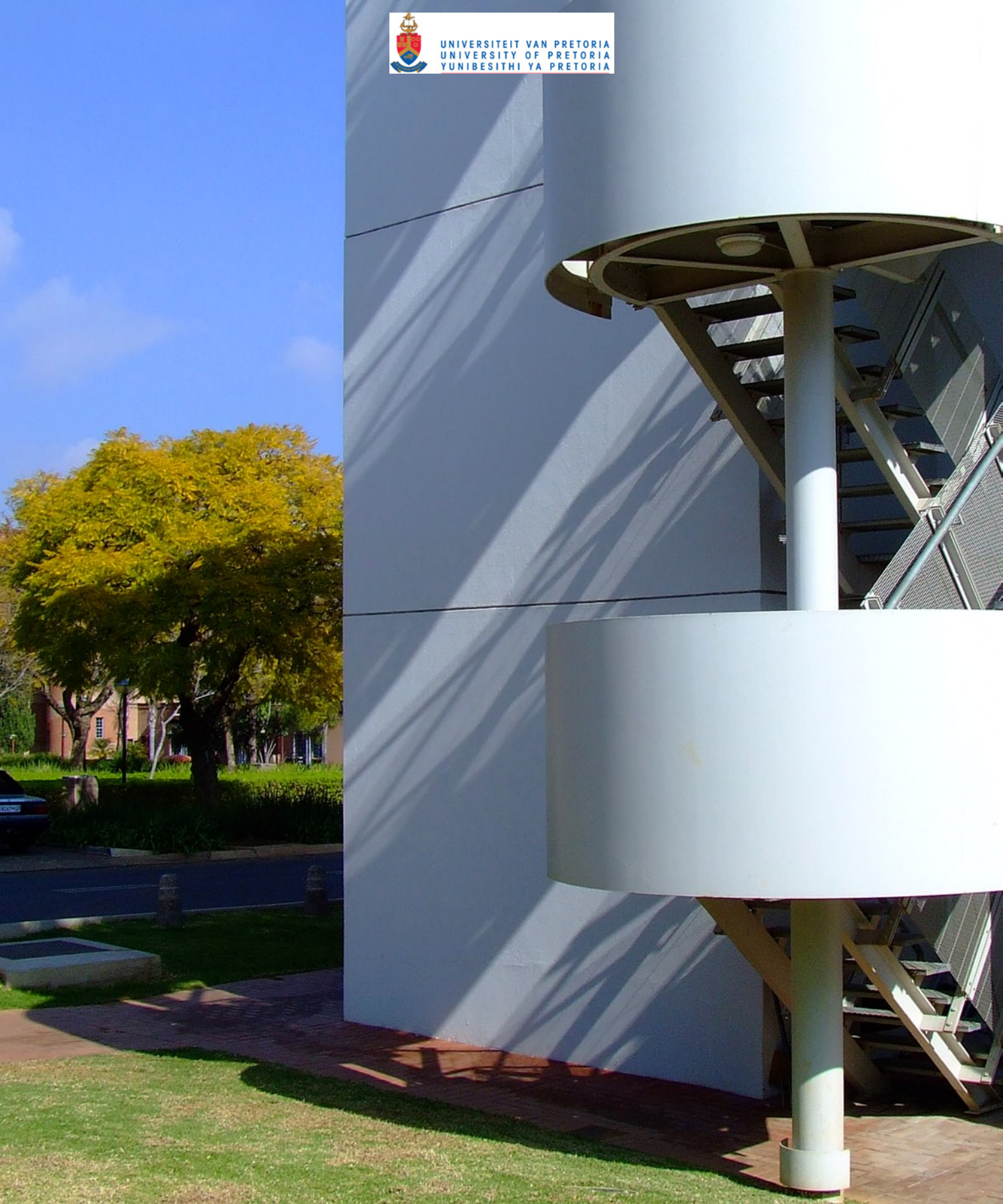




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## DESIGN INVESTIGATION

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INTRODUCTION 6.1

SURFACE 6.2

FORM 6.3

INTERVENTION 6.4

## 6.1 Introduction

The theory chapter concluded with the discussion of deep surface, architectural surface as a representational and spatial tool. Deep surface is identified as an architectural element that is defined by its significant others and visa versa. This chapter seeks to show the development of architectural surface in the research facility and its significant others; Structure, Space and Services. Secondary to the development of and exploration of deep surface as a concept this chapter also tracks architectural surface as and element capable of camouflage and branding.

The design development of the research facility will be studied in three main sections including Surface, covering the conceptual, structural, skin and spatial design and development of the building surface. Secondly the chapter will look at the formal exploration and design covering key aspects including; views, circulation and orientation.



Figure 6.1: Study of people in landscape as source of light





## 6.2 Surface Development

To develop an appropriate architectural surface a dynamic contextual response was required. As indicated in chapter two there are a number of key defining characteristic dominating the site. `Surface` had to respond to, define and be defined by these key elements.

A. The first of the elements is the nature of the site. The site`s contextual feel is that of an intimate, small scale and isolated mini precinct.

B. Trees define the boundaries of the site, they enhance its natural character and provide excellent passive climate control on site.

C. Movement, as the site is located at a crucial intersection on campus where the main vehicle route (ring road) and one of the main pedestrian routes ( Tukkie laan) cross. As well as being the gateway to the administrative heart of the campus, it is a site that is bordered by and shaped by movement.

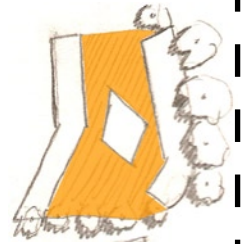
D. Iconic buildings on the campus landscape border the site on all sides, from large impressive brutalist concrete buildings to more intimate facilities. Two of the site`s four neighbours are iconic in their own right and the other two understated yet important in their own right.

From these four key contextual indicators I developed certain performance criteria to help guide the surface development. Further to the contextual performance criteria the exploration also demanded the development of performance criteria for Structure, Space, and Services.

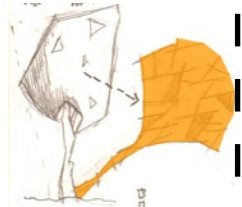
### 6.2.1 Performance Criteria

#### Context

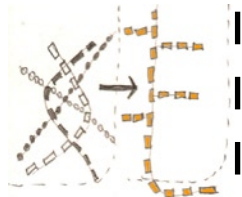
1. Recreate or enhance the intimate feel of the site.



2. The trees on site should be used as generative image and texture



3. Enhance and streamline the movement on and next to the site



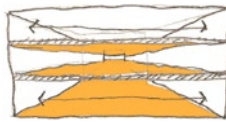
4. Respect iconic neighbour buildings and do not dominate





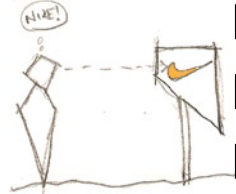
Structure

5. The surface structure must provide obstruction free interior space within the facility



Image

9. The surface must create a unique identity for the research facility and discipline on campus.



Space

6. Spatially the proposed surface must act as a defining element and enhance the deep surface concept.



Services

7. The surface element must provide for the functional requirements of a research facility by accommodating services.



Environment

8. Environmental requirements must play an active role in the shaping and design of the surface.





## 6.2.2 Conceptual 'Skin' Development

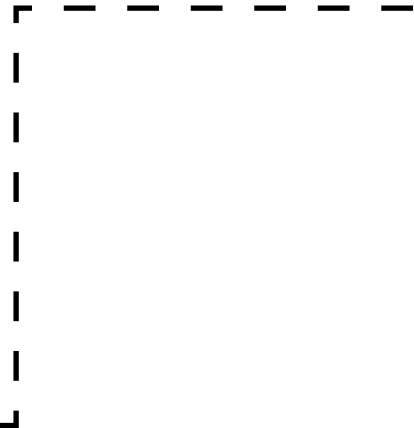
Taking in to account the above set out performance criteria, the surface that has to be developed is a complex entity, requiring the input of numerous indicators. From an analysis of the indicators a number of appropriate conceptual responses can be **'generated'** . In progressive practises like Serero from France and their peers, this would be a matter of introducing these parameters to generative design software coupled to a main frame hardware system, generating infinite solutions from the parameters.

However due to the constraints and lack of software, hardware and knowledge this was not an option that was available to me. Thus I set out to develop an analogue generative system that might give me glimpses of the possibilities inherent within these parameters. The analogue generative process considered the following elements; Structural grids, images, Structural requirements, Space and environmental influences.

Following are two of these analogue generative studies.

Generate A , shows the development of a surface with a structural and aesthetic quality that can be traced back, directly to the image that defines it.

Generate B shows how by varying the input in only a slight manner develops a completely different result. These studies were invaluable in terms of understanding the problem at hand and although they did not directly develop the final surface, they influenced the final surface development, and aided in its development.



Generate A

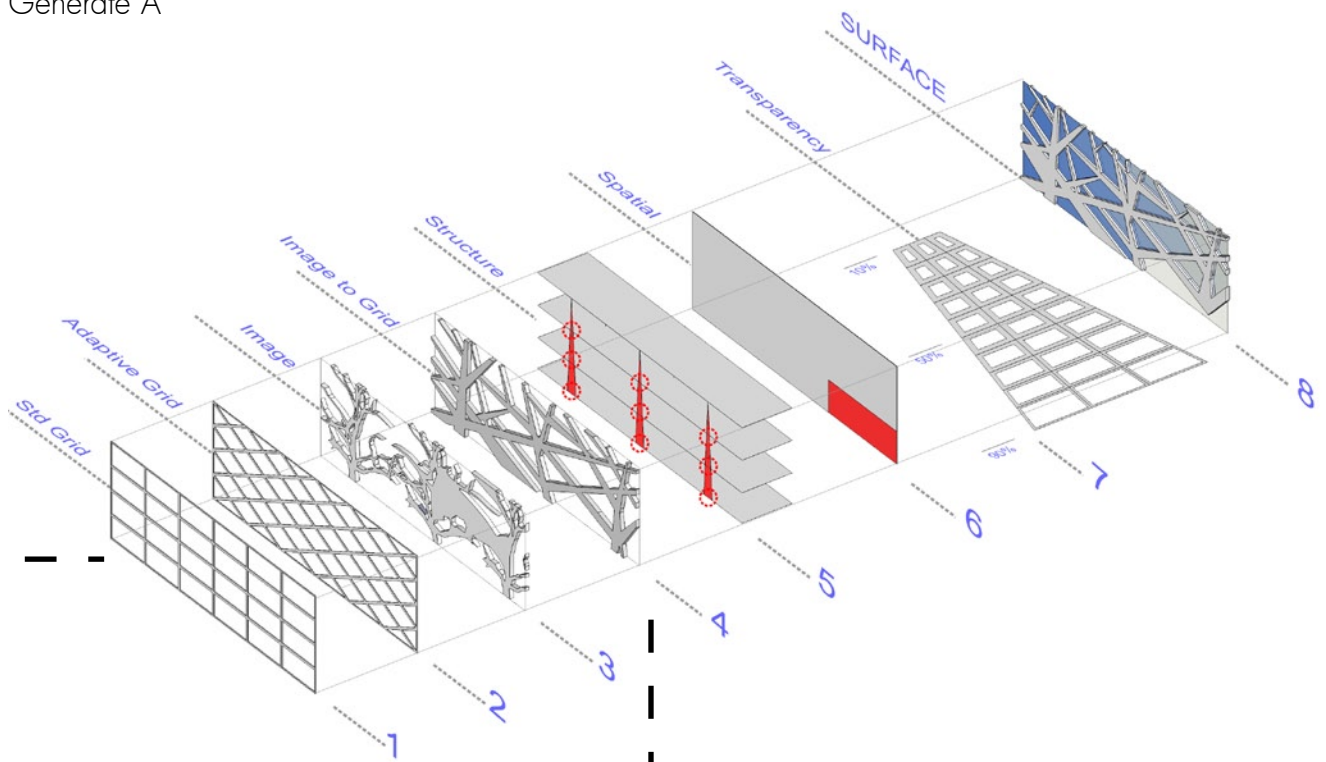
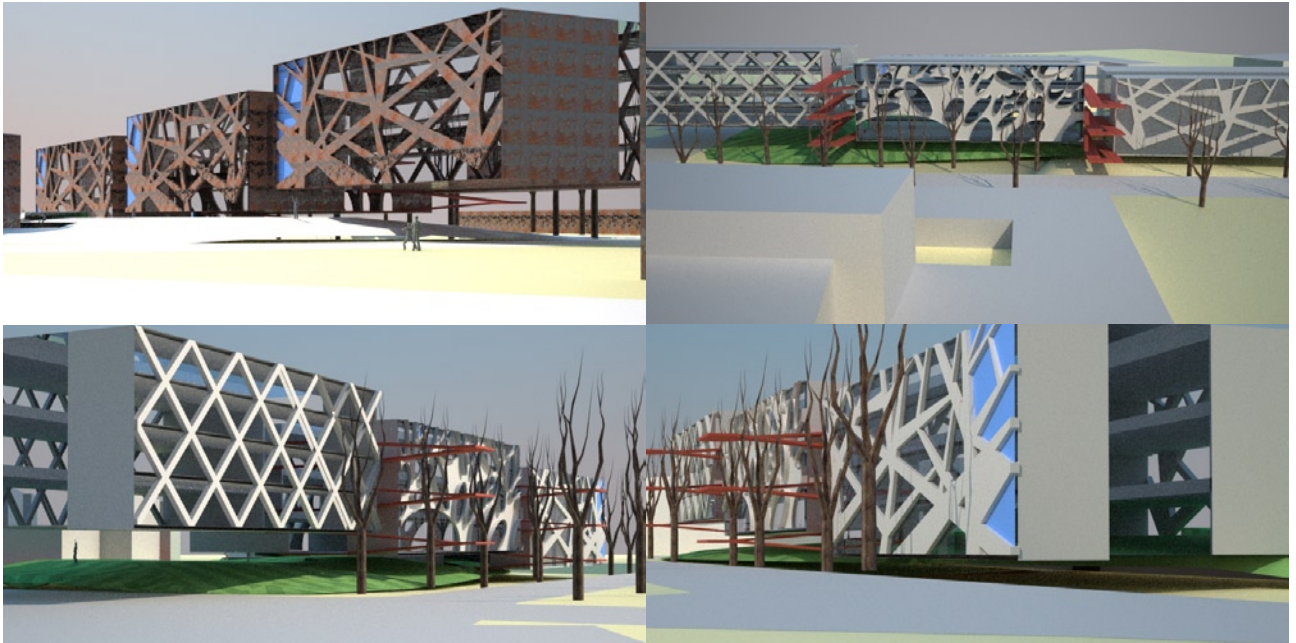


Figure 6.2: Analogue Generative process A

Figure 6.3-6: Conceptual facade studies from analogue generation process





Generate B

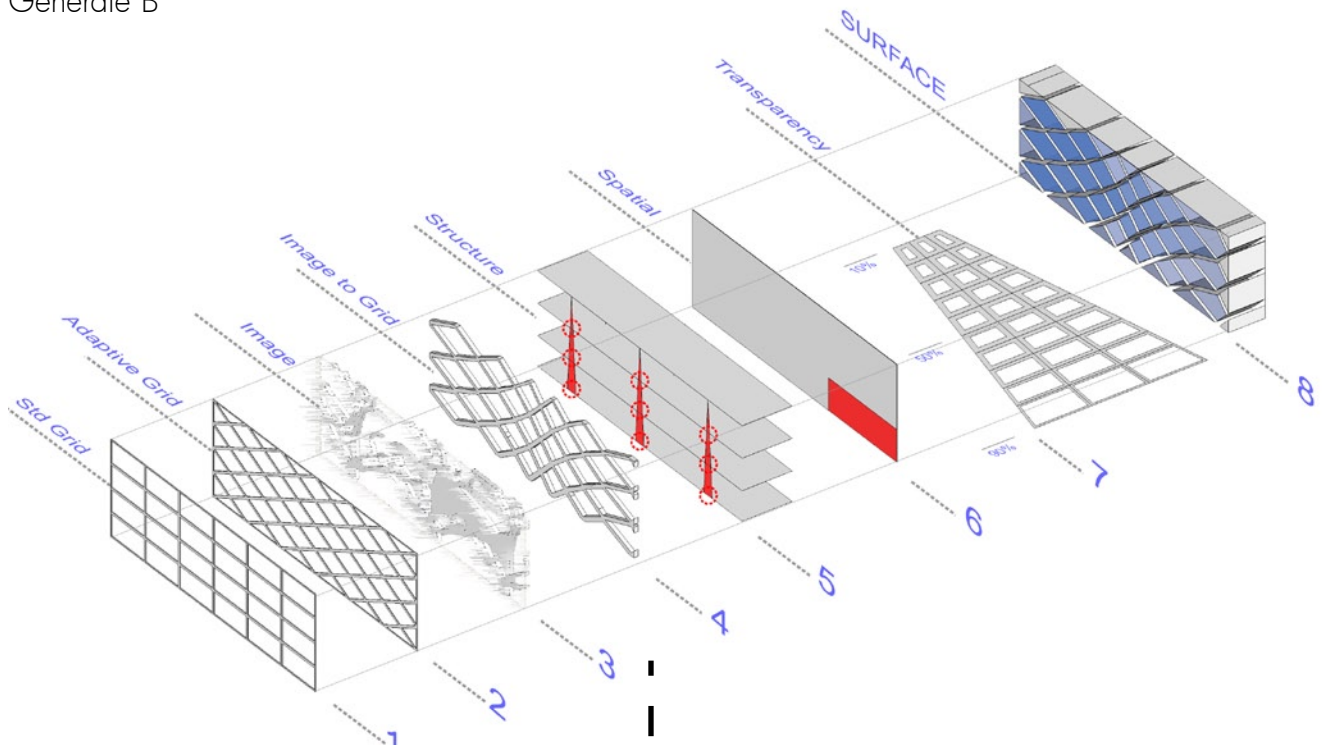
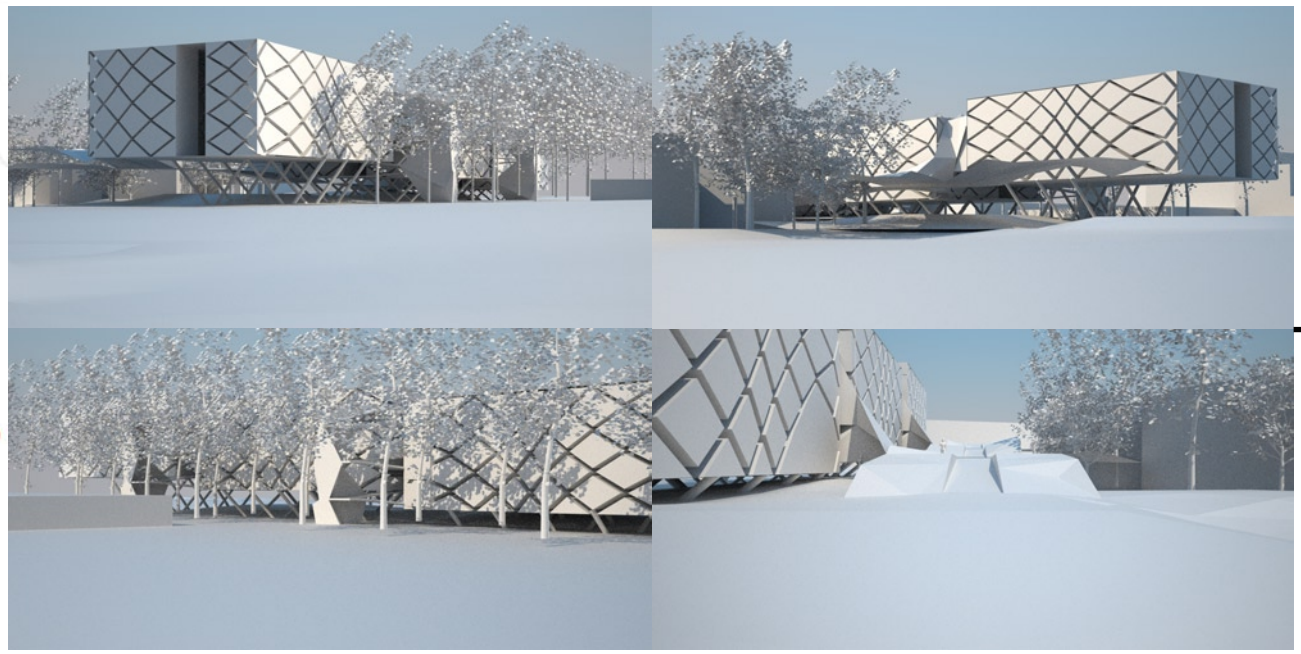


Figure 6.7: Analogue Generative process B

Figure 6.8-11: Contextual facade studies from analogue generation process B





Below follows a description of the generative system as developed during the generating process. It gives a brief description of each of each of the stages of the surface development.



Generate B : deep surface generative process

- 1 - Std. grid is seen as the optimum division of grid on 2d plane taken a contextually
- 2 - Consideration of 3d and structural requirements leads to the development of the adaptive grid
- 3 - The new cells formed by the adaptive can be considered at optimum performance level, which is then applied to a pattern generating image
- 4 - The application of the `image` transforms the adaptive grid from static to dynamic `undulating` grid
- 5&6 - From the development of the dynamic grid the generation process the application of structural and spatial requirements ( load transfer, connection point ,openings ect. )
- 7 - To generate final layer of the deep surface requires he application of a transparency graph ( i.e. Opacity)

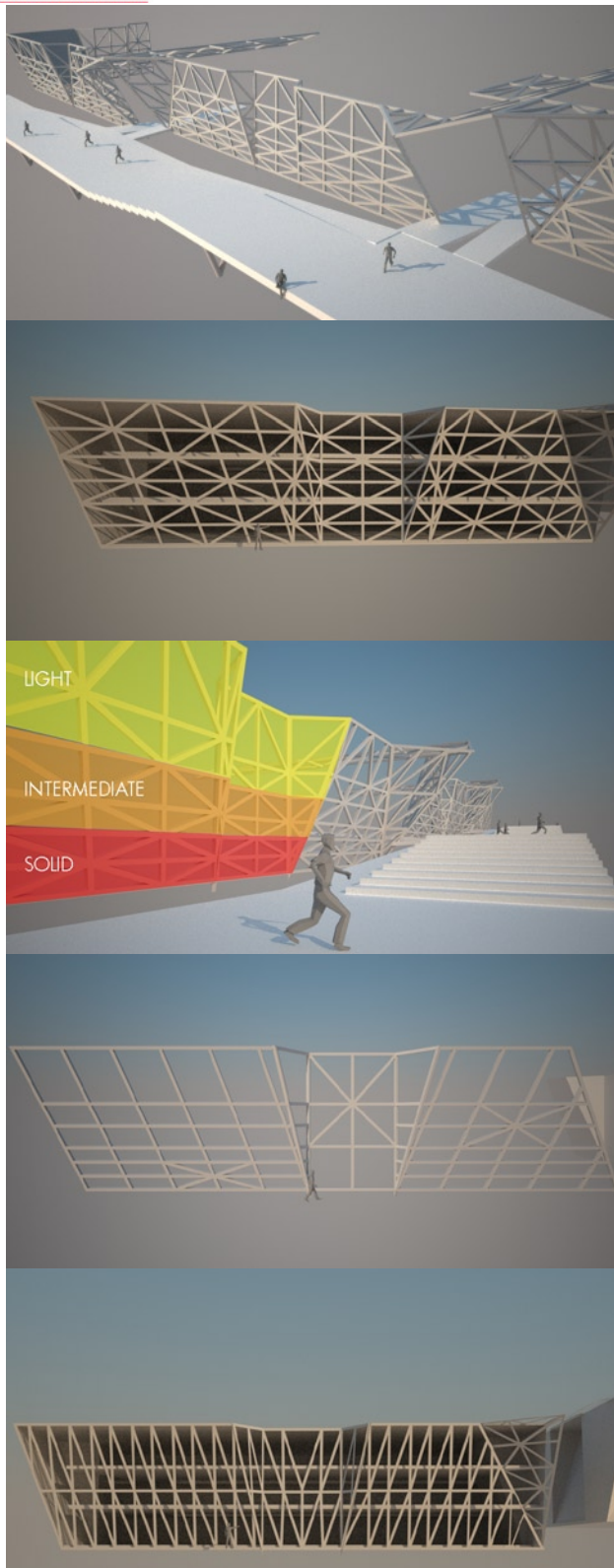


### 6.2.3 Surface Structure development

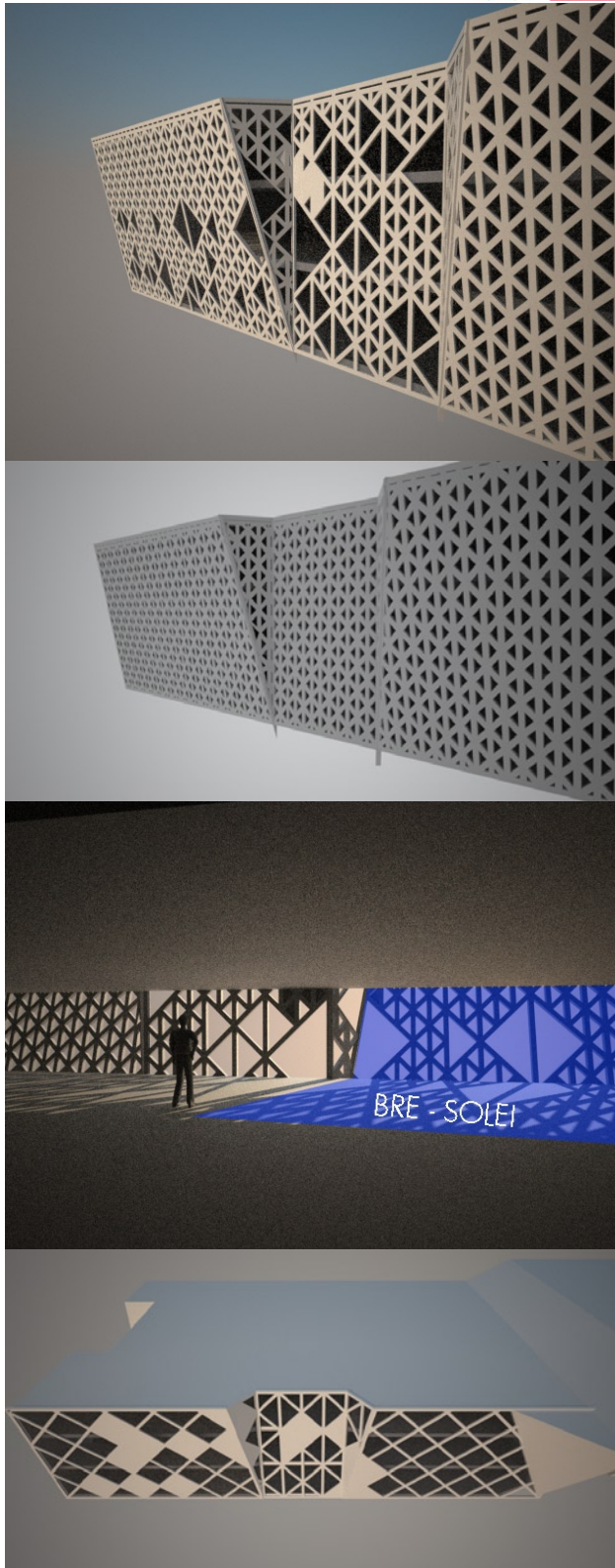
“The architect who considers him or herself to be an artist, dealing through the medium of built form with the philosophical preoccupations of the age in which he or she lives, is surely engaged in a titanic struggle. One aspect of that struggle is the need to determine building forms which are structurally viable. All artists must acquire mastery of the technology of their chosen medium but few face difficulties which are as formidable as those who choose buildings as their means of expression. The sculptor has to contend with similar structural problems but his or her difficulties are trivial by comparison with those of the architect. The difference is one of scale the size of a building, compared to that of a work of sculpture, means that the technical hurdle which must be surmounted by the architect is of a different order of magnitude to those which are faced by most other artists. The structure of a building is the armature which preserves its integrity in response to load (Macdonald, J.)”

Figure 6.12-16: Structural development studies

Figures 6.12-16 show the development of a structural system that uses the image of the tree and its natural branching in a rigid triangulated grid, however this system was deemed unsuitable due to its restrictive and cluttered nature. However in this system the effective nature of the tree structure in terms of a solid to light structure is identified.







Figures 6.17-20 illustrates the development of a structural system, focussing on a part of the image of the tree, the triangulated structure. This structure was also deemed unsuitable. Another important component of the final structural design was identified. The fact that the structure could act as an environmental control element. Further was the appearance of the structure at human scale and eye level.

Figure 6.17-20: Structural development studies

I think that James Macdonald (Macdonald, J.) sums up the dilemma very eloquently of the architect, in his book 'Structural design for architects'. If this is the case when working with conventional construction and architectural design, many of the hurdles as stated get exponentially enhanced when working with the development of 'Deep Surface' as set out in chapter 3. Concurrently with the investigation of conceptual surface through the analogue generative process, the study of structure was engaged. Again the structural component of the deep surface entity had to be developed while conforming to the performance criteria as set out in section 5.2.1. Ideally the structure as with the surface would be a free form entity as generated in Generator B, however due to the constraints as set out in section 5.2.2, this was not feasible. Working with the restriction, flexibility and characteristics of structural steel, numerous structural systems were evaluated as part of the generative process. On the previous as well as this page the first attempts at the development of a suitable structure can be seen. On the following two pages the final conceptual development of the surface structure can be seen. In the technical chapter the structure is explained in greater depth.



Figures 6.22-25 Indicates the first experiments with a structural system composed of a diagrid lattice structure. The evaluation of a regular versus flattened grid.

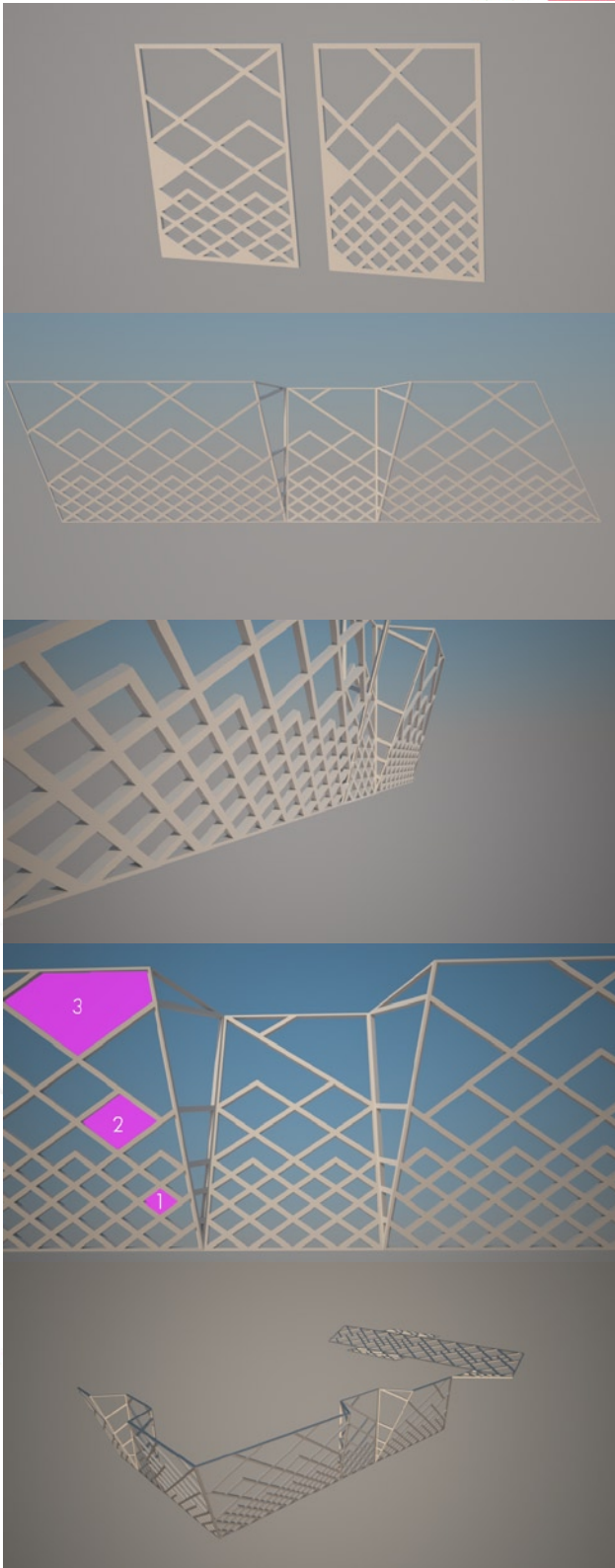


Figure 6.21-24: Structural development studies

The development of a three scale structural grid is evident from images 6.25 . This is yet another vital component in the final structural design of the surface.





The application of cladding elements in figures 6.26 - 28 shows an early developmental phase of what the final surface texture and pattern could become.

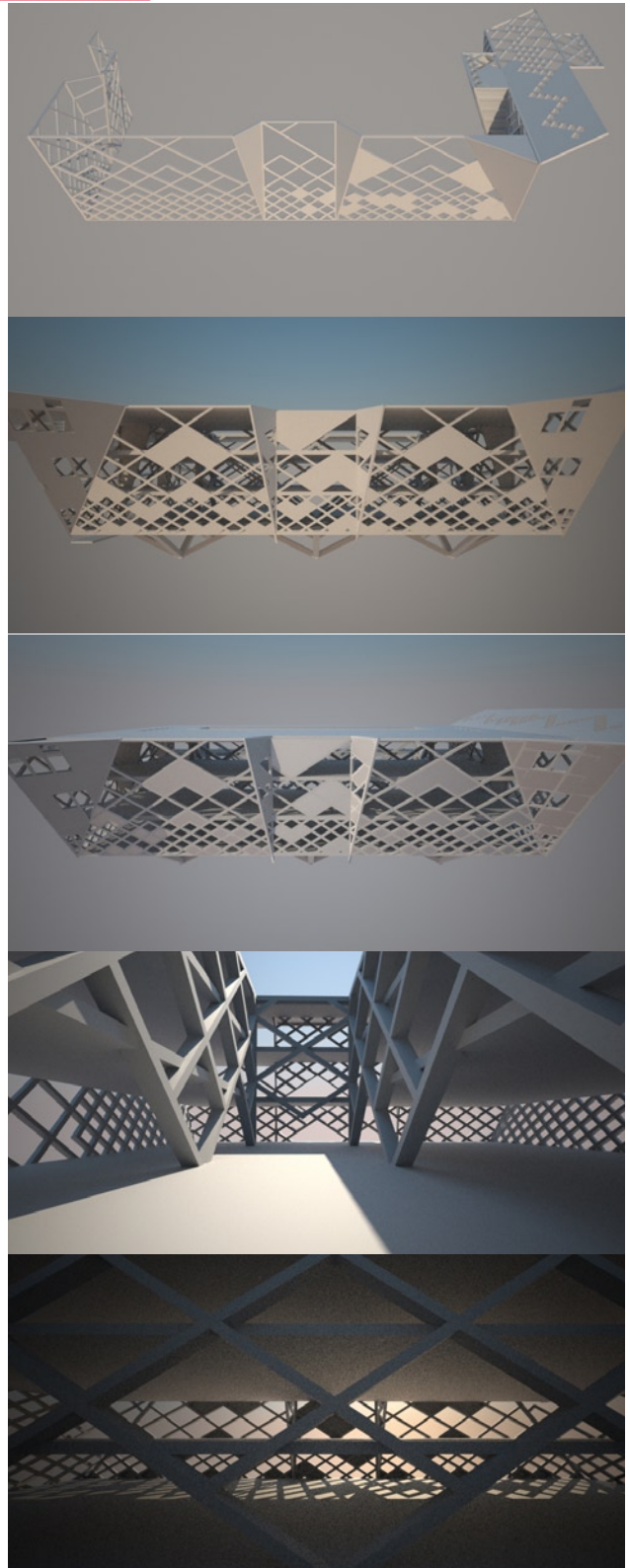


Figure 6.25-29: Structural development studies

The natural design development progression of a deep surface structural component can be seen in images 6.29 - 30 where the structure is folded inward to become the internal structural element.

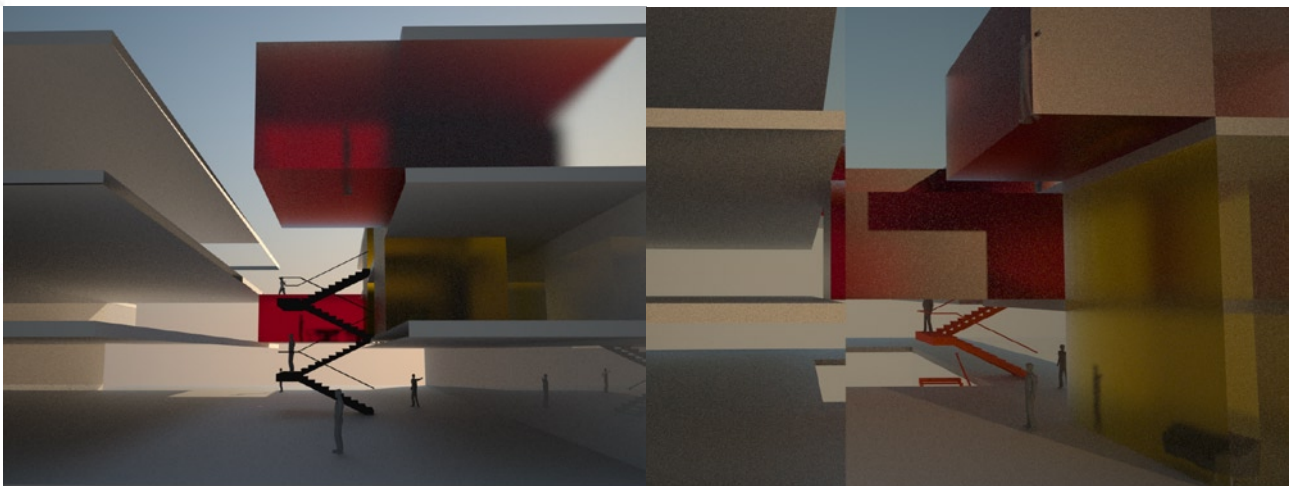
## 6.2.4 Spatial Exploration

“Space constantly encompassing our being. Through the volume of space, we move see forms, hear sounds, feel breezes, smell the fragrances of a flower garden in bloom. Its visual form, its dimensions and scale, the quality of its light - all of these qualities depend on our perception of the spatial boundaries defined by elements of form. As space begins to be captured, enclosed, molded and organised by the elements of mass, architecture comes to being.”

The above quotation comes from Francis Ching’s `Form Space and Order and exploring spatial development in context of the `Deep Surface` theory was an interesting exploration of what is possible and achievable within the constraints of performance criteria. Figure 31 illustrates the first exploration in to the spatial aspect of deep surface, developing a contiguous entity that encompasses all the requirements of `Deep Surface`. Within the research facility certain specialised functional requirements for interaction and other technological requirements are needed. In the conceptual images below (32-41) the red cubes represent `Deep Surface` spatial elements and the yellow double volume break out spaces.

The conceptual development of the atrium and connection spaces focused on developing interesting, dynamic and exiting spaces. These spaces serve as the `community pubs`, places to meet and discuss, places of chance encounters, places where the occupants of the facility feel at home. In contrast to the `pub` analogy, these space also need to create exiting research spaces, hence they are all located in, above, across or linked to the central atrium structure and to all transition zone. The following images document the exploration of such spatial requirements.

Figure 6.30,31: Deep surface tubes spatial exploration



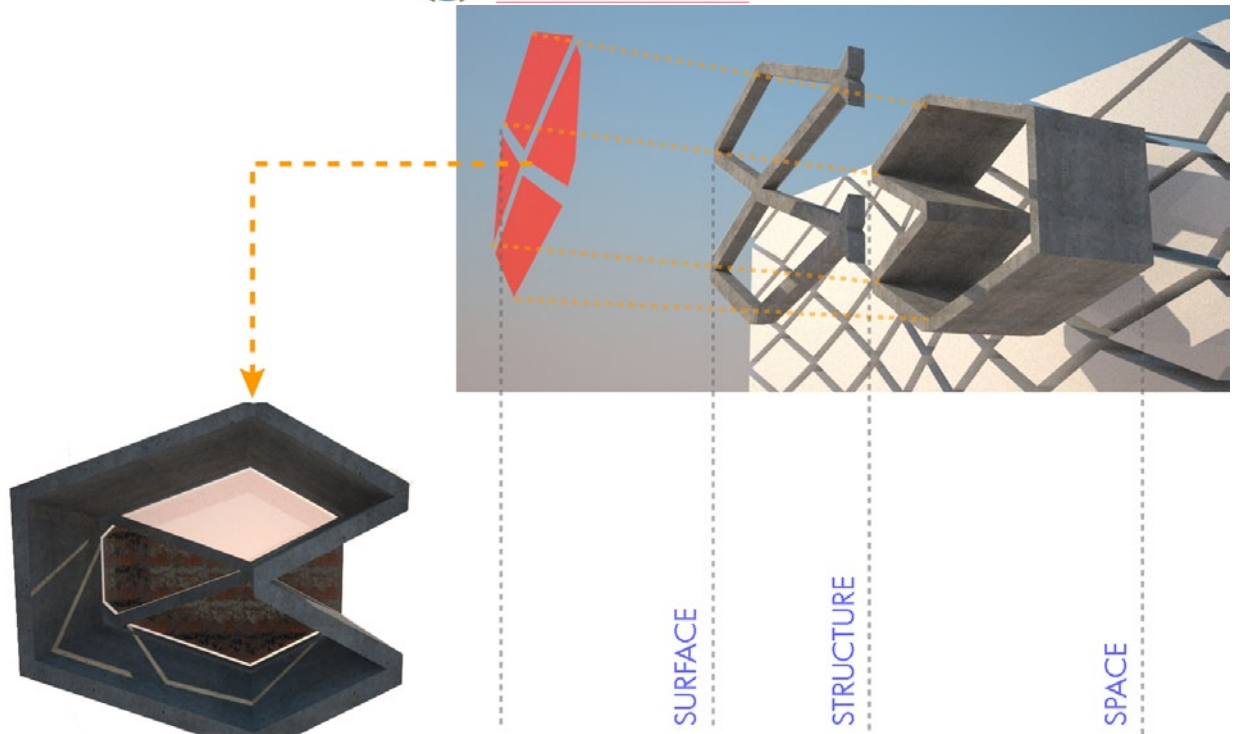
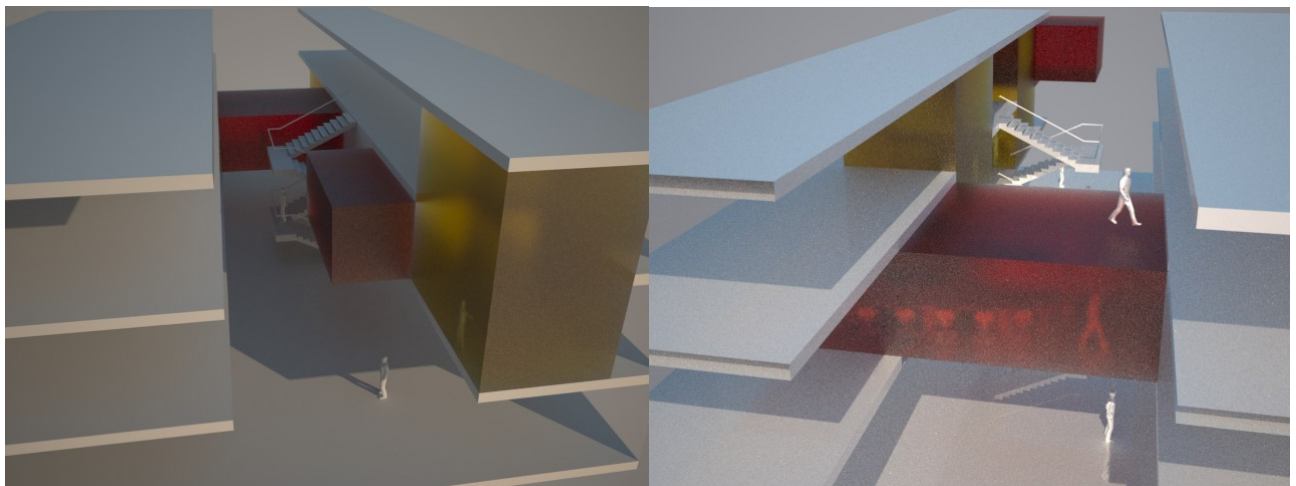


Figure 6.32: Initial conceptual rendering of Deep Surface

Figure 6.33,34: Break out spaces exploration





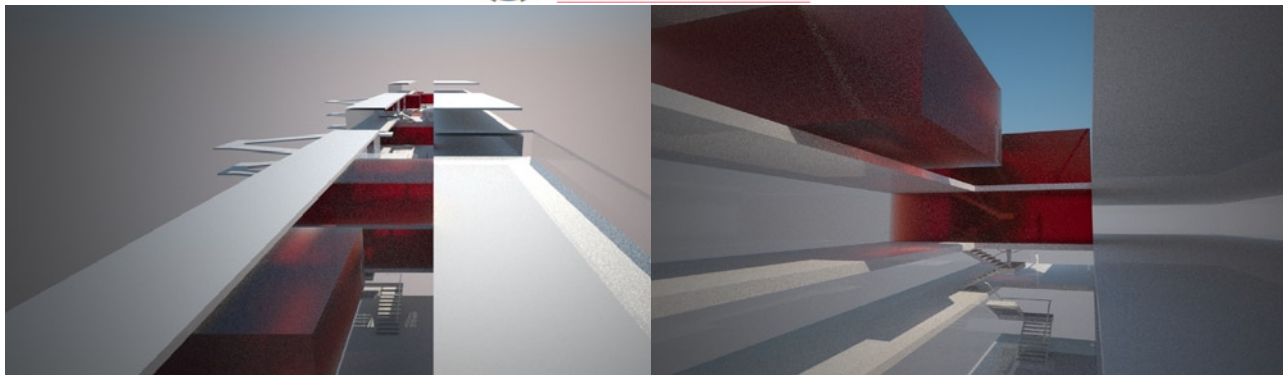
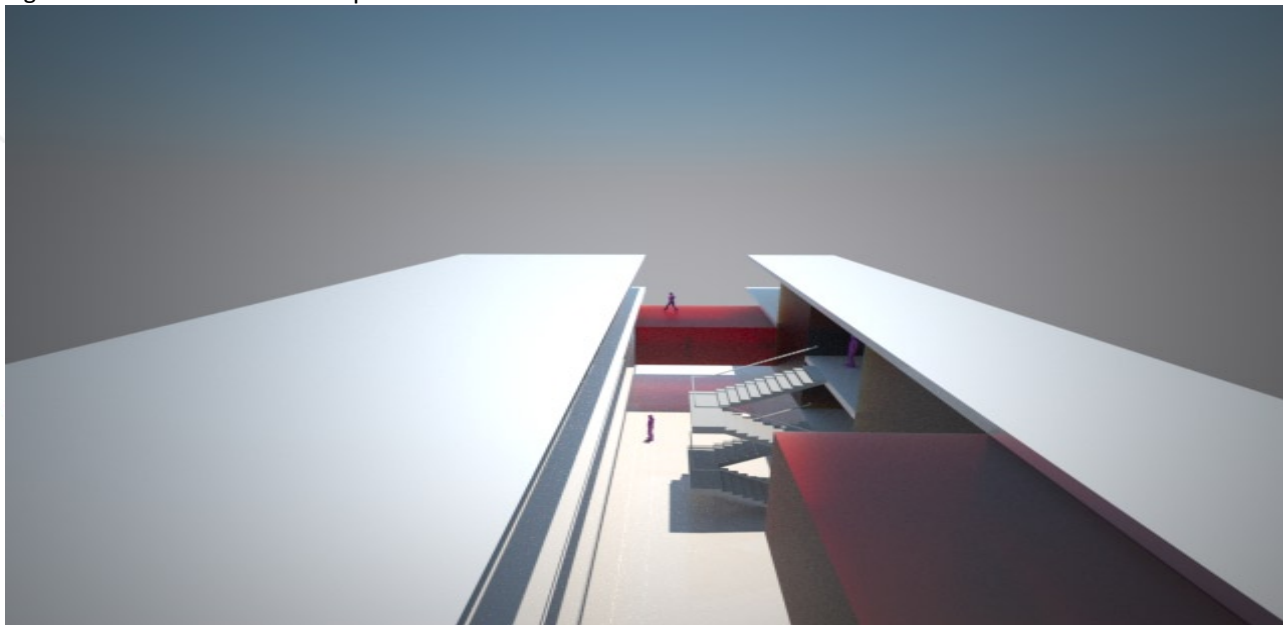


Figure 6.35,36: Conceptual spatial study of atrium



Figure 6.37: Aerial view of deep surface tubes



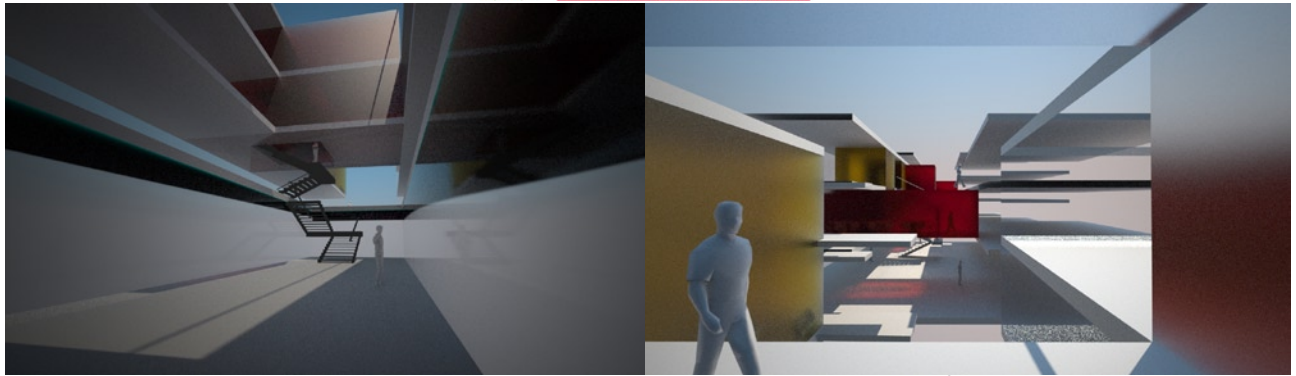
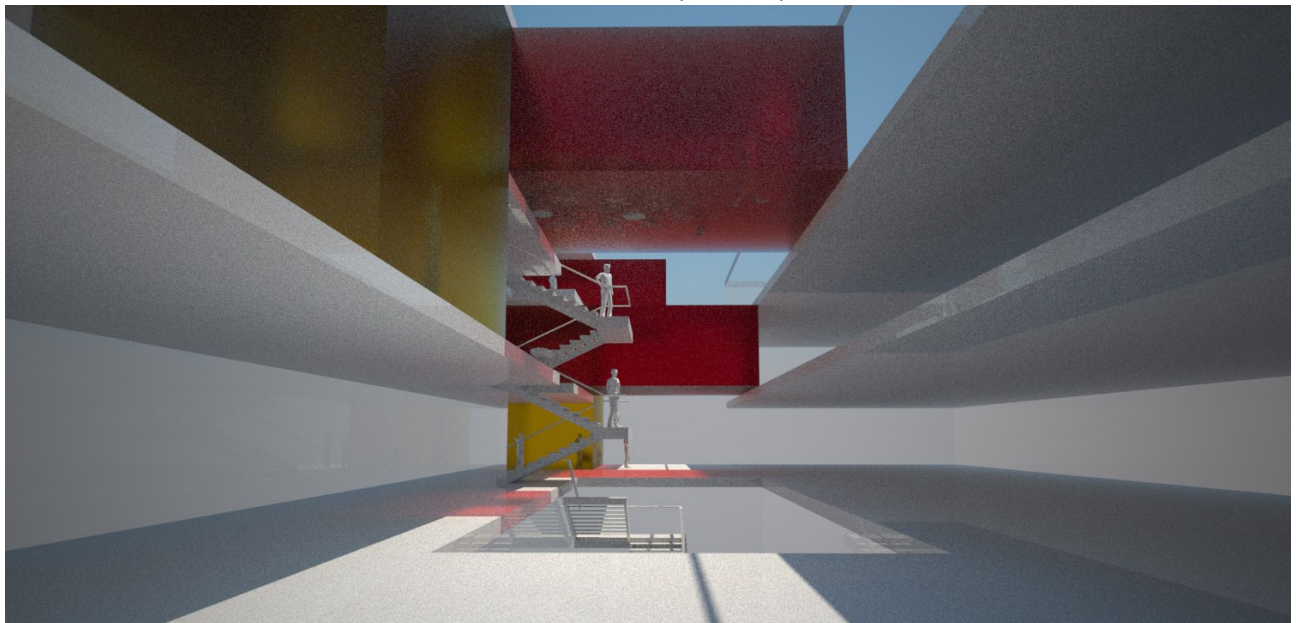


Figure 6.38,39: Deep Surface spatial study

Figure 6.40: View of quadruple volume atrium and spatial exploration



## 6.3 Form Development

“ Architectural form is the point of contact between mass and space ... Architectural forms, textures, materials, modulation of light and shade, colour all combined to inject a quality or spirit that articulates space. The quality of the architecture will be determined by the skill of the designer using and relating these elements, both in the interior spaces and in the spaces around buildings (Edmund N. Bacon, *The design of cities*, 1974).”

Francis Ching quotes Edmund Bacon in ‘Form Space and Order’, and as he notes; Form is a term that has several meanings....However it can roughly be defined by certain characteristics like shape, size, colour, texture, position, orientation and visual inertia.

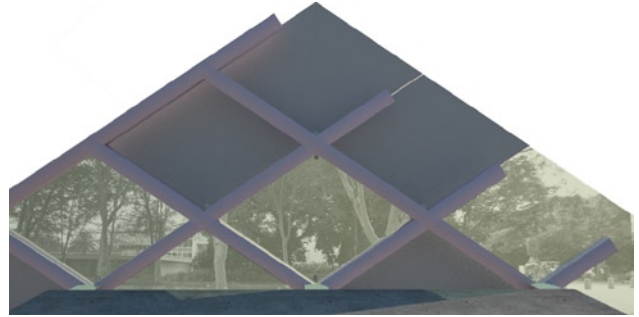
Formal development in my research facility is informed by five main influencing factors; Views, Movement, Environmental restrictions, Theoretical approach and Facility planning. In this section I propose to cover only the first three indicators listed as the others are discussed in greater depth in other chapters.

### 6.3.1 Views

As one of the prominent contextual form development indicators views from and to the site building played a major part in its formal development. Views in and from a building defined the occupants spatial experience, they are tools that can be used as orientation devices, focal points or connections to the external environment.

Due to the traditional introverted nature of research and the contemporary performance criteria of providing external views to encourage innovative research, the facilities development focussed very strongly on external views, focal point and axis as a form giving indicator.

Figure 6.41: Conceptual view from deep surface



The formal exploration around views lead to the development of three distinct view orientated zones within the facility. Figure 6.50 - 53 shows the different zones. The zones can be identified as ‘Transitions Zones’ where internal circulation, spatial and programmatic changes take place. Primary focal point views or ‘Atrium view Zones’ that are also connected to transitions zone and the ‘Main Entrance’ view point.

Figures 6.43 - 48 show main focal view points, transition zone views and possible entrance view frames.

In figure 6.49 the facilities massing in relation to its views indicators are show.

Another major influencing factor in the development of the facility was the connection between the Visual Arts building and the Music Department, in the original context, they are obscured from one another even though they belong to the same precinct. This led to a strategy of elevating the building in a terrace style, to clear all visual impediments and give these two iconic building the visual link and recognition that they deserve.



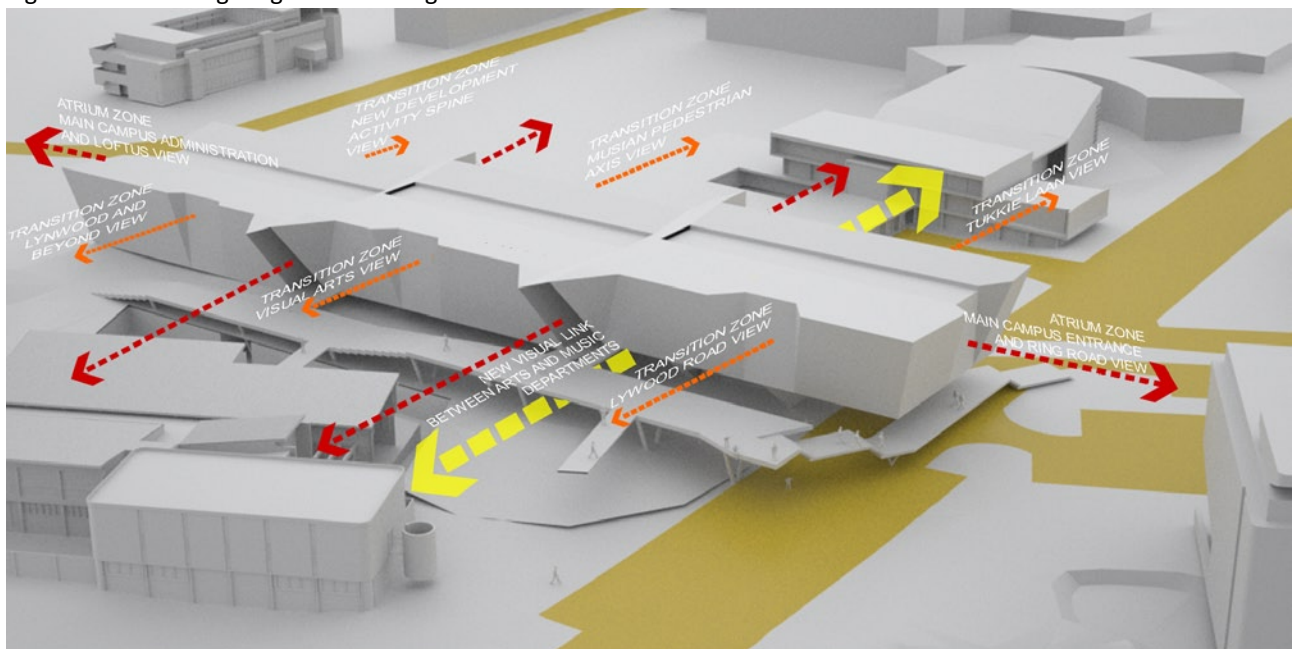


Figure 6.42-44: Focal point views as part of formal development

Figure 6.45-47: Focal point views as part of formal development



Figure 6.48: Massing Diagram Indicating main views and axis



FORM DEVELOPMENT



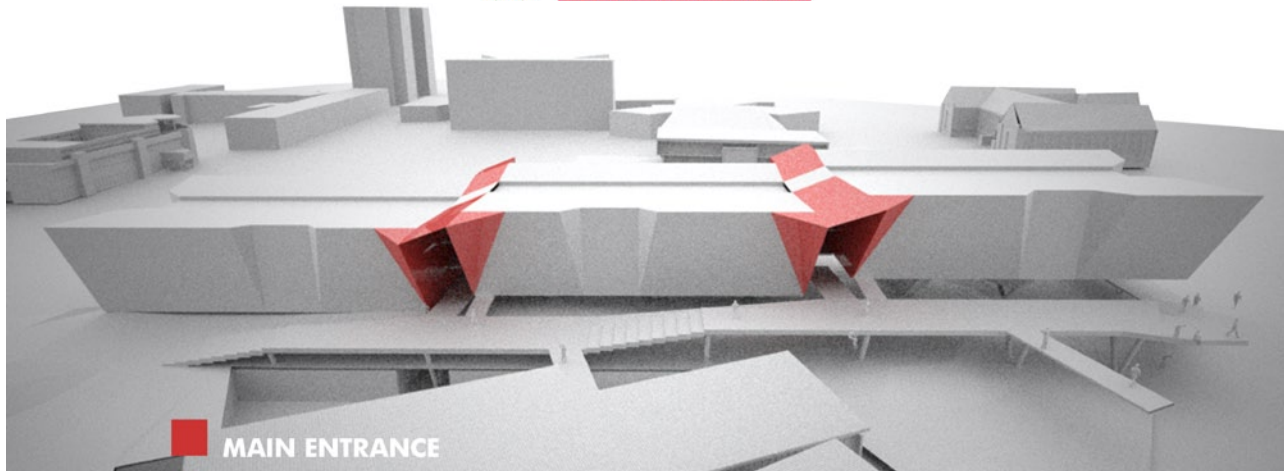


Figure 6.49: Conceptual massing diagram indicating main entrances

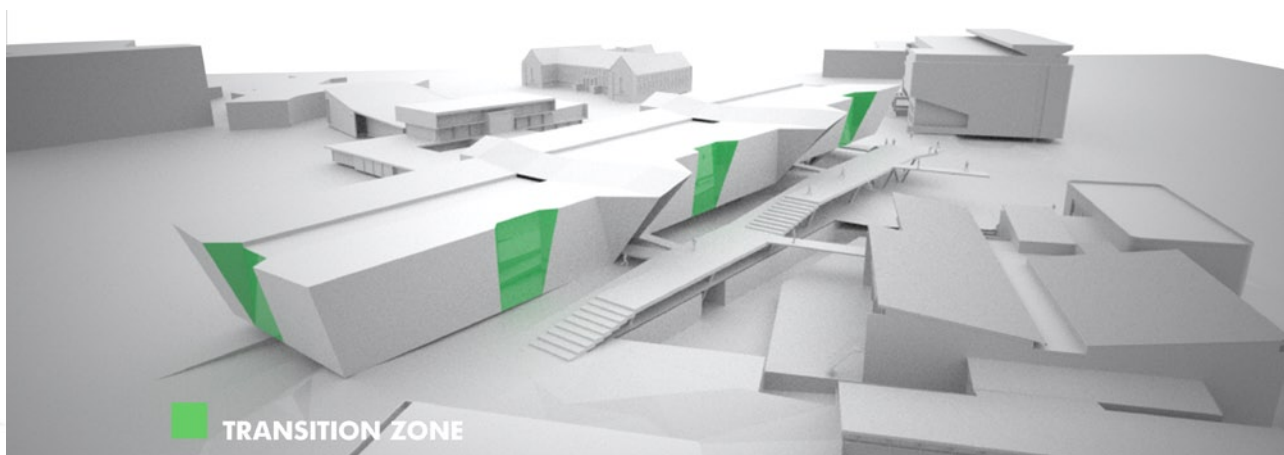
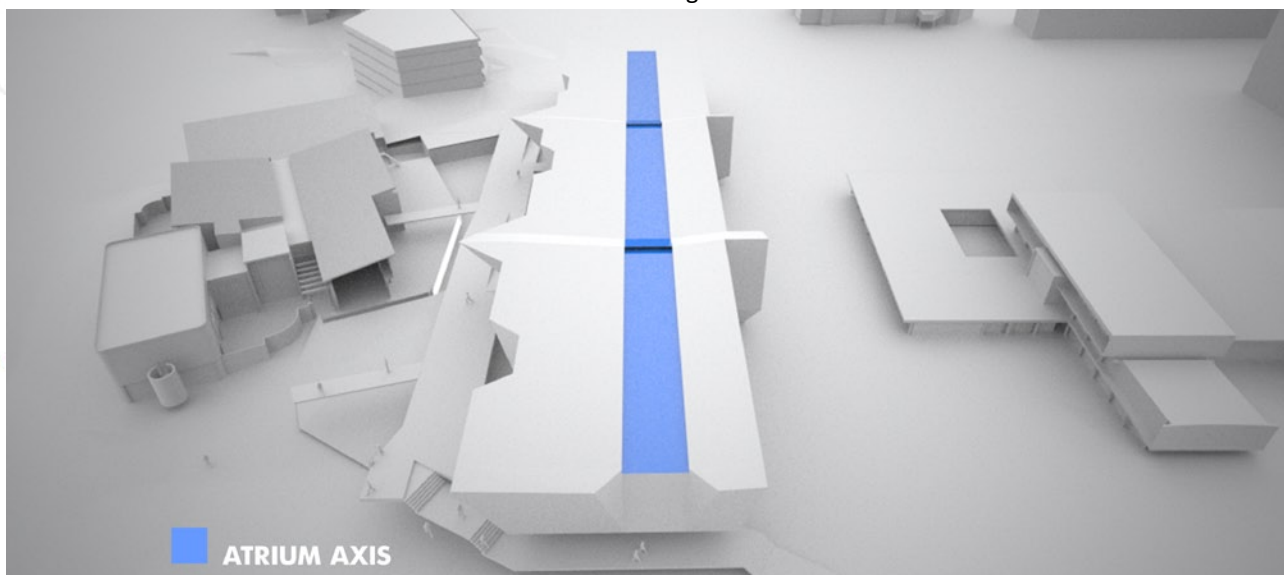


Figure 6.50: Transition Zones

Figure 6.51: Connective atrium axis



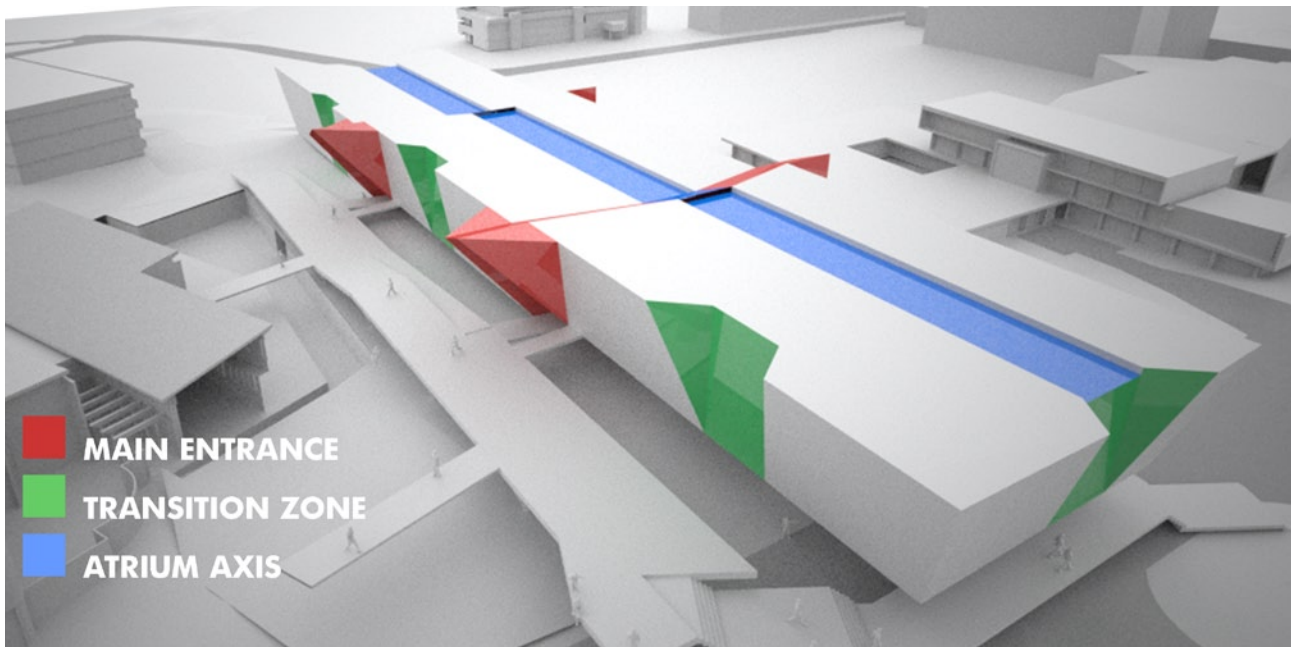


Figure 6.52: Combination of view determined formal development



### 6.3.2 Circulation

As one of the major form, activity and vitality defining indicators present on a site, the circulation needs to be considered very carefully. As stated by Ching, the path of our movement can be conceived as the perceptual threads that links the spaces of a building or any series of internal or exterior spaces together.

“ Since we move in **Time** through a **Sequence of Spaces...** “

A further study of Chings approach to circulation and movement one identifies the following key parameters involved when designing circulation through space.

- A. Approach
- B. Entrance
- C. Path-space relationships

A number of performance criteria were of critical importance parallel to Chings concern when looking at the development of the external spatial circulation system.

1. The establishment of a new precinct connection between arts and research
2. The locality of the major ringroad and tukkies intersection
3. Dealing with a corner site appropriately
4. Forming the circulation as part of a spatial extension of the surface of the facility.

In figures 6.54 - 58 the development of the external circulation system can be seen. From initial conception to final design the system made use of the design indicators as listed above, thus the evolution of the design to the most appropriate solution as shown in figure 6.59 .

Facilitating inter precinct, inter disciplinary and inter-ractional circulation, communication and connection is the main aim of the raised circulation walkway.

Due to the corner nature of the site it was difficult to determine a suitable main entrance for such a large facility. Together with the parameters of focal view points, creating three independent yet integrated research units, facilitating environmental awareness the development of two main entrances as is seen in figure 50 was inevitable. Figure 6.60 shows the sketch exploration of the above mentioned concept. In these two main entrances the walkway enter in to the main entrances and pass through the facility in to the horizontal/awareness circulation zone.

The walkway also proposes to connect on the first floor level to the Visual Arts department and the proposed new addition to the visual arts facility. This will facilitate the walkway as being the connective tissue between the arts and research precincts.

The last important factor is the walkway is designed path-space specific interaction zones, allowing the walkway to become an outdoor extension of the research environment, with spaces and places to pause, discuss and interact. In fact becoming a social space in its own right, a mirror of the internal atrium street connecting the research facilities, the walkway is the exterior communal connective street.





First conceptual exploration of circulation system as free form connective tissue like substance, morphing and adapting to its functional and spatial requirements.

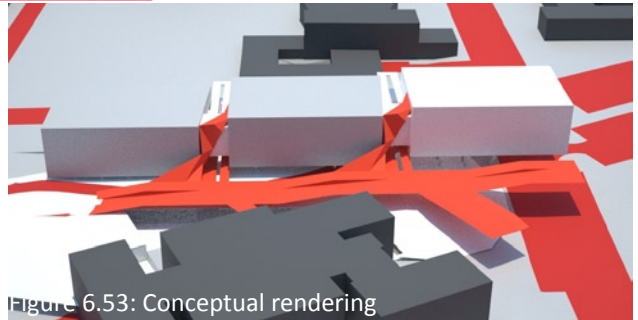


Figure 6.53: Conceptual rendering

First conceptual exploration viewing the walkway as light emitting entity.

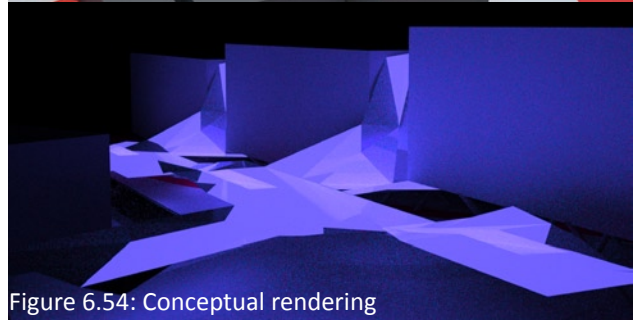


Figure 6.54: Conceptual rendering

Further exploration of walkway surface connecting from main boukunde entrance and spanning across the tukkie laan pedestrian entrance.



Figure 6.55: Walkway from boukunde

Exploration of circulation surface in recognition of the major movement intersection at the main campus ringroad.

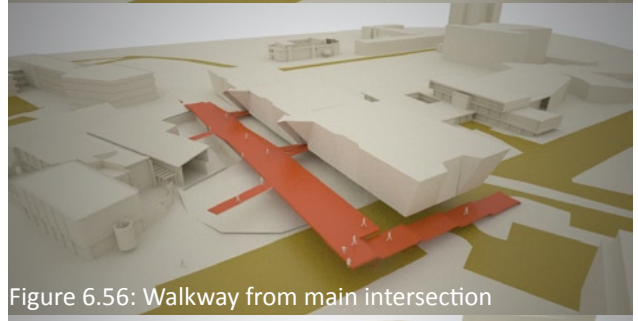


Figure 6.56: Walkway from main intersection

Development of circulation taking in to account the path-space relationship of Ching, the experience of pedestrians while moving from open space to below the facility and open space again, while moving parallel to the main ground level pedestrian network. The development strives to create and facilitate environmental and spatial awareness.

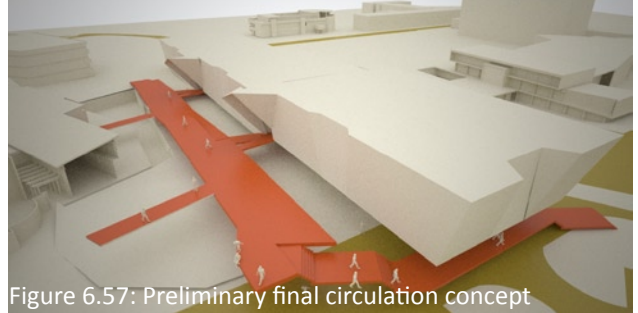


Figure 6.57: Preliminary final circulation concept



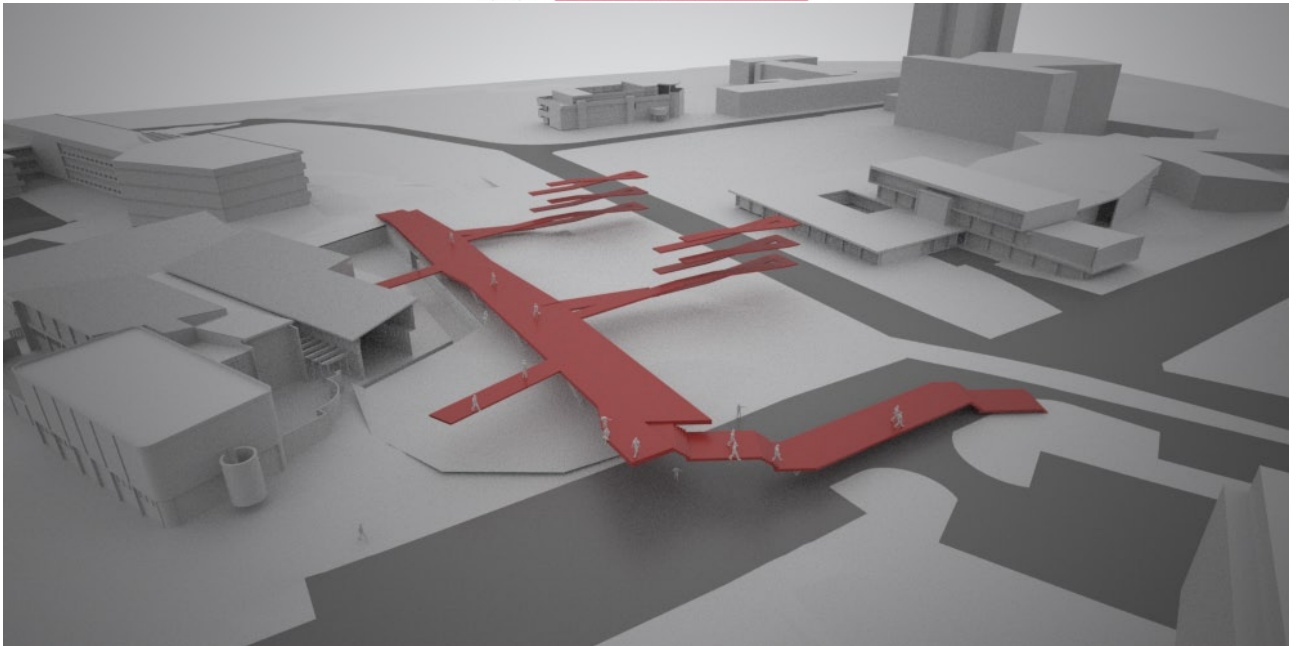
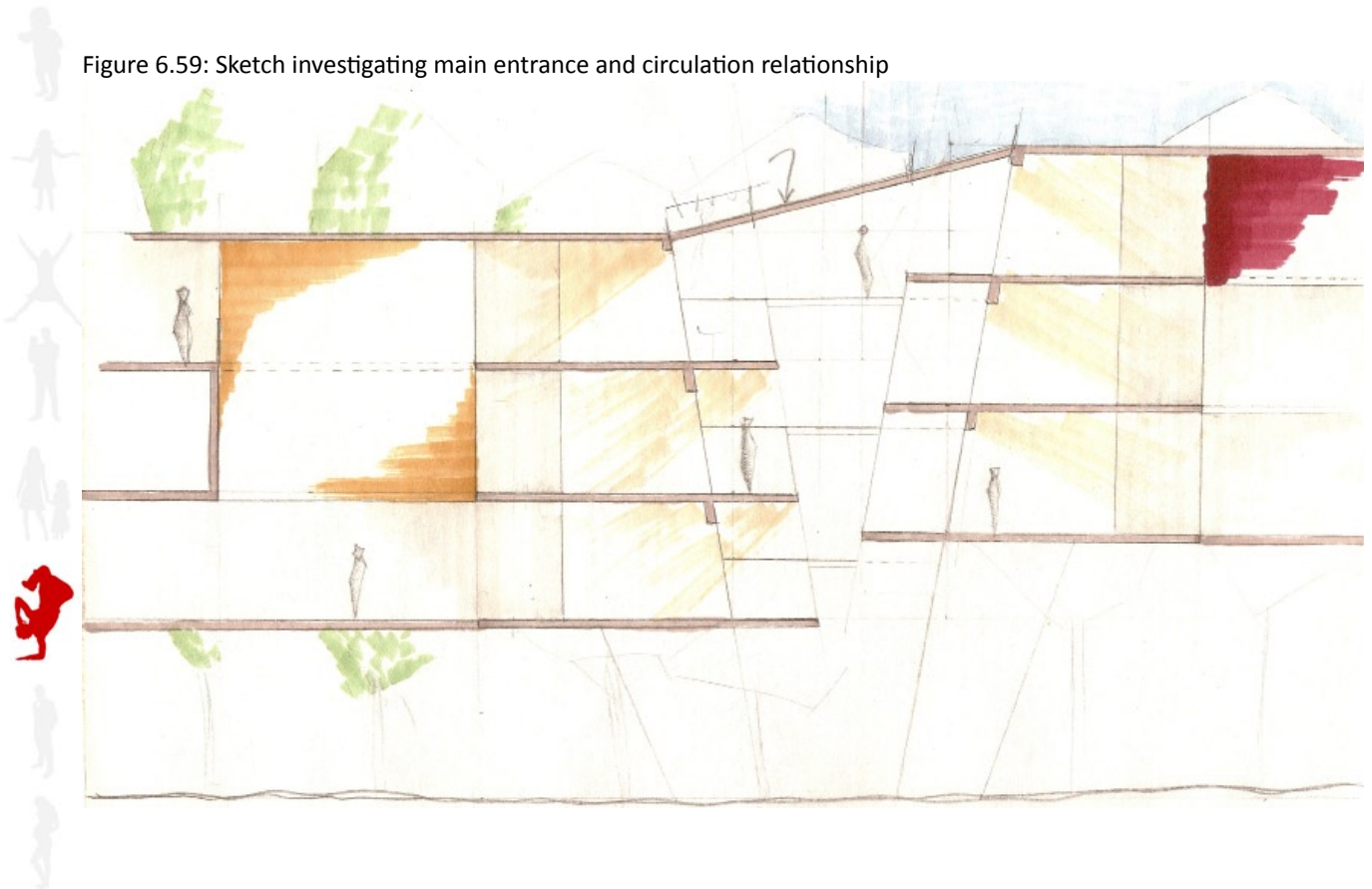


Figure 6.58: Final Conceptual model of circulation system

Figure 6.59: Sketch investigating main entrance and circulation relationship





## 6.4 Intervention

The following section contains numerous parts that represent the proposed research facility for the University of Pretoria.

Artistic impressionis of one of the proposed connective atrium spaces are represented in section 6.4.1.

Section 6.4.2 contains the technical drawings that define the detailing construction and planning of the facility

The final contextual three dimensional representation of the facility are contained in section 6.4.3.

### 6.4.1 3D Atrium Views

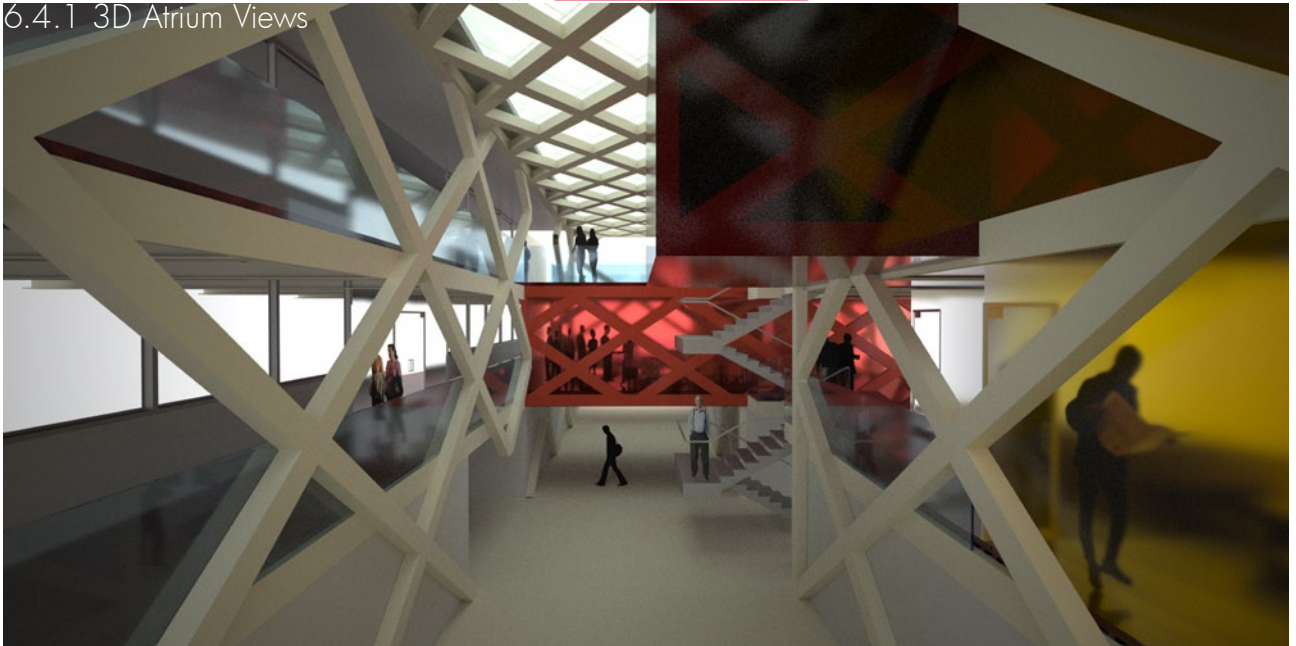
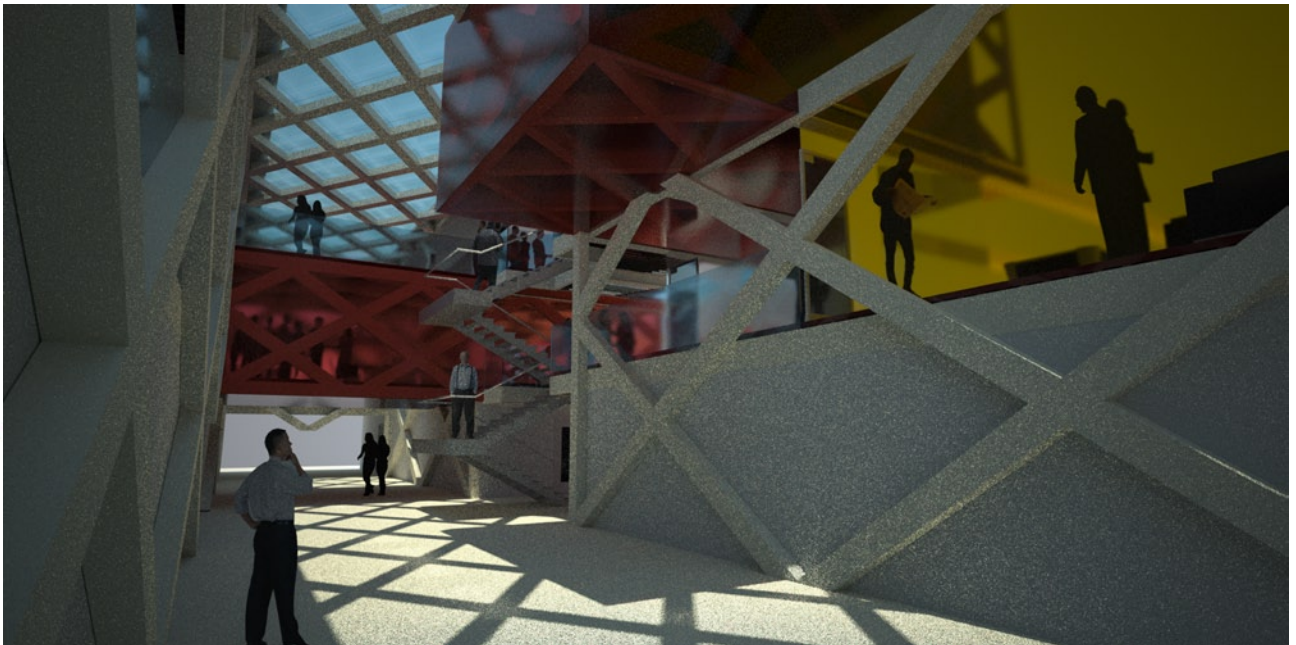


Figure 6.60: Perspective artistic impression of one of the proposed atrium zone with all its connective and interactional devices. The proposed tubes (red) and break out space (double volume, yellow) can be clearly seen.

Figure 6.61: Perspective artistic impression of one the proposed atrium zone showing the vertical link between structure and space in the atrium zones, as well as daylight penetration at midday in the summer.





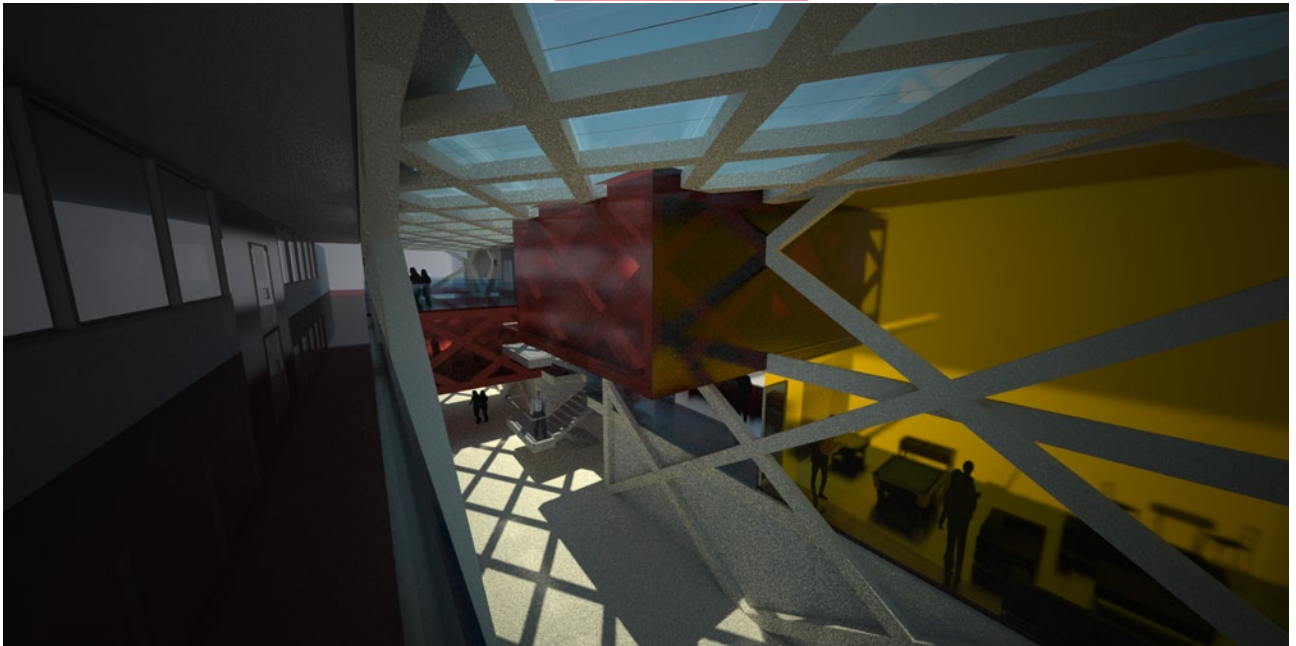


Figure 6.62: Perspective artistic impression of one of the proposed atrium zones from the upper laboratory circulations space. The full extent of the double volume break out spaces can be seen from this vantage point.

Figure 6.63: Perspective artistic impression illustrating the interior of the long connective tube, the flexible interior can be subdivided in to small conference facilities or used as a big open exhibition or conference space.





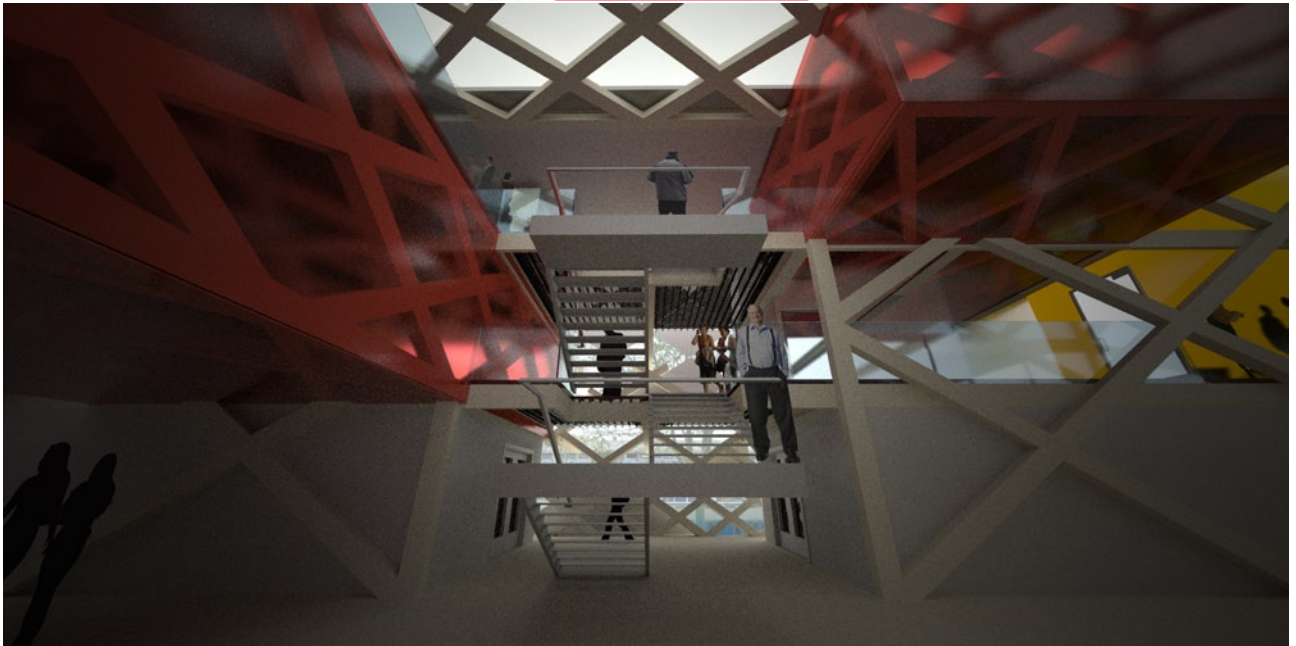
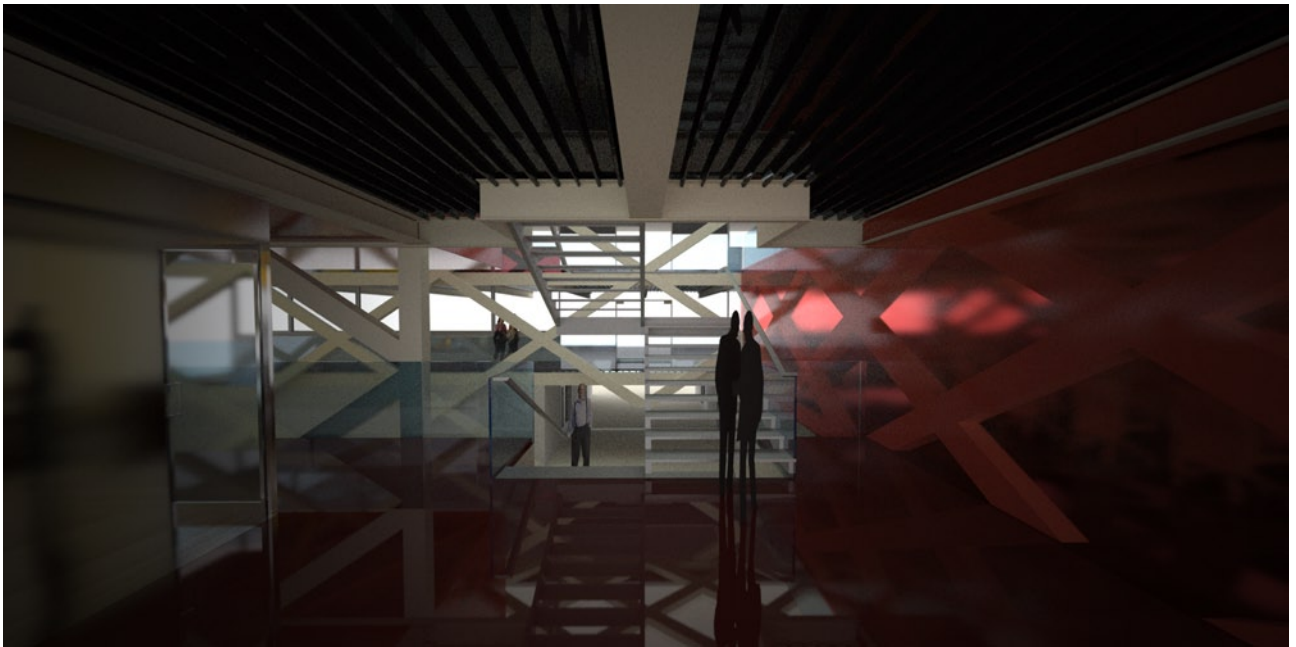


Figure 6.64: Perspective artistic impression illustrating the view of the transitions zone with vertical circulation in the atrium.

Figure 6.65: Perspective artistic impression from the proposed transition zone at second floor level in to the atrium.



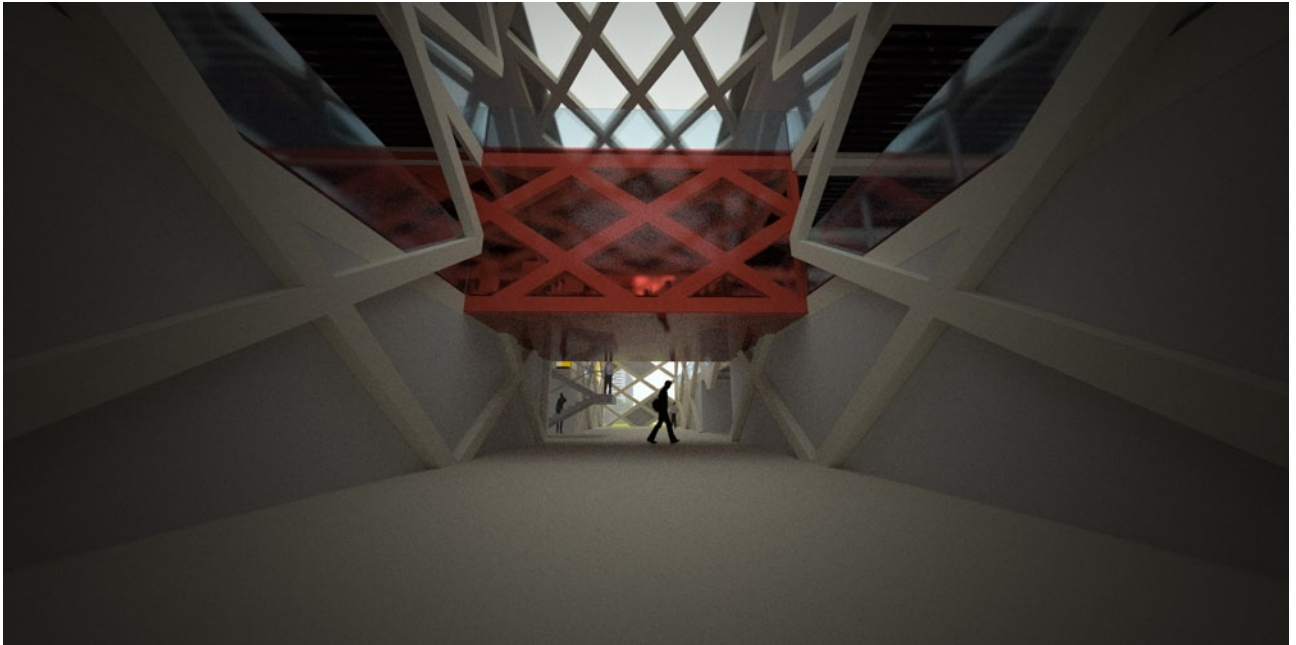
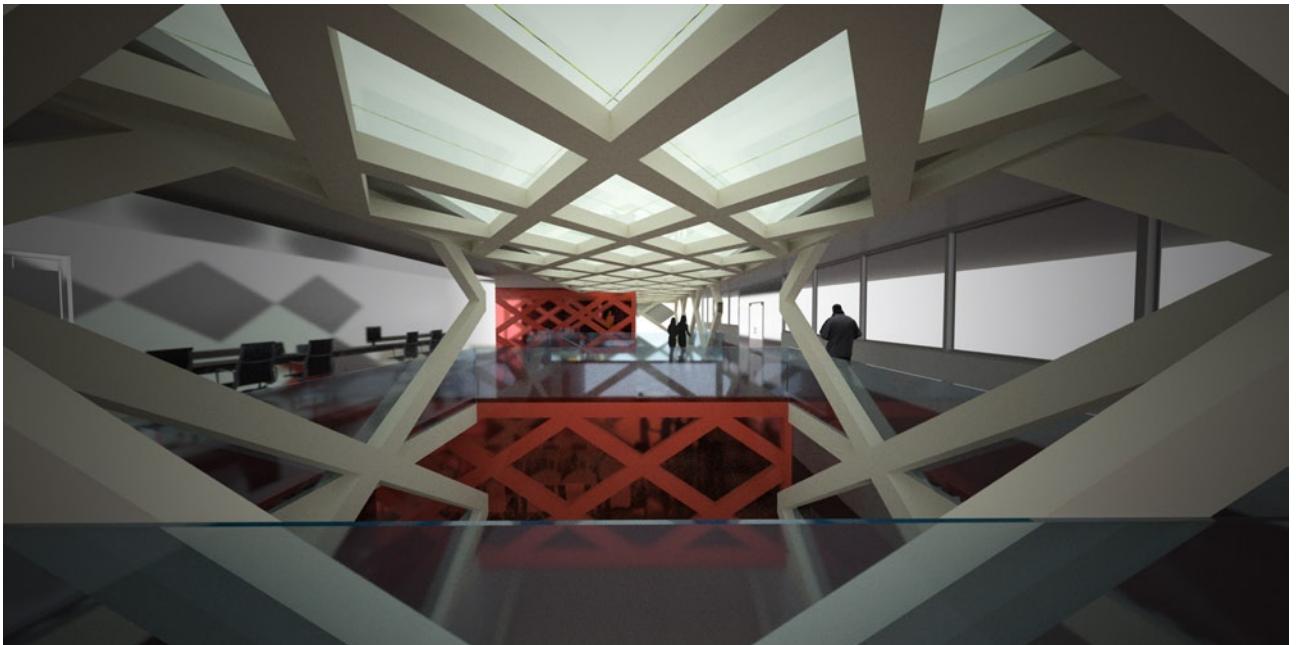


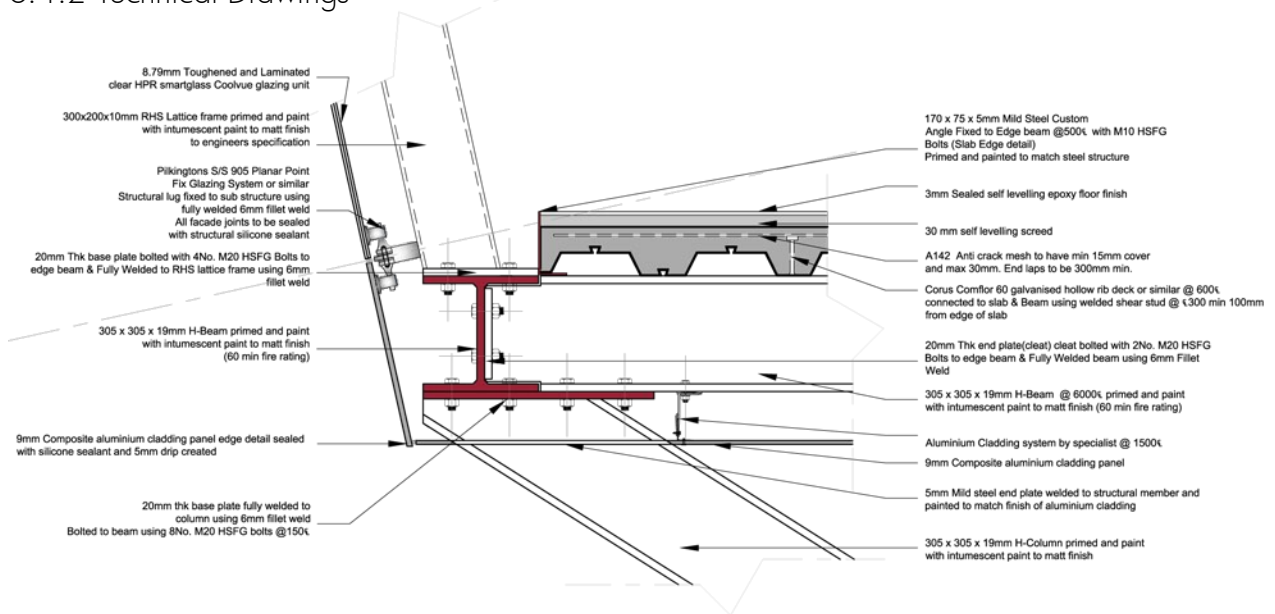
Figure 6.66: Perspective artistic impression illustrating the view of the atrium as it will be experienced when entering the research unit at first floor level.

Figure 6.67: Perspective artistic impression illustrating the view of the atrium as it will be experienced when entering the research unit at third floor level. One post graduate research units can be seen to the left as well as the penetrating tube acting as horizontal circulation.



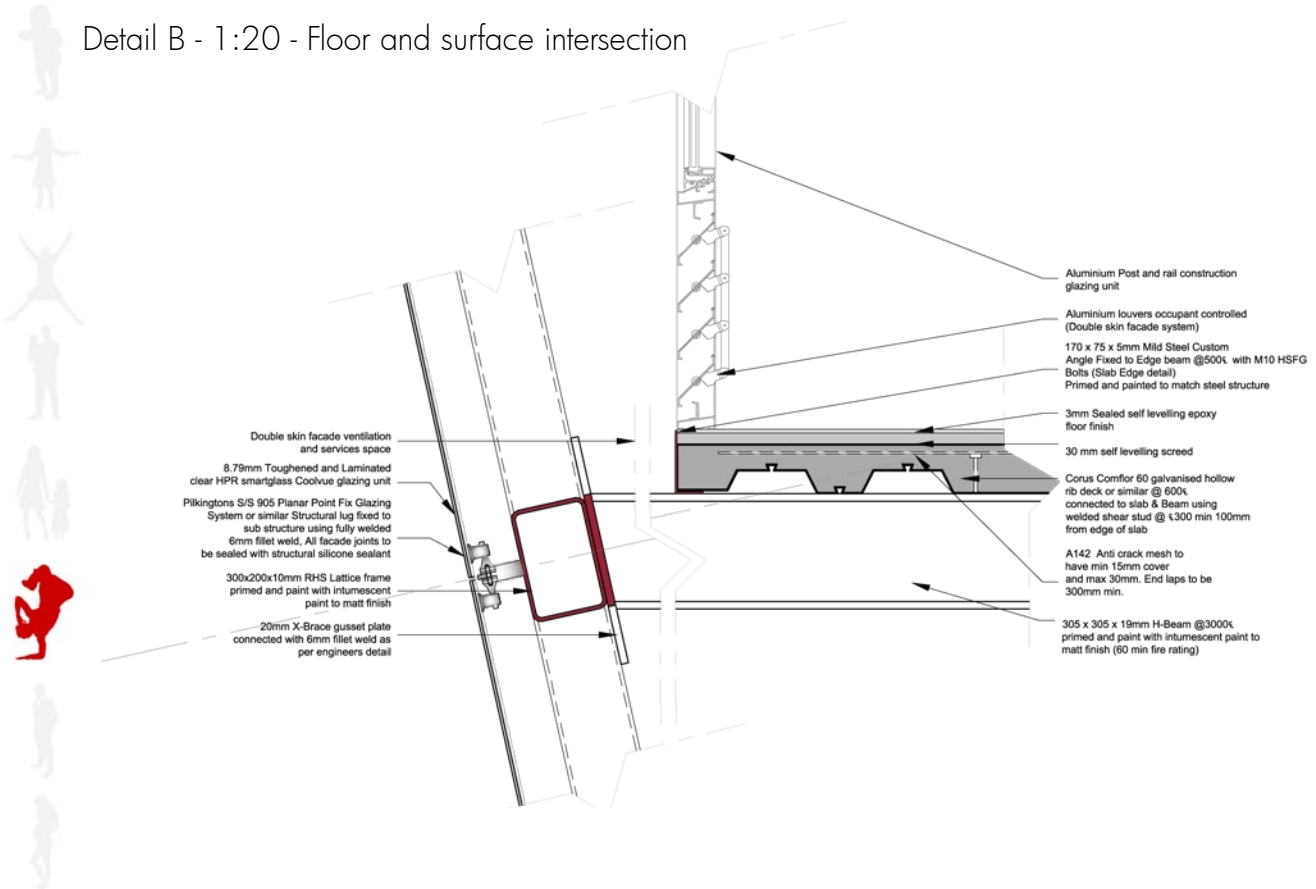


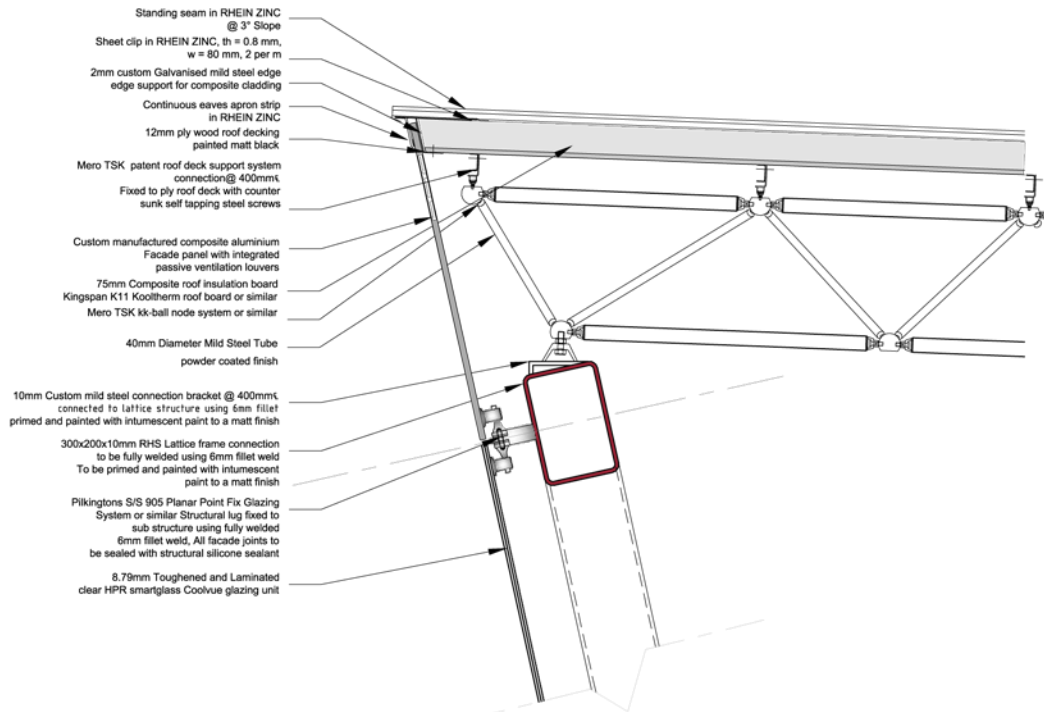
## 6.4.2 Technical Drawings



Detail A - 1:20 - Primary base support structure

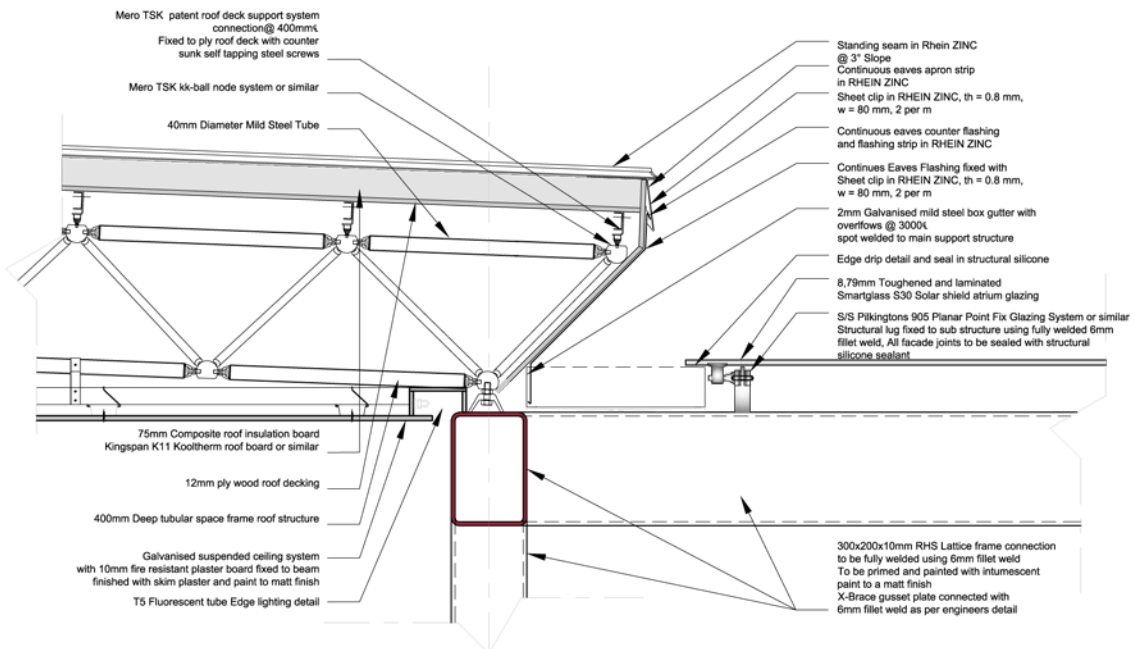
Detail B - 1:20 - Floor and surface intersection



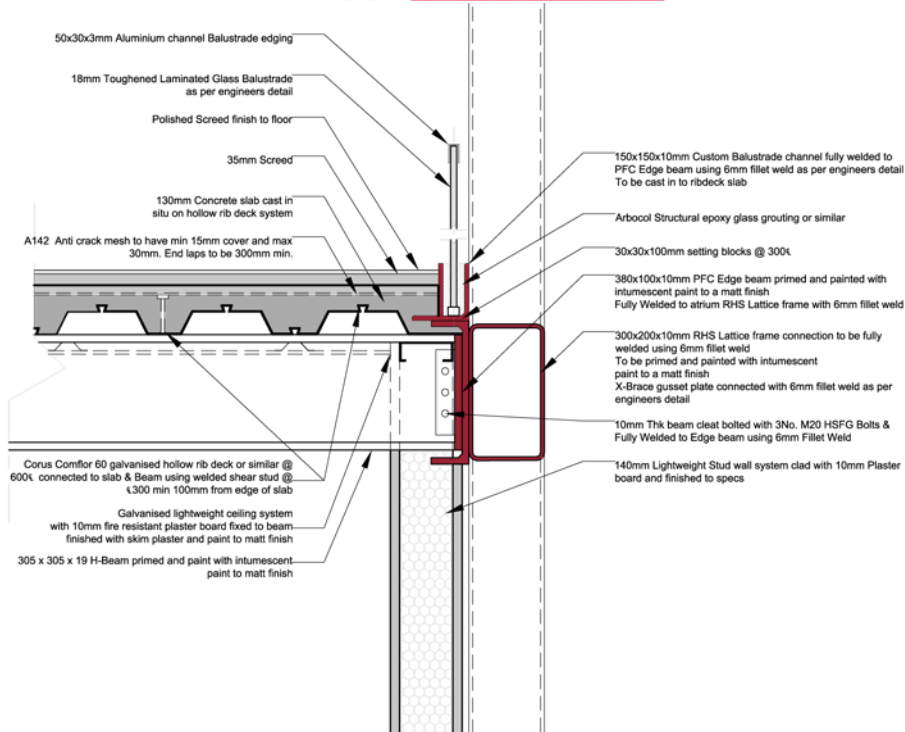


Detail C - 1:20 - Roof and envelope intersection

Detail D - 1:20 - Atrium glazing and drainage

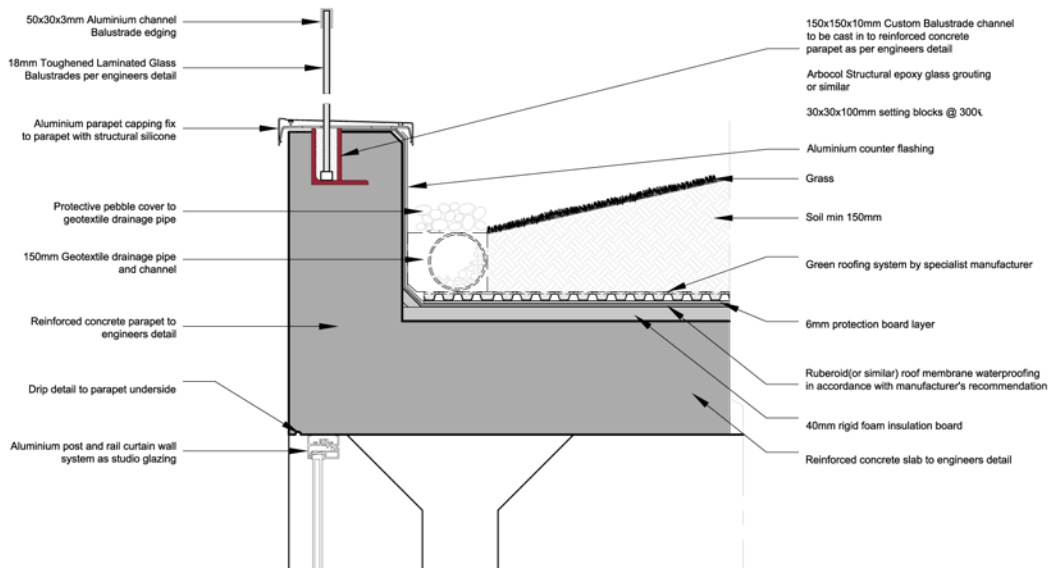


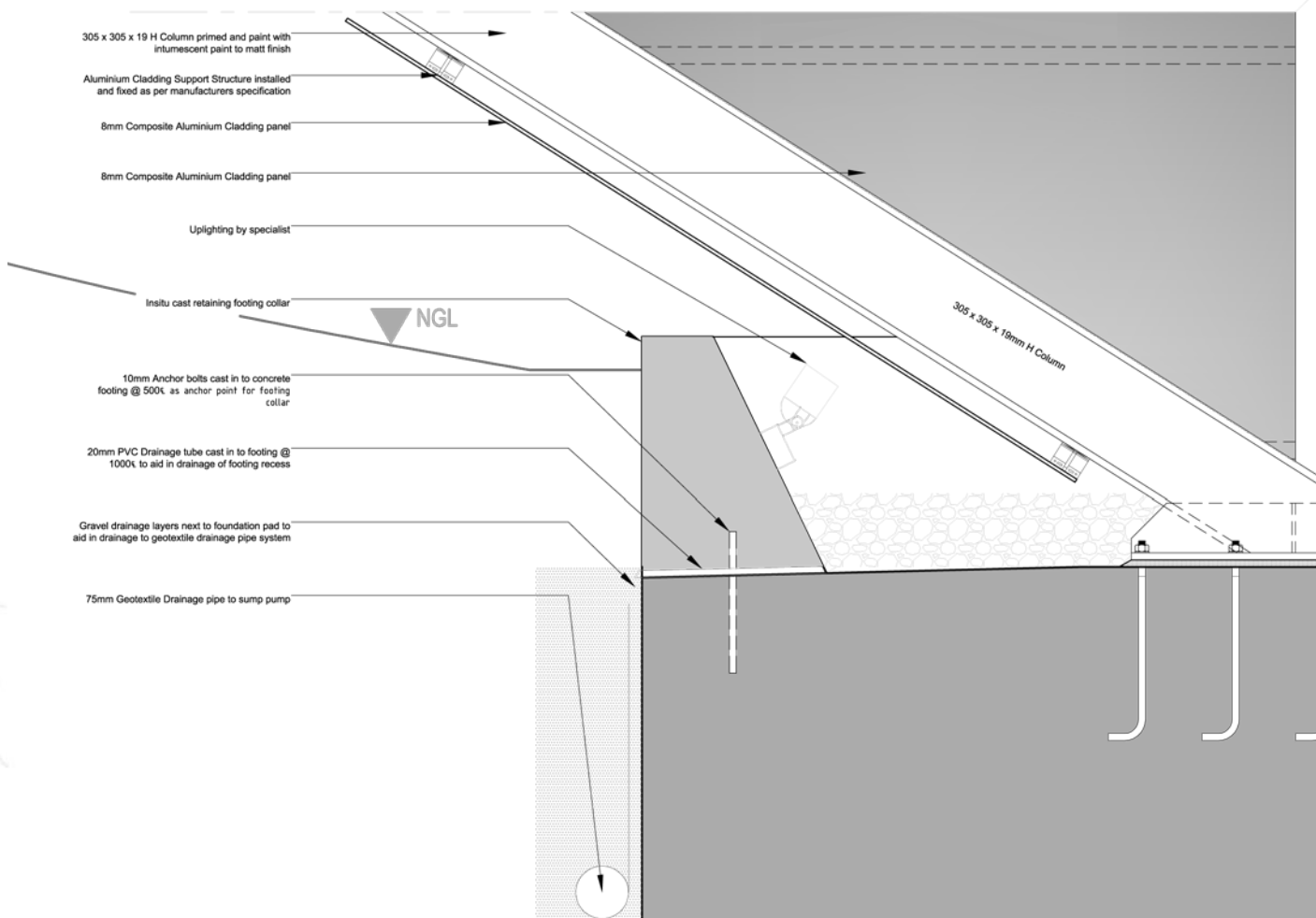




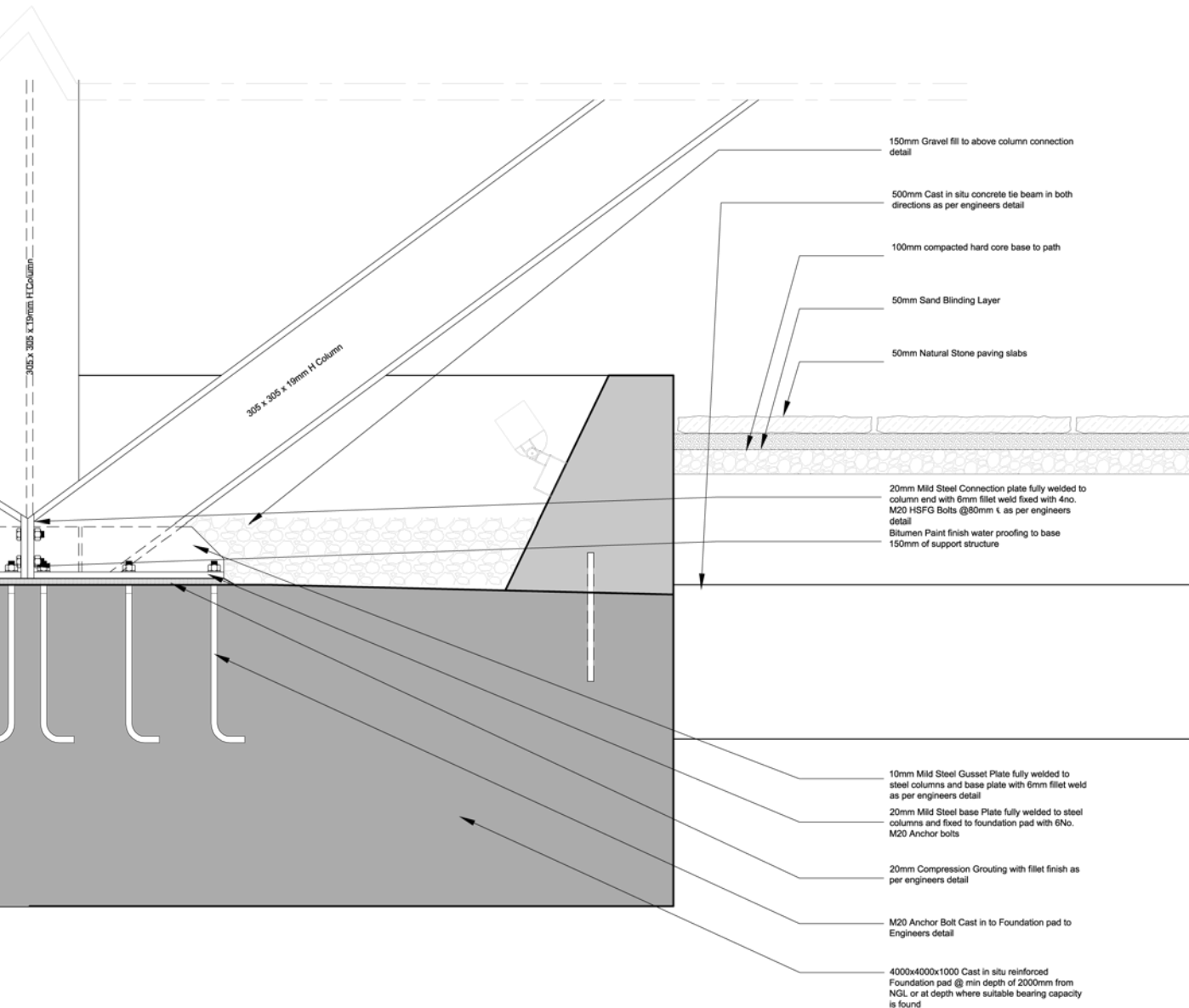
Detail E - 1:20 - Atrium lattice floor intersection

Detail G - 1:20 - Green roof parapet and balustrade detail



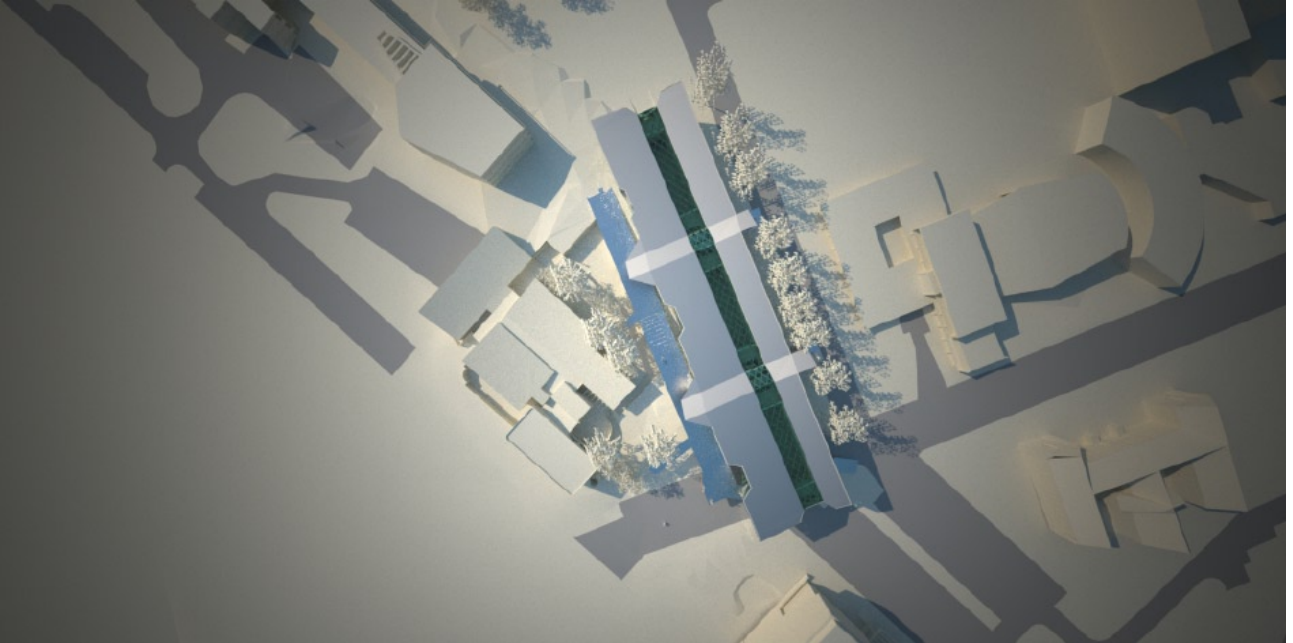
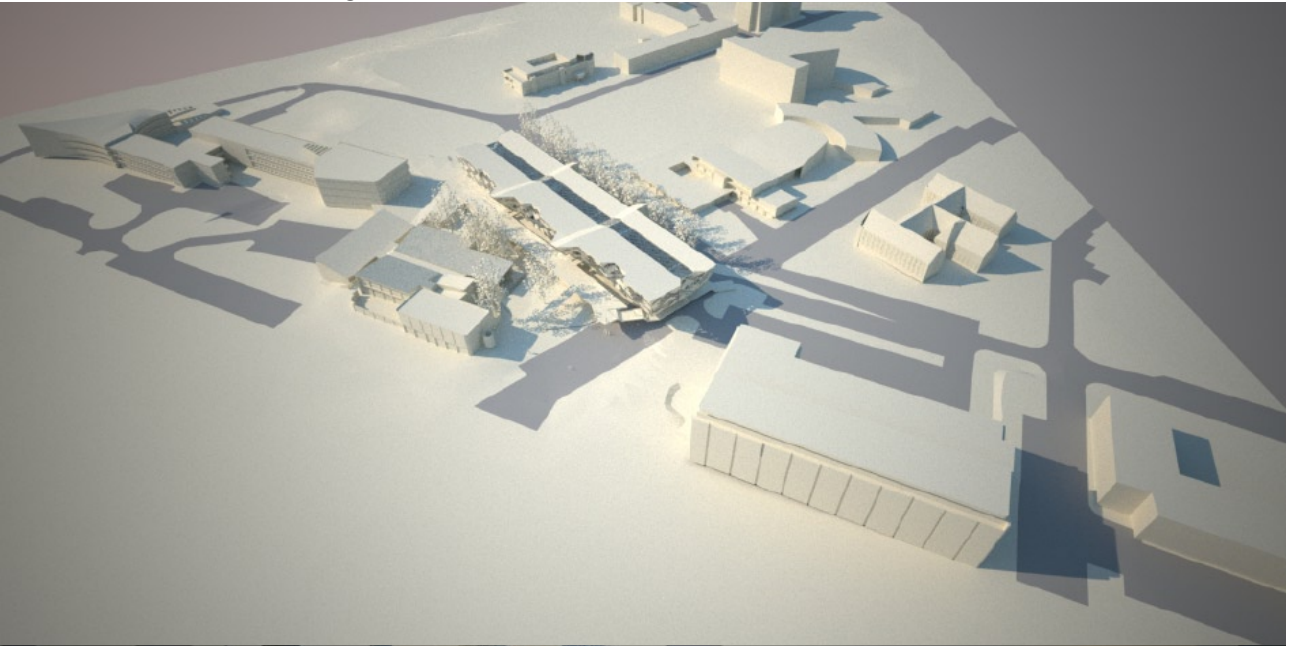


Detail F - 1:20 - Foundation assembly and connections



### 6.4.3 3D Contextual Renderings

Isometric Context Rendering

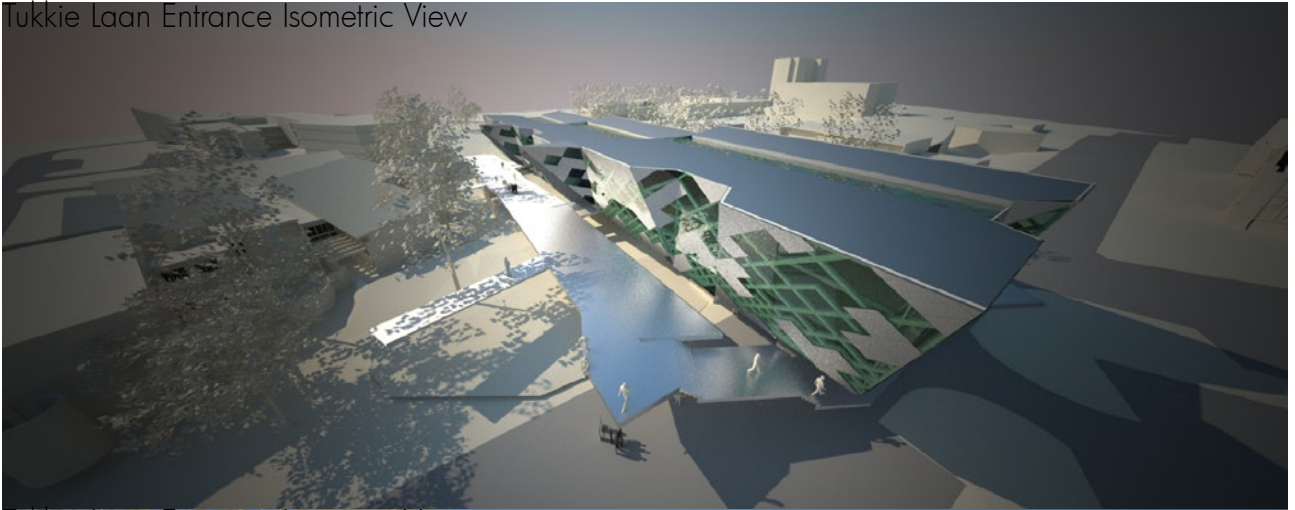


Birds Eye View Rendering

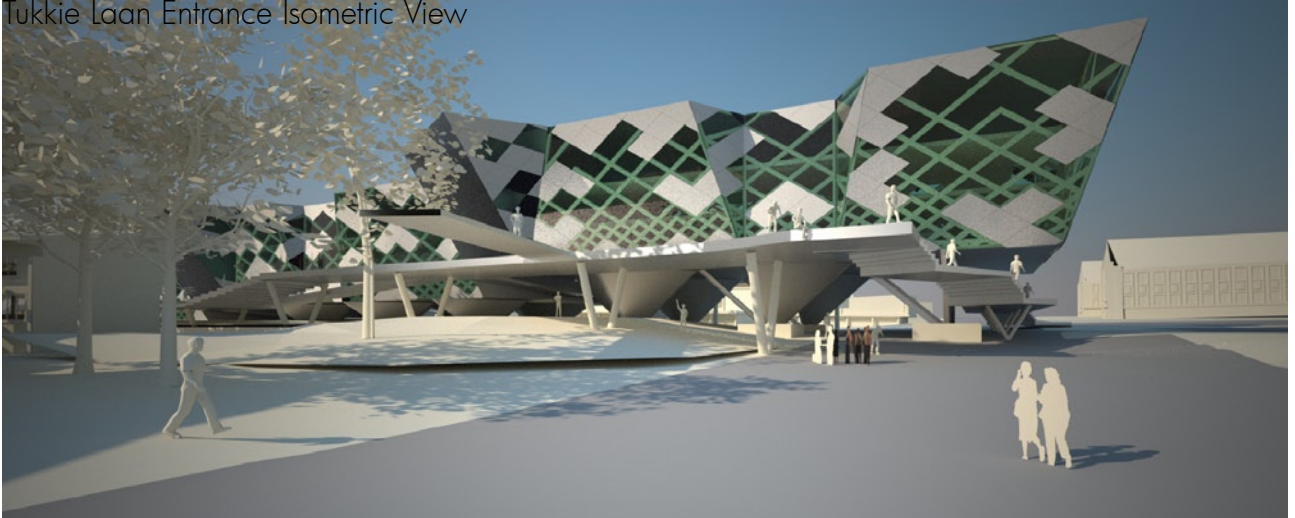




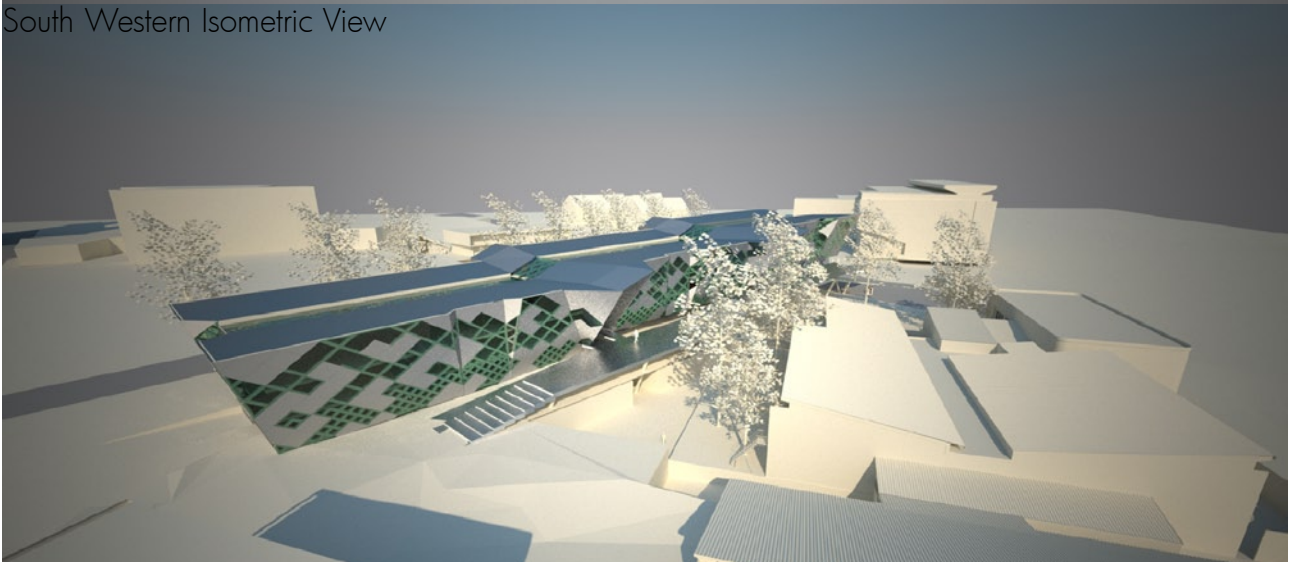
Tukkie Laan Entrance Isometric View



Tukkie Laan Entrance Isometric View

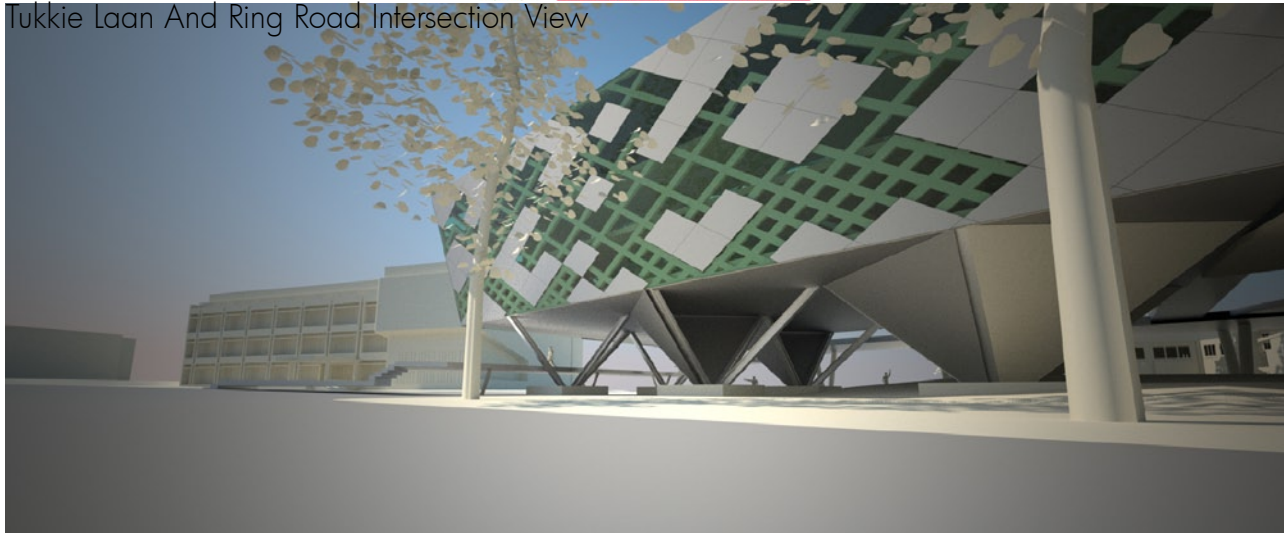


South Western Isometric View

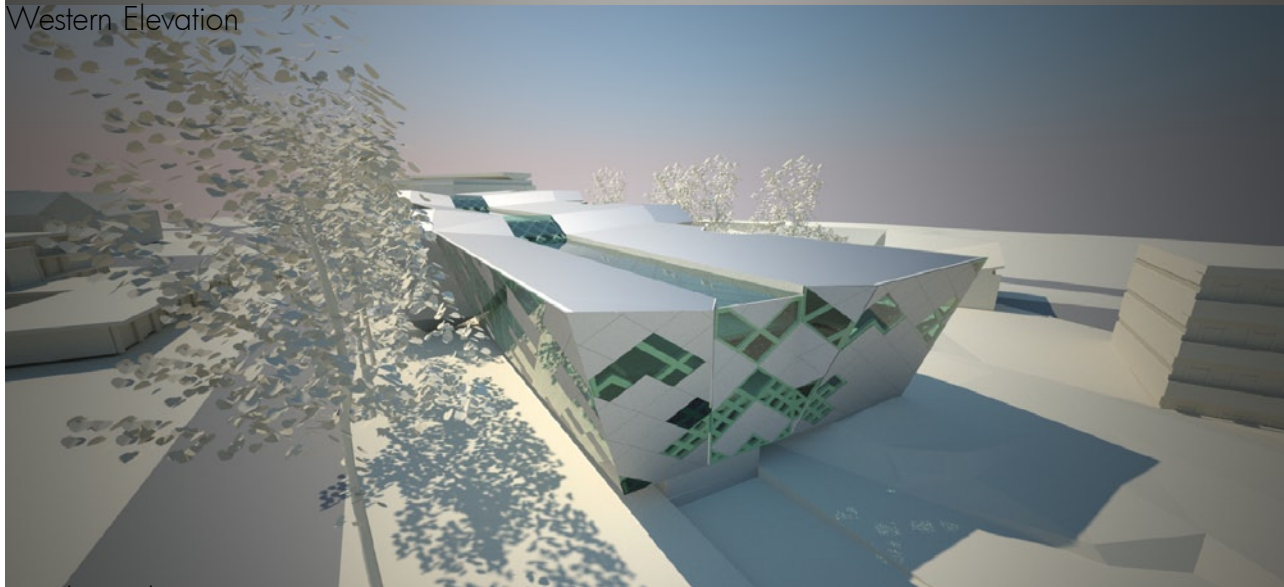




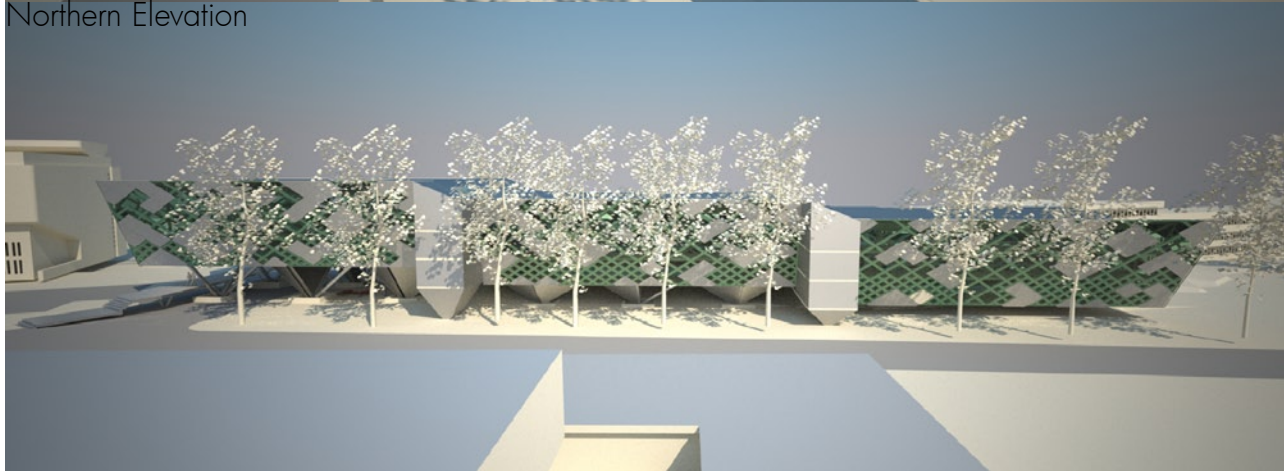
Tukkie Laan And Ring Road Intersection View



Western Elevation



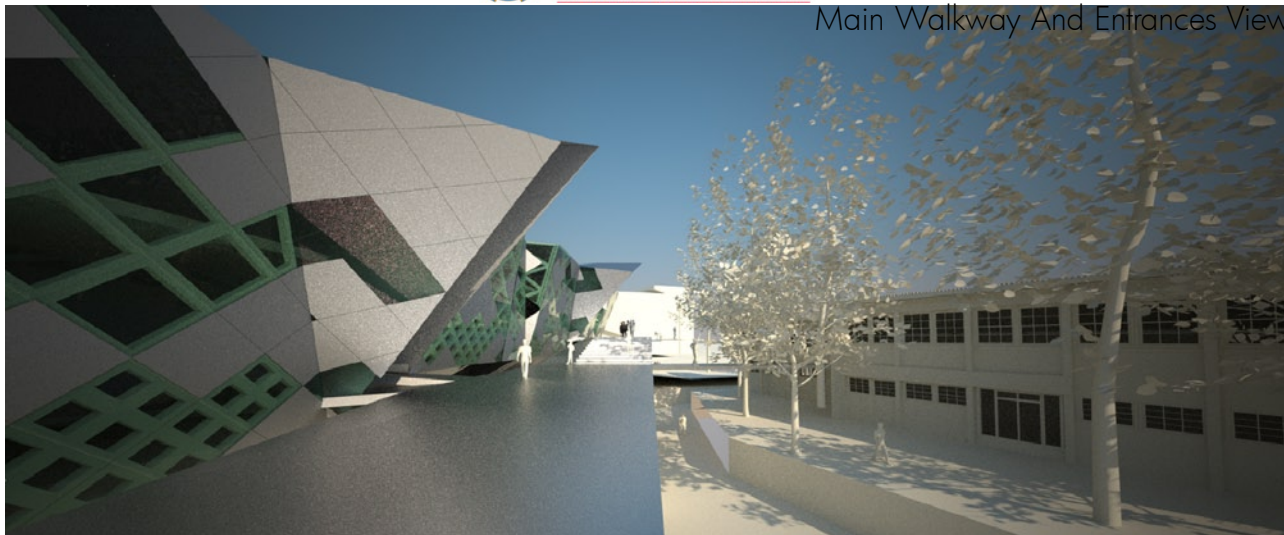
Northern Elevation



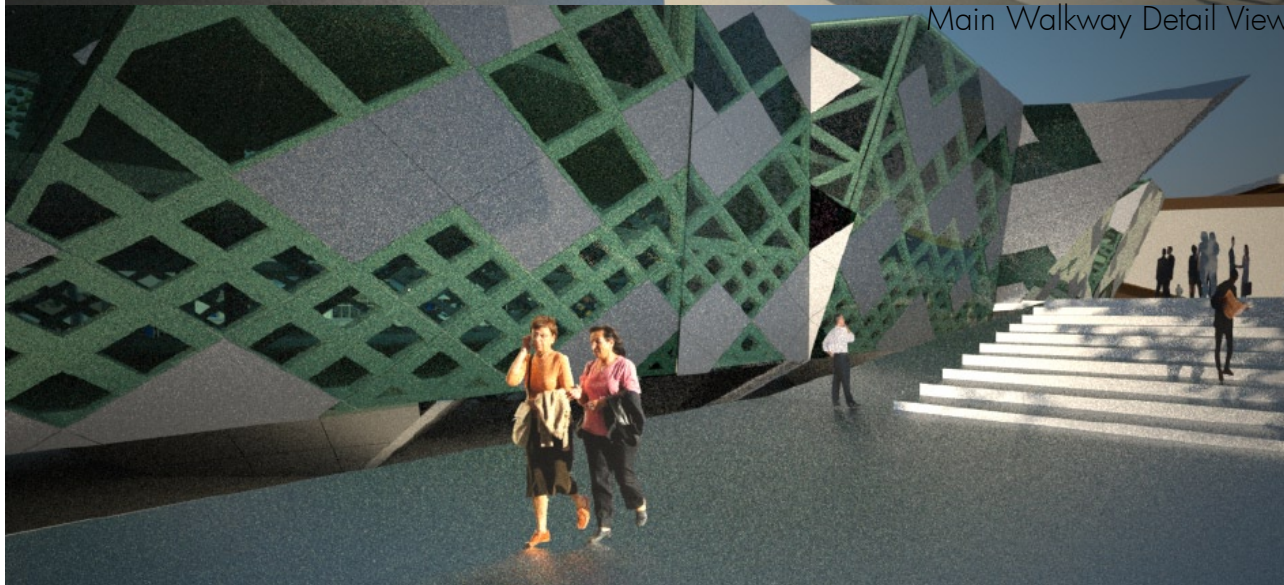




Main Walkway And Entrances View



Main Walkway Detail View



Eastern Elevation

