making use of the walkway would be provided with information concerning the mangroves making people aware of their surroundings.

Although limited information is available concerning the rehabilitation of mangrove forests, the basic requirements have been identified as tidal change. The factors involved are the flooding depth, duration and frequency. A specialist would have to be involved to design an appropriate artificial system using water from Cato Creek after it has been through an artificial wetland.

Suggested mangroves are: Durban Bay mangrove; black mangrove; white mangrove and the red mangrove.

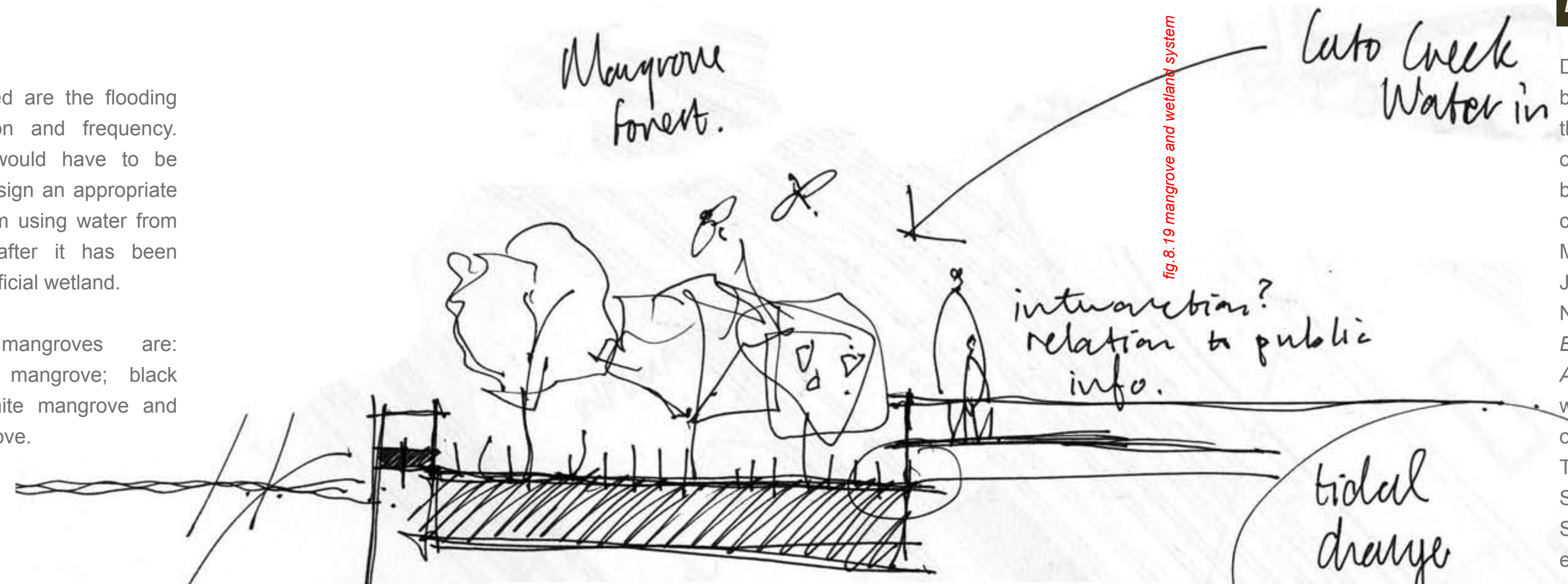

fig.8.19 mangrove and wetland system

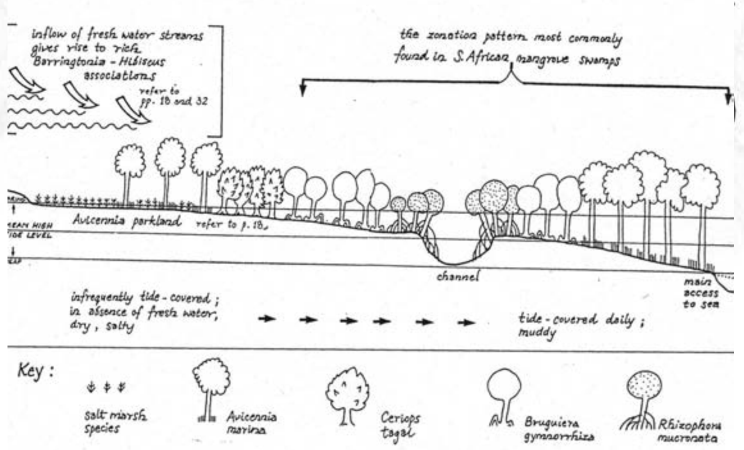

fig.8.20 mangrove and wetland system

Landscape

Durban falls within the coastal bushveld-grassland biome, therefore vegetation characteristic of this habitat have been selected to be used within the project. "Typical canopy species are: Coast Red Milkwood *Mimusops caffra*, Dune Jackalberry *Diospyros rotundifolia*, Natal Guarri *Euclea natalensis*, *Brachylaena discolour* and *Apodytes dimidiate*. Secondary woody vegetation is patchy and often characterised by Sweet Thorn *Acacia karroo* together with Scented Thorn *A. nilotica* and Splendid Thorn *A. robusta*." [Low et al, 1998, p.30] A combination of these species are to be used in the public space in front of the building. This forest of trees is to be viewed as an extension of the building. The shadows are continued into the building through the use of randomly spaced skylights. These trees also provide shading for people waiting.

The roof garden is to be planted with the grassy matrix characteristic of the biome: Ngongoni Bristlegrass *Aristida junciformis*, *Eragrostis spp.*, *Sporobolus spp.*, *Hyparrhenia spp.*, *Digitaria spp.*, *Setaria spp.* and *Themeda triandra*. [Low et al, 1998, p.30]

The vegetation walls are to be planted with indigenous creepers such as the climbing aloe, *Aloe ciliaris*. These vegetation walls will emphasise the contrast between the existing harbour texture and the new intervention.

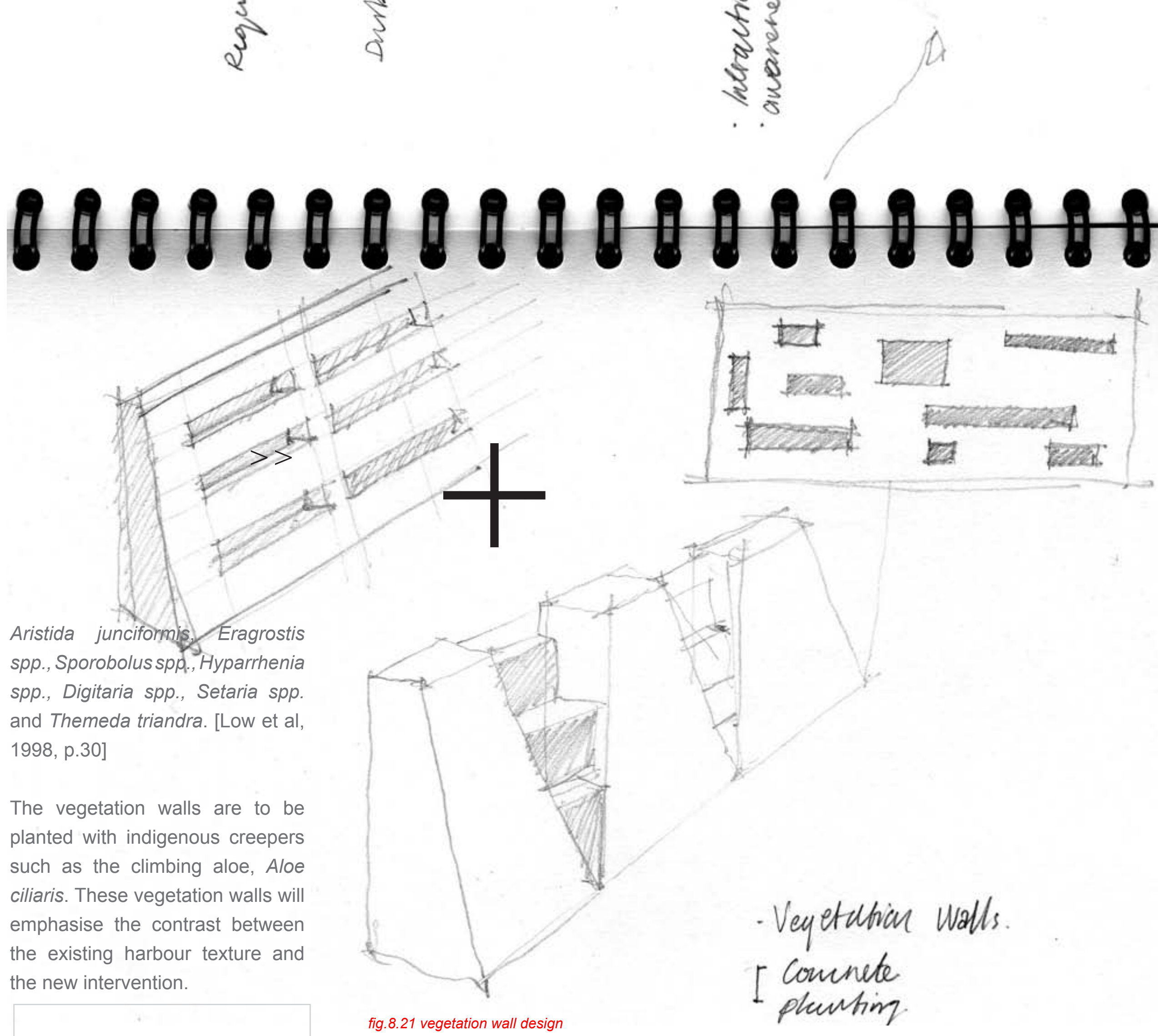

fig.8.21 vegetation wall design

Sunscreens

The sunscreens on the south western façade have been designed to shade the glazing preventing solar heat gain, while still allowing a view of the harbour from the restaurant. These screens are constructed of a stainless steel structure supporting timber battens. It is important to note that when a cruise liner is in port the building will be shaded completely.

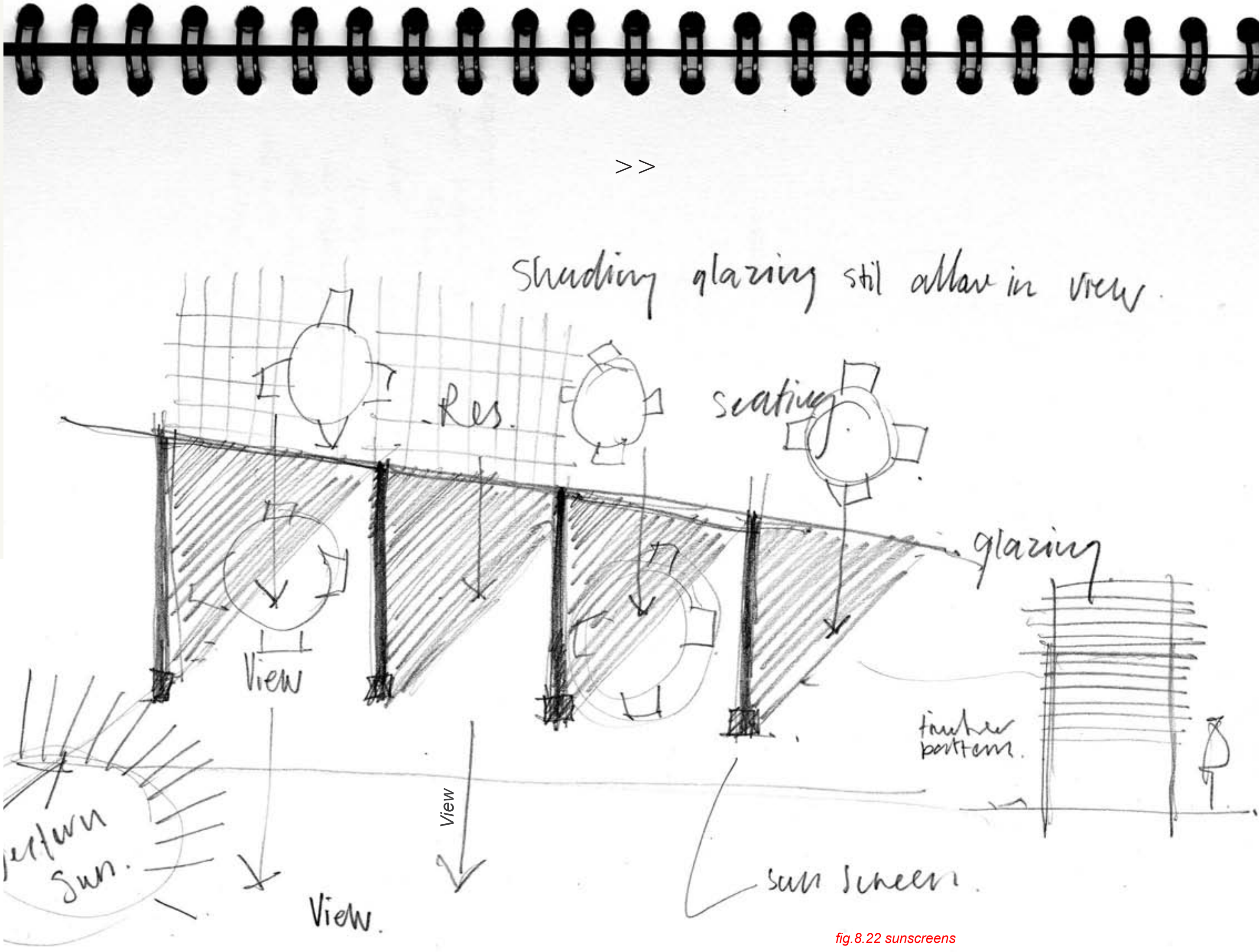

fig.8.22 sunscreens

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9.0 Technical Drawings