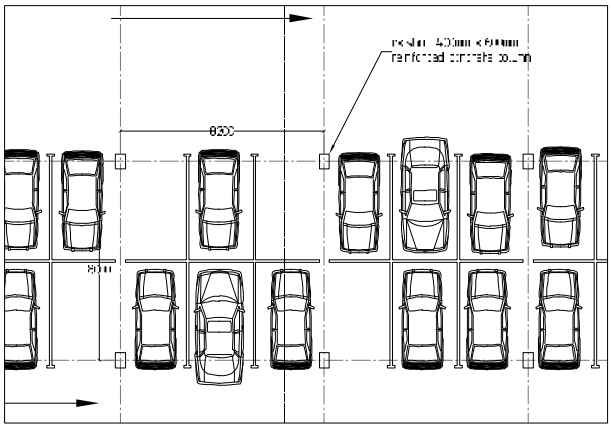
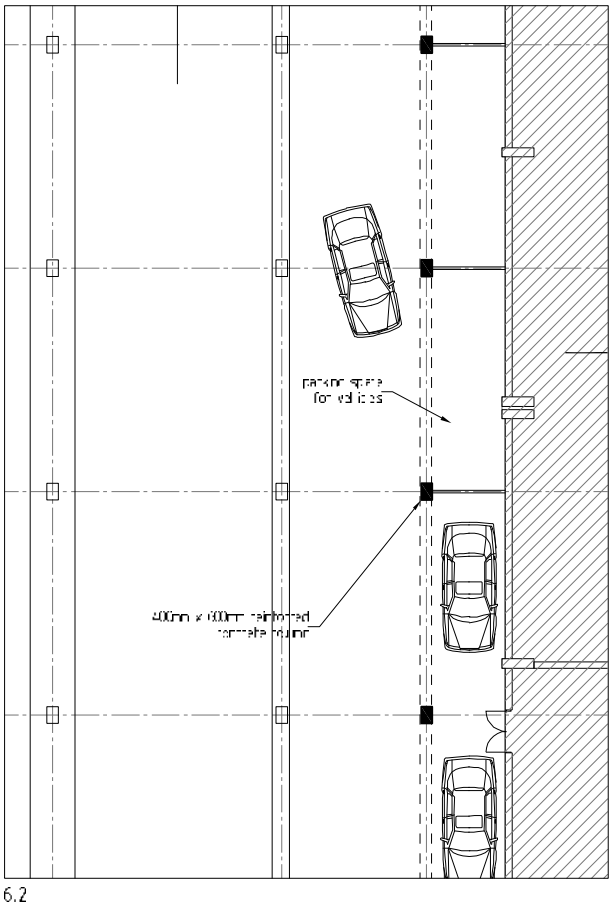
>>technical inquiry

Structural Grid System

One of the more notable aspects that need to be dealt with in the planning of the structure is that the symbiotic building is to be placed on top of an existing parking lot. This requires that the structure respond to the existing column grid system beneath the square level. The structure of the existing two level parking areas consists of 400mm x 600mm concrete columns (with the longer section in a north-south direction) arranged on a 8,0m x 8,2m grid. The design of the symbiotic building's structure was done in consideration to the existing grid system. The structural columns used in the new building are thus the same size as the existing columns. Where columns could not be overlaid the existing grid system, it is ensured that they are on the same line as the grid system below. Provisions are made to reinforce these areas so that the new columns can be supported by means of bracing beams, to be designed by an engineer. A new set of columns had to be inserted next to the State Theatre to support the new service duct (still to be discussed). These columns will extend down through the two basement levels. The new columns will not impede the parking or traffic in the basements as they are in an area marked for parallel parking and the spaces between the columns become parking bays.



6.1



6.2

Fig 6.1 column grid spacings
Fig 6.2 parking spaces under service duct supports
Fig 6.3 diagram indicating the service core of the new structure (orange)

Serviceable area

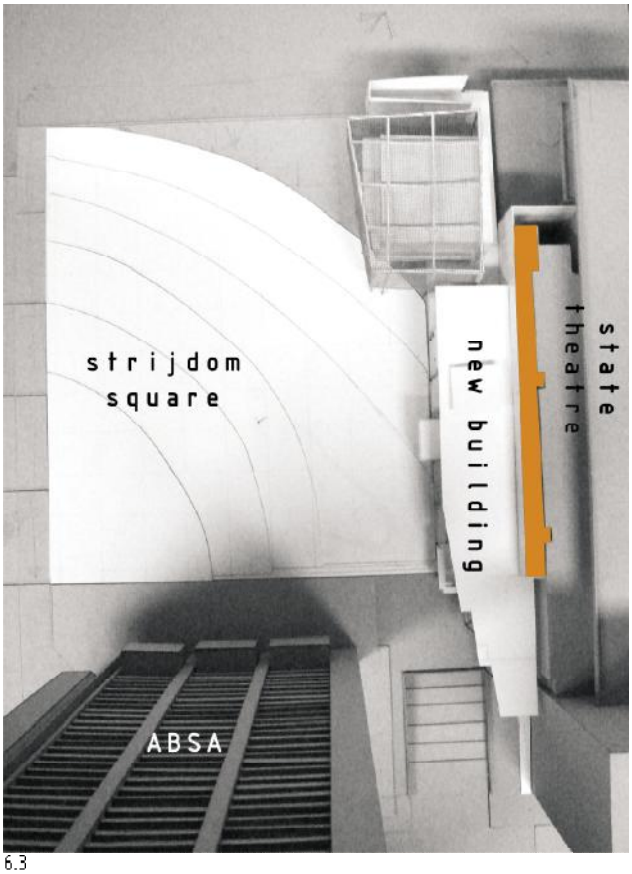
As an extension of the State Theatre, the new building required service access. The serviceable area becomes a large duct between the new building and the existing. This service duct is an open area running along the length of the building for a distance of 62,5m and is 2,5m wide. It is open right up to the top. The area of the State Theatre facing onto the new duct consists of changing areas and bathrooms for the performers. The new duct will block natural sunlight and passive ventilation to this area but this is not a matter of concern. Upon inquiry and a physical inspection it was noted that the windows to these rooms were just below slab height, which meant that the duct would not be impeding views from these rooms. The windows are also tinted with a heavy dark laminate (to deal with western light) so little natural light is allowed into the rooms. These rooms are artificially lit. The windows are also non-opening sections and do not allow any natural air into the rooms. The rooms are mechanically ventilated. From this information, the new service duct would not affect the western façade of the State theatre in any detrimental way.

The new service duct will allow for services such as:

>> Access to the kitchens on the ground floor for deliveries. This is gained via either the service lift on the southern side or through a door on the northern side of the service area.

>> The gas cylinders for the gas stoves in the kitchen will be delivered and stored in the area.

>> This becomes the refuse area for the kitchens. Bins can be kept outside the kitchen back doors. On the day of refuse removal, they can be moved to the southern end of the service duct for storage. This storage area will be mechanically ventilated. The reason for mechanical ventilation is that if it were to be passively ventilated, the smell of the refuse area would enter into the area of the food court and the square. It is rather going to be ventilated out into the duct and up towards the roof area away from habitable areas. From the refuse area, the bins will be taken down the elevators into the underground parking lot. From here they will be wheeled to the service area of the State Theatre and collected with their refuse.



6.3

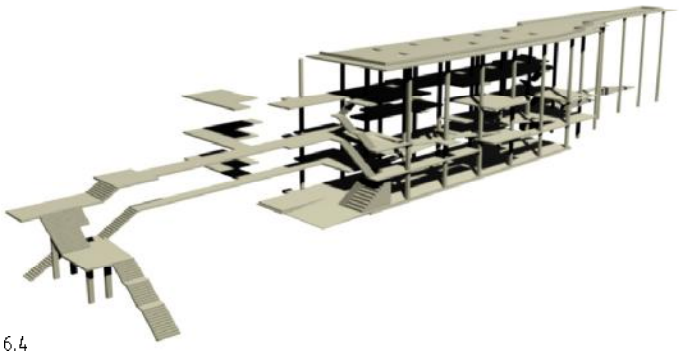
>> All extractor fans for kitchens and similar equipment (i.e. air-conditioning units) that need to be ventilated will be done so into the service duct.

>> All sanitary drainage will collect into OVP's and be drained in the same manner as the existing drainage. The pipes will run under the soffit of the underground parking lot and connect with the main municipal line in Church Street.

>> The western side of the State Theatre is where the bathrooms are located therefore water connection and electricity connection points for the new building will be connected here as well.

Material use in the building

The majority of the structure consists of reinforced concrete columns and slab. Because the spans are relatively long (8,0m and more) supporting steel I-beams are provided between the concrete columns for extra support. In implementing the concept of 'cross-programming' the use of materials had to be of such a nature the events could be carried out to their full potential.

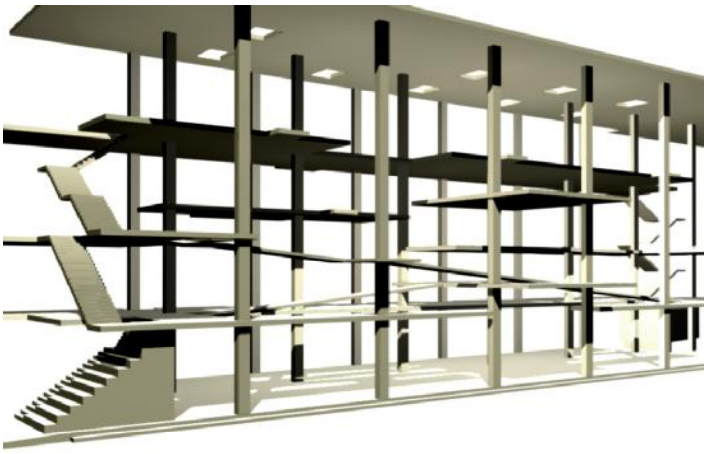


6.4

In order to achieve this, the concrete column and slab structure becomes the skeletal framework supporting these events. Lighter materials become the infill or attachments to the robust skeletal construction. Vertical and horizontal movement throughout is also a reinforced concrete structure. The movement routes are heavier elements as they too become part of the structural 'skeleton'. The framework of the building is to be represented in such a way, that if the lighter elements of the building are to be removed, the core of the building would remain. That essence is the spaces created by the structure as well as the way in which you move through that structure from space to space.

6.5

The light-weight materials start to layer the structure and give depth and complexity to the interior spaces and exterior envelope of the building. The lighter materials create specific spaces and areas within the skeletal make-up. The staircase to the south of the theatre is encompassed in light-weight polycarbonate sheeting. At some levels of the staircase there is only one skin of the sheeting, on other levels two or three. The sheeting consists of panels different sizes colours. Some panels will allow more light through than others. This will create differing atmospheres within the staircase area.



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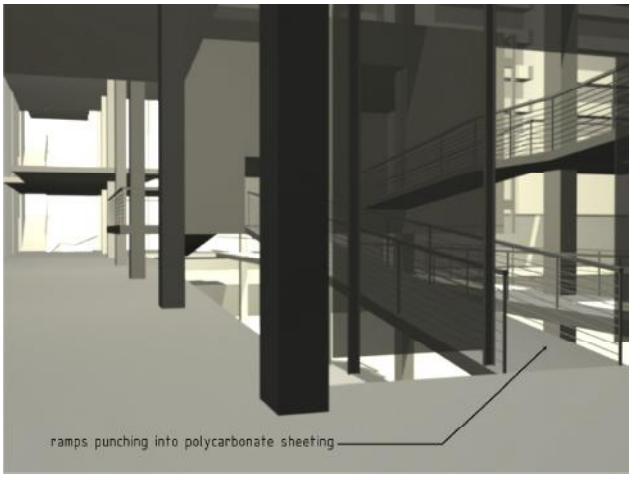


6.8

Fig 6.4 3D images of building indicating only the column & slab system

Fig 6.5 3D images of building indicating only the column & slab system

Fig 6.6 3D images of building indicating only the column & slab system

Fig 6.7 3D image indicating the ramp systems that punch into the various spaces of the building

Fig 6.8 interior 3D showing the ramp system

The play of light will be continuous as the sun moves through the sky. Some parts of the polycarbonate skin will move through into other parts of the structure indicating a continuance of movement and atmosphere. The ground floor food court space will open onto the square. As the entire length of the building is west facing the kitchen areas and movement area are set deep back into the structure. Above this are the series of movement areas and a bridge component on the exterior of the structure. This prevents western sun from entering the space. Trees along the façade provide additional shading. These trees are intended for people wanting a shaded place to sit and eat after purchasing food. But they also provide additional protection from the setting sun in the afternoons.

The open exhibition areas on the first floor are created by the concrete floor structure. Again the light-weight materials are used to define spaces and create specific moods with lighting and textures. When approaching the exhibition space from the southern end of the building up the series of ramps provided, a subtle transition will take you from the outside to the interior of the building. Immediately to the left is the space enclosed by timber slats. This space gives the impression that you are still inside the building. The timber slats are constructed with 50mm openings between each, enclosing the space visually, though not entirely an interior space. It is of such a nature that you are still exposed to the natural elements. It will be roofed but rain, wind and sunlight can penetrate the space and you will be exposed as though still outside. The gaps between the timber slats cast shadow lines across the space once the sun enters in the afternoon. The enclosure will also have a series of lockable doors. This will allow the exhibitor using the space to control the access and movement of viewers. They can also create different spaces by allowing movement to a specific area, then restricting movement to another.

Further into the exhibition space the area becomes enclosed with glazing. The translucent qualities of glass allow an outside scene, in this case the square, to become a part of the interior and the people in the square become part of the performance happening within the building. In the middle of the structure a heavy enclosed element sits on a split level just above the first floor. The movement ramps punch into this 'box' giving the impression of penetration. This box-like element has a dual role in that it is a landing area for the ramps moving between the first and second floor levels, but is also an exhibition area.

This box again gives a different quality to the rest of the exhibition spaces as it is more privatized. Access can be controlled by means of roller-shutter doors. It only allows light in from the west. This light is let in through sliding stainless steel mesh frames which sit on the façade of the 'box' (see Fig 6.7). During times when there is no direct western sun these panels can open up onto the square. When the sun gets too low they can be closed to provide protection from the sun. The light will not be completely blocked so a different atmosphere will be created by the play of light.

The box interacts with the first floor as the eastern side opens onto it. This affords those on the first floor a glimpse into the 'box' and people in the box can visually or physically interact with the people moving about on the first floor. Inside the box on a higher level is the food preparation area where ready made food can be heated up and prepared for serving on the second floor area where the entertainment area is. From the 'box' movement up another ramp will take you up to the second floor where the entrance to the theatre is situated.

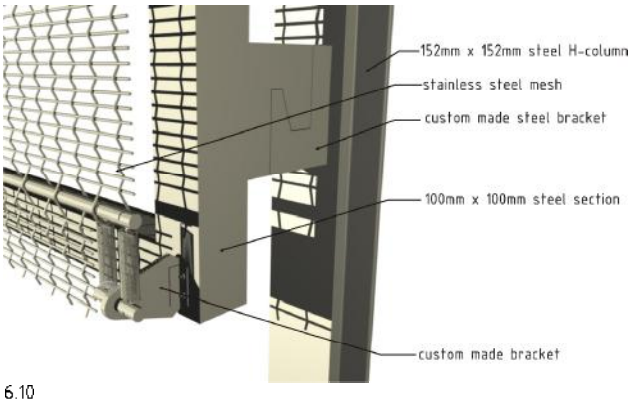
The theatre is also a concrete structure. It is a very important skeletal component in the building. Using the heavy concrete material indicates its permanence and importance to the structure. Access to the theatre is via a light-weight steel walkway.

6.9

This element emphasizes the theatre's heavy, strong box-like feeling in contrast to the light walkway. The theatre's programme, as mentioned previously, has been deconstructed to allow flexible use of the space. In order to achieve this, concrete has been used for the permanent elements of the theatre. The machine room where the pneumatic lifts are located and the surrounding structural element, as well as the sound control rooms above are all cast from reinforced concrete. Light-weight elements control the flexibility of the space- namely the movable sliding panels that enclose the theatre space.

These panels can open the theatre entirely to the square and surroundings, or create an intimate theatrical space. The inner face of the panels will be finished with timber slats. The gaps between the sliding panels will allow sufficient sound to escape and the coffer slab disperses sound. This would alleviate the reverberation of sound. It must be noted that the theatre is not intended nor designed for productions with exceptional sound quality. The theatre is designed for productions that would not normally occur in the State Theatre itself therefore acoustics and high quality lighting is not needed. The outer skin of the sliding panel is weather-resistant metal sheeting. This ensures that if it were to start raining or the wind became too strong, the theatre had the capacity to protect its patrons.

Surrounding the theatre structure is a light-weight steel structure that supports a framing system onto which a stainless steel metal cloth is fixed. The structure is light-weight as it takes into consideration the parking levels below, creating the feeling of a theatre draped in cloth. This allows visual access in and out of the theatre, but has enough opacity that it frames the theatre within, defining inside and outside. The steel frame has sliding movable sections so that certain areas can open onto the square. On the third floor you find the rehearsal spaces. As mentioned in previous chapters, people are fascinated by watching others. The rehearsal spaces encourage visual access from the square. This is achieved through the use of glazing, affording people full view of those rehearsing or dancing in the space.



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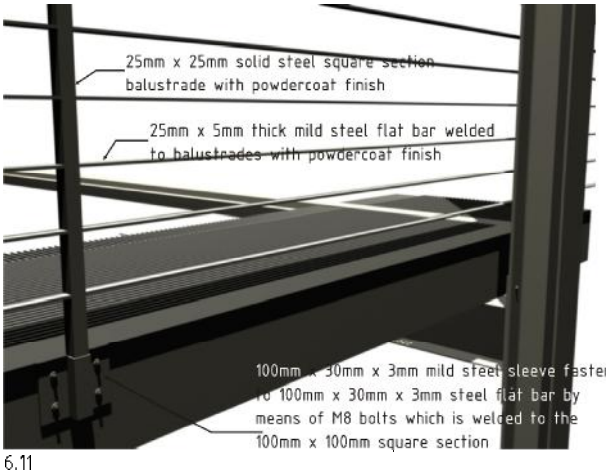

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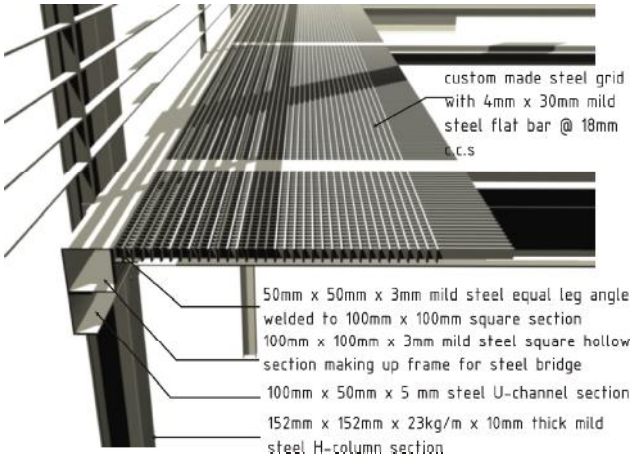

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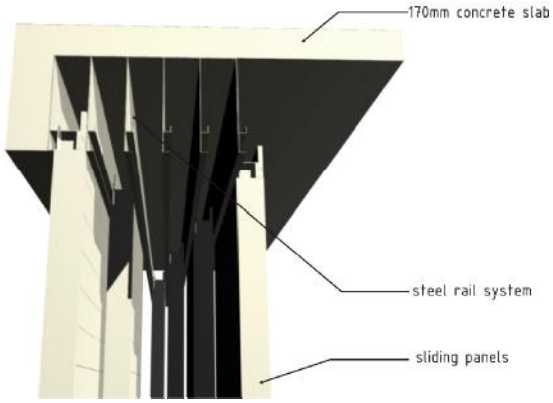


6.13

Fig 6.9 3D of interior of building on the first floor showing the split level of the exhibition spaces

Fig 6.10 3D detail of stainless steel mesh to surround theatre and to be used as the sun protection material for the western sun

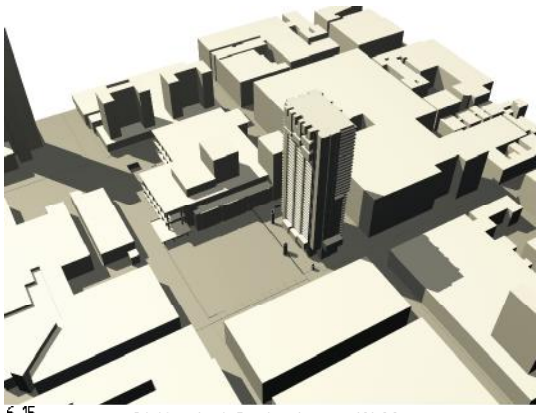
Fig 6.11 3D detail of steel bridge around the theatre

Fig 6.12 3D detail of steel bridge around the theatre

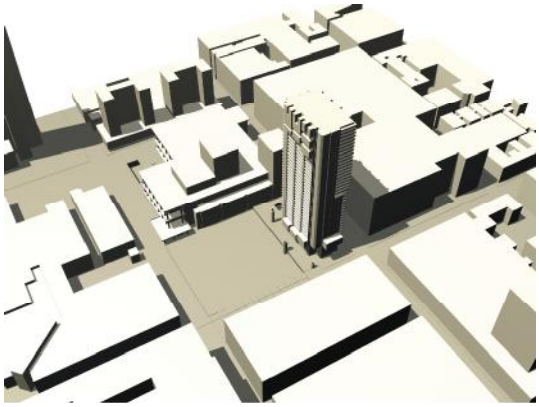
Fig 6.13 3D detail of sliding panels in the theatre

Western Sun

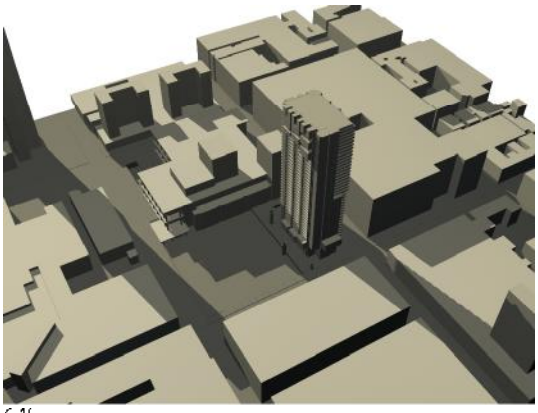
An important element that needs technical resolution is the fact that the entire building is west-facing. To ensure the thermal comfort of the building it becomes important to place sun-protection devices on the outer edge of the building, thereby creating a barrier on the exterior rather than shade elements on the interior. The sun only becomes a problem after 15h00 in the afternoon as it starts moving lower in the sky. Therefore provision needs to be made for low-angle sunlight that penetrates the structure towards the end of the day. These sun-protection devices are fixed at specific points on the outer skin of the building between the columns. Some areas of the building will need more protection than others for different times of the day and year. An analysis of the existing sun penetration onto the western façade of the State Theatre was undertaken in order to gain insight into the specific design required for solar control. Sun angles for different times of the year at late afternoon times were superimposed onto sections of the structure analyzing placement of sun-protection devices. Not all of the structure will be shaded from the sun as some solar gain into the structure will be used to employ the "Fly-wheel affect" for winter advantage (NAPIER: 3.6.1). This would allow heat absorption by the mass elements like the concrete in the structure during the day so that this heat can be re-radiated back into the structure at night for warmth.



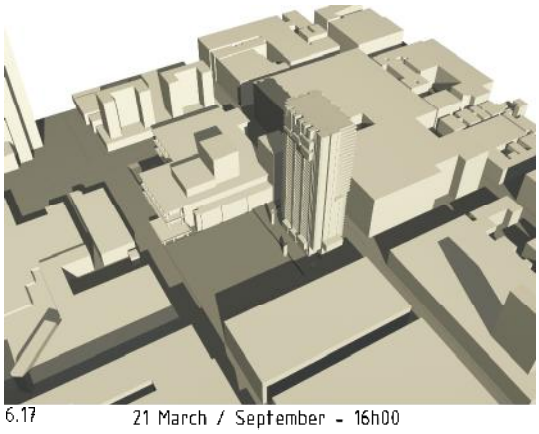
6.15 21 March / September - 10h00



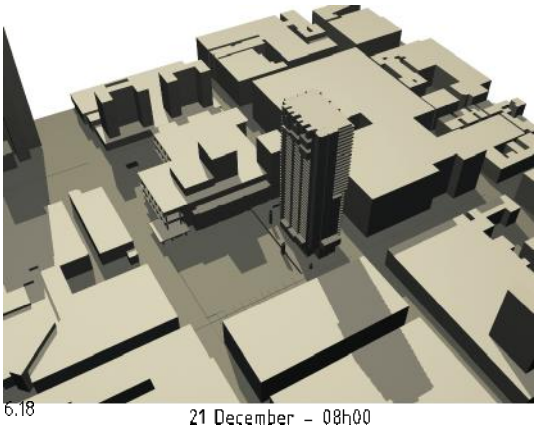
6.16 21 March / September - 12h00



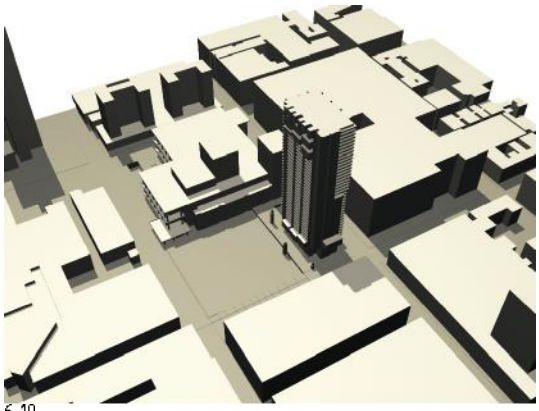
6.14 21 March / September - 08h00



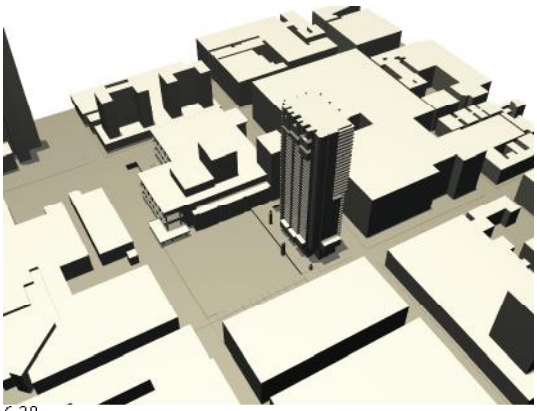
6.17 21 March / September - 16h00



6.18 21 December - 08h00

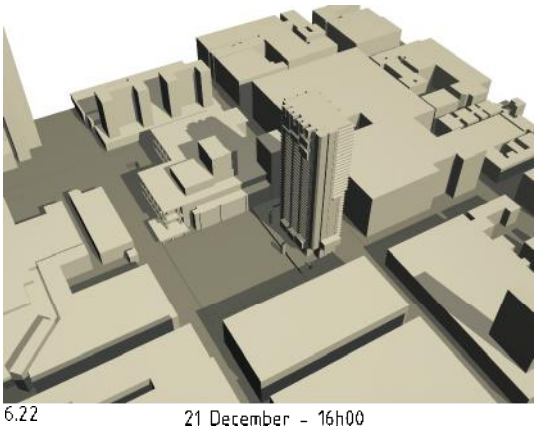


6.19 21 December - 10h00

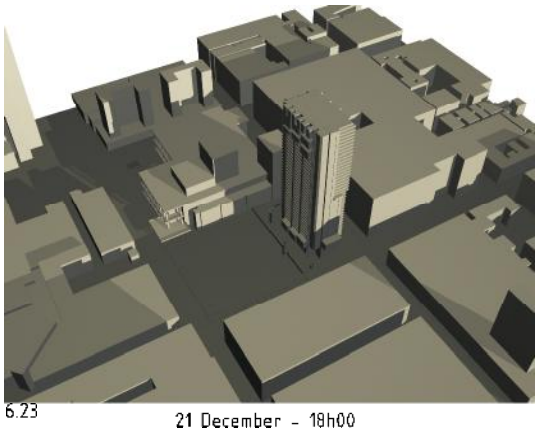


6.20 21 December - 12h00

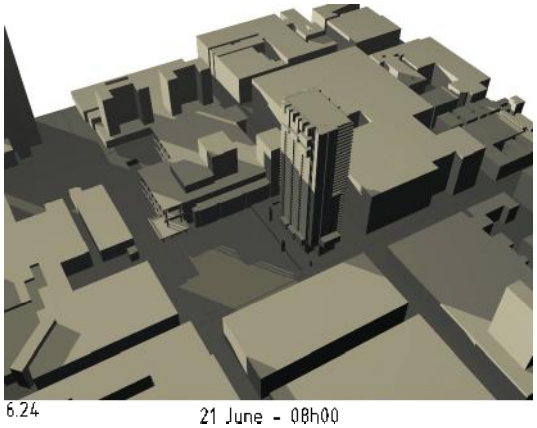
6.21 21 December - 14h00



6.22 21 December - 16h00

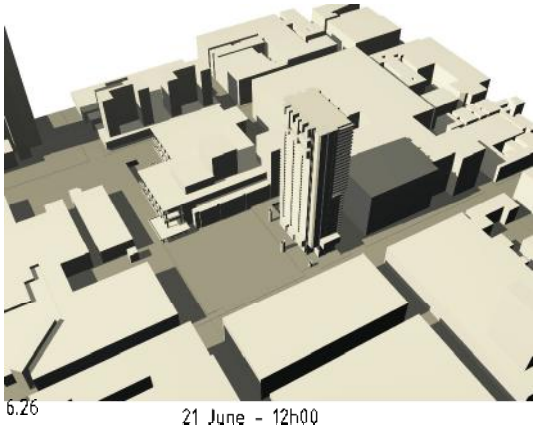


6.23 21 December - 18h00

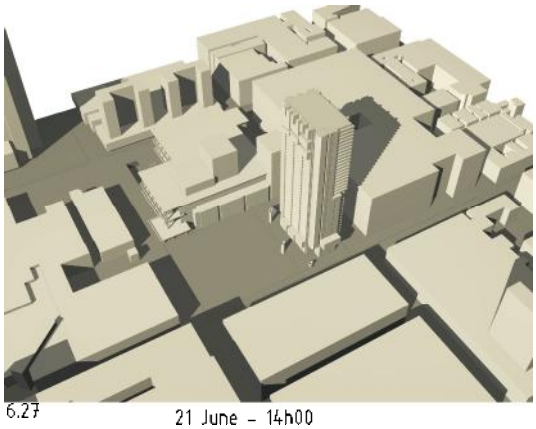


6.24 21 June - 08h00

6.25 21 June - 10h00

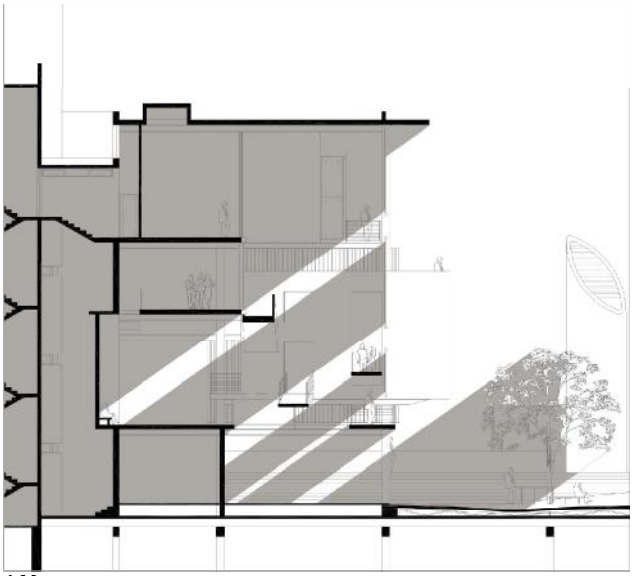


6.26 21 June - 12h00



6.27 21 June - 14h00

6.28 21 June - 16h00



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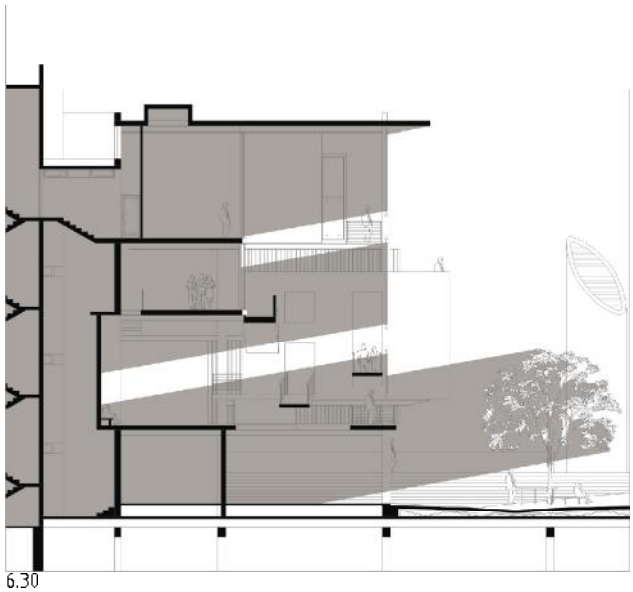

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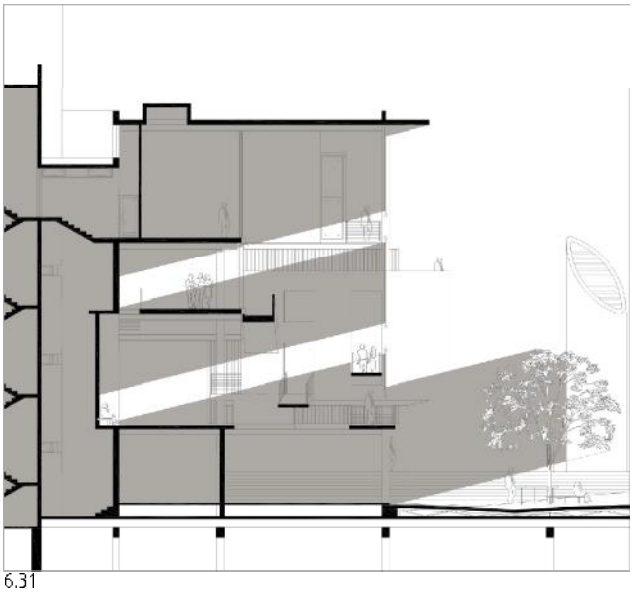
Fig 6.29 sun penetration for 21 December @ 16h00
Fig 6.30 sun penetration for 21 December @18h18
Fig 6.31 sun penetration for 21 June @ 16h18
Fig 6.32 sun penetration for 21 March./September @ 16h18



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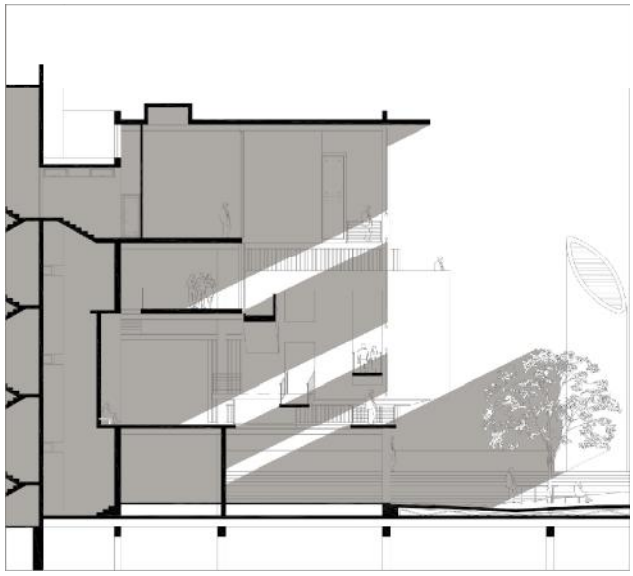

6.32

>>2D technical investigation