

CHAPTER FIVE

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APPROACH TO DESIGN

“If we assume that buildings are acts of construction that will occur whether we like them or not, architecture is an attempt to give shape to them, then the act of design may be to transform what already is into what could be in such a manner that preserves what once was. By rescuing the object from the process, we may make mirrors of our continued existence in time and space.” (Betsky, A; 2000)

5.1 _INTRODUCTION TO DESIGN DISCOURSE

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Economic growth and social development are vital in order to address the historical legacy of under-development and deprivation that has contributed to leaving our cities and towns spatially and socially divided, highly inefficient, reliant on subsidies (particularly for public transport) and in many areas, environmentally disastrous. Unless a concerted effort is made to alter and improve land-use and transport patterns, communities and the private sector will be unable to respond to all development opportunities. Development and public sector funds should be able to create the necessary conditions for local communities and the private sector to grow and develop. This is necessary to establish the basis for lasting growth from which all South Africans will benefit and to provide the context within which communities and private sector activity (formal, informal and international) can grow and expand such as in the case outlined in the draft Cape Metropolitan Spatial Development Framework (1996; pg 3).

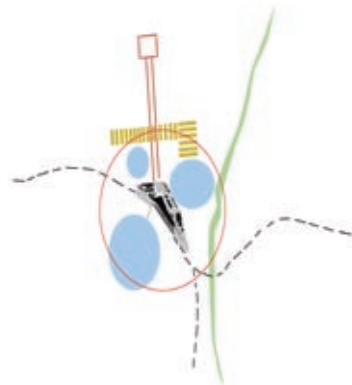


FIG. 5.1.1 Diagrammatic and conceptual sketch of site and context

Inner city development and redevelopment is vital to any city, in order to contain its resources, increase productivity, control urban sprawl and protect the historical, natural and agricultural assets to its particular region. Pretoria is no exception to the phenomenon of urban sprawl and its detrimental effects to the inner city. Major developments are only occurring in the east where land values and open space were the catalysts for the housing and retail boom, as well as the establishment of “office parks”. The effect on the inner city can only be negative, where once thriving activities that brought urban life to our city are either left to decay as the city continues to lose its assets, scattered in other parts of the metropolis, or (and possibly worst of all) they are re-concentrated in other areas that were not designated for the activities they now support, in terms of land-use and infrastructure. Cities do constantly change their functional diagrams, however in the attempt to control urban sprawl we need to question the reasons for rezoning residential areas and providing greater infrastructure in these regions whilst little concern is given to the CBD itself.

Unless initiatives are set in place in order to create growth and stimulate development, through public or private investments or even a combination of the two, the result is the degradation of the inner city. Such initiatives need to act as catalysts for further development in order to create, or recreate the densification values that the South African city needs in order to have a thriving, functioning CBD.

With the development of the Gautrain Station at Pretoria within the CBD, there is major potential in creating a functional and meaningful space that could bring many aspects of urban form into play. However, the site immediate to the proposed Gautrain Station has been earmarked as a mere parking facility and suitable development has been ignored. If well designed, a suitable development in this precinct could enhance the area, surrounding nodes and their corridors, as well as compliment local developments such as Salvokop, Freedom Park, the Paul Kruger Street Spine, Museum Mall and the Nelson Mandela Development Corridor.

A suitable development for the precinct would be an inter-modal facility that sees the culmination of all the immediate modes of transport i.e. the existing long distance and regional bus facilities, taxi rank, metro-rail as well as the proposed Gautrain Rapid Rail (see Context Analysis pg 40-41 and Design Directives pg 1-6) into an integrated, mixed-use urban node that serves as a connector to local facilities and nearby nodes, as well as regional and national areas. With these transport activities forming the catalyst required to activate or enhance an urban node, it in turn becomes the generator of development opportunities in the immediate environment. *“Modal interchanges provide excellent locations for retail, offices and community facilities, as well as for informal sector activity”* (Cape Metropolitan Council, 1996: 34)



FIG. 5.1.2 Existing major lines of movement in the Pretoria Station area, showing the location of the proposed Gautrain Station and building forms to be demolished

5.2_ URBAN DESIGN OBJECTIVES

The design development exposes the urban design objectives in order to produce form-giving criteria to the precinct. This in turn is analysed to produce an appropriate built structure that responds to the characteristics of the site, the precinct and the environment in reaction to the accommodation schedule and needs identified in the Design Directives and Baseline Document of this study.

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URBAN DESIGN OBJECTIVES	APPROACH	ACCOMODATION
1. Response to the Gautrain Station development as a catalyst of further development opportunities to the immediate urban environment and CBD of Pretoria.	Identify social, economical and environmental issues that address the need for a suitable development	Site selected within Pretoria Station Precinct immediate to the area of development for the Gautrain Station
2. Provide clear connections to the Gautrain Station in terms of visibility and approach that encourages pedestrian movement	Identify the most important lines of visibility and approach across the precinct and immediate urban environment.	Retain open-space and clear relationships between the Gautrain Station, the axial view from Station Square, and Railway Street
3. Reinforce important physical connections to nearby facilities and nodes, in terms of historical, existing and those resulting from the development of this Brownfield site	Allow connections to guide the establishment of built forms to the site in an appropriate system	Defined forms identified that respond to important connections and commence relationships in the urban environment that reinforce these connections
4. Address the street edge at Railway St	Reinforce the major line of vehicular movement and incorporate facilities that accommodate for pedestrian movement and needs	Retail edging at ground level maximised to address the street, whilst maintaining suitable access to the precinct for vehicular and pedestrian movement.
5. Provide a public urban open space for physical orientation and social interaction	Allow relationships of built form and movement systems to define open spaces appropriate to the development and precinct	Defined open space network system that creates public square and allows for myriad connections between facilities and visual axes.
6. Respect historical buildings and their significance, their relationships to the physical environment as well as their scale	Provide suitable character to the development that expresses an attempt to reinforce the <i>genius loci</i> (spirit of the place).	Massing of built form structured to respect the scale of the precinct and reinforcing an interaction with historical buildings whilst addressing the accommodation needs and relationships between built forms and proposed development

5.2.1. INTEGRATION OF PROPOSED DEVELOPMENT WITH GAUTRAIN STATION AREA

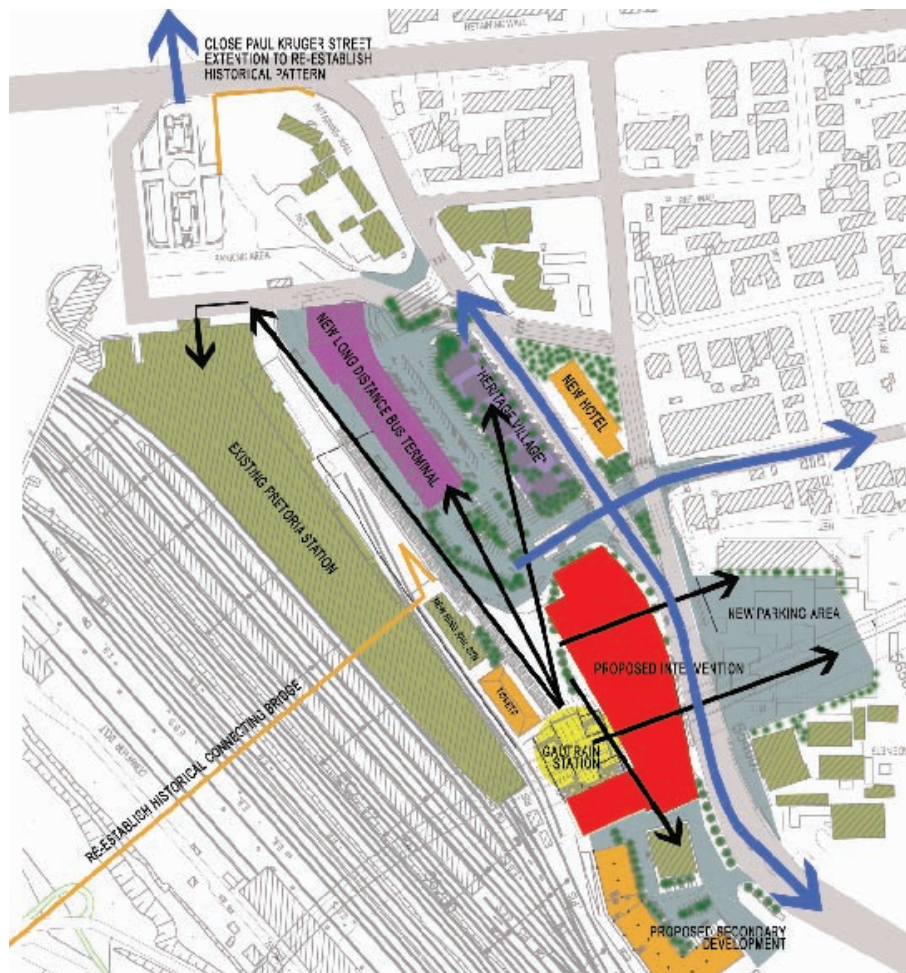


FIG. 5.2.1.1 proposed urban landuse



FIG. 5.2.1.2 Historical connections and structures

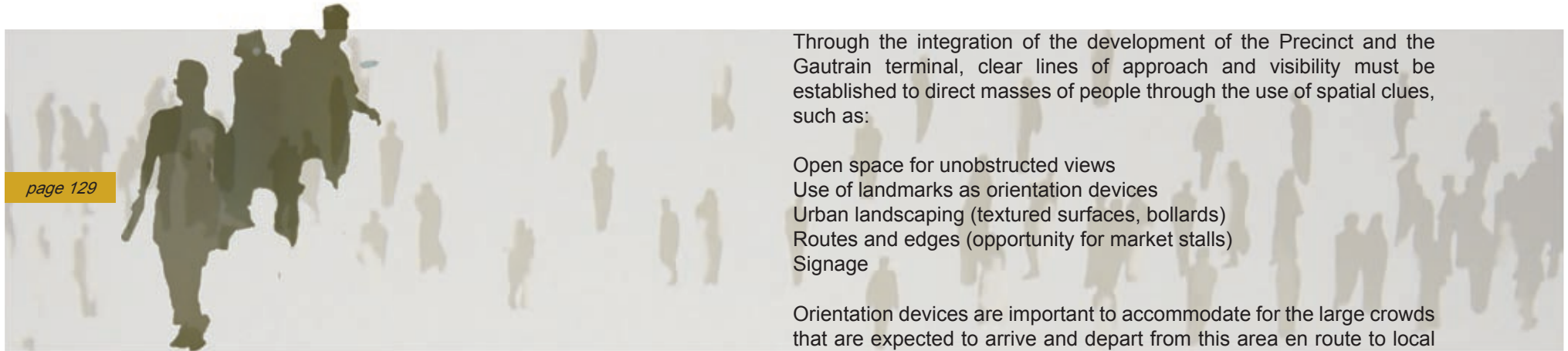


FIG. 5.2.1.3 Representation of site for intervention

The development at the Pretoria Station Precinct must be integrated with the Gautrain terminal to ensure the success of the precinct as a well-balanced mixed-use node that will cater for the demands and activities of the market. As the location of the development is situated in such close proximity to a major point of arrival and departure to the capital, it therefore must act as a gateway and express itself as such. Therefore, it should be symbolic to Pretoria and achieve the status of the vision the city strives toward; “*The leading international African city of excellence, that empowers the community to prosper in a safe and healthy environment*” (Capitol Consortium 1999). The symbolism must be taken throughout the design, as the built form will be a showcase for Pretoria City en route to the CBD and other nodes of attraction. Sequentially, as the built forms are to also cater for direct community involvement, it is therefore also showcasing the immediate community, adding to the drama of the architecture.

5.2.2. PROVIDE CLEAR CONNECTIONS TO THE GAUTRAIN STATION IN TERMS OF VISIBILITY AND APPROACH THAT ENCOURAGES PEDESTRIAN MOVEMENT

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Through the integration of the development of the Precinct and the Gautrain terminal, clear lines of approach and visibility must be established to direct masses of people through the use of spatial clues, such as:

- Open space for unobstructed views
- Use of landmarks as orientation devices
- Urban landscaping (textured surfaces, bollards)
- Routes and edges (opportunity for market stalls)
- Signage

Orientation devices are important to accommodate for the large crowds that are expected to arrive and depart from this area en route to local attractions such as Freedom Park and Museum Mall. Open space is one of the most important, allowing people to experience as much of the environment as possible, giving a sense of place and orientation. Here a public square becomes an important element in the scheme, while a clear visual relationship must be established between the Gautrain terminal and Railway Street.

Landmarks become necessary points of gathering and orientation and are incorporated into the design of the overall scheme. These can include the proposed conceptual Gautrain Station roof structure, a possible vertical element at the station itself that can be illuminated at night to attract attention to its position, the reused historical building for the Ring Rail Station on axis with the vehicular entrance to the site and the proposed reconnecting bridge to Salvokop, an information and ticket office positioned where it can be observed from all directions and recognized for its function, as well as the public square itself at the center of the scheme.

Incorporated into the design of the urban landscape, textured surfaces and use of bollards aid to direct the public across the precinct define important routes and edges and guide the movement of people. Signage is important to provide physical directional opportunities and adds to the character of the street furniture.

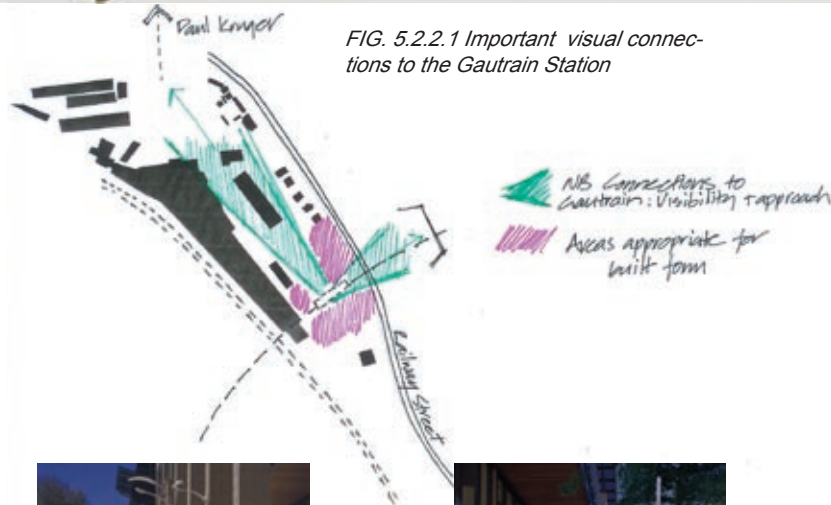


FIG. 5.2.2.1 Important visual connections to the Gautrain Station



FIG. 5.2.2.2 Bollards at Melrose Arch



FIG. 5.2.2.3 Street signs at Melrose Arch



FIG. 5.2.2.4 Sketch expressing visual connection of Gautrain Station to Railway Street. Note the vertical landmark element to the station.

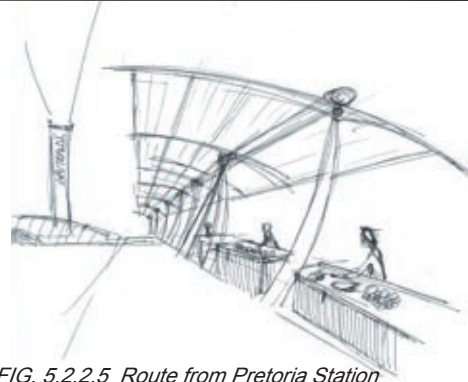


FIG. 5.2.2.5 Route from Pretoria Station to Gautrain station; market possibility

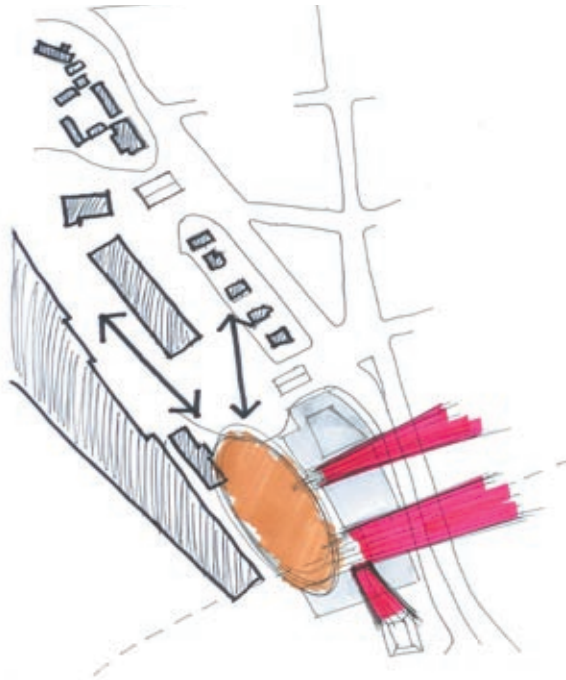


FIG. 5.2.2.6 Sketch expressing access through building

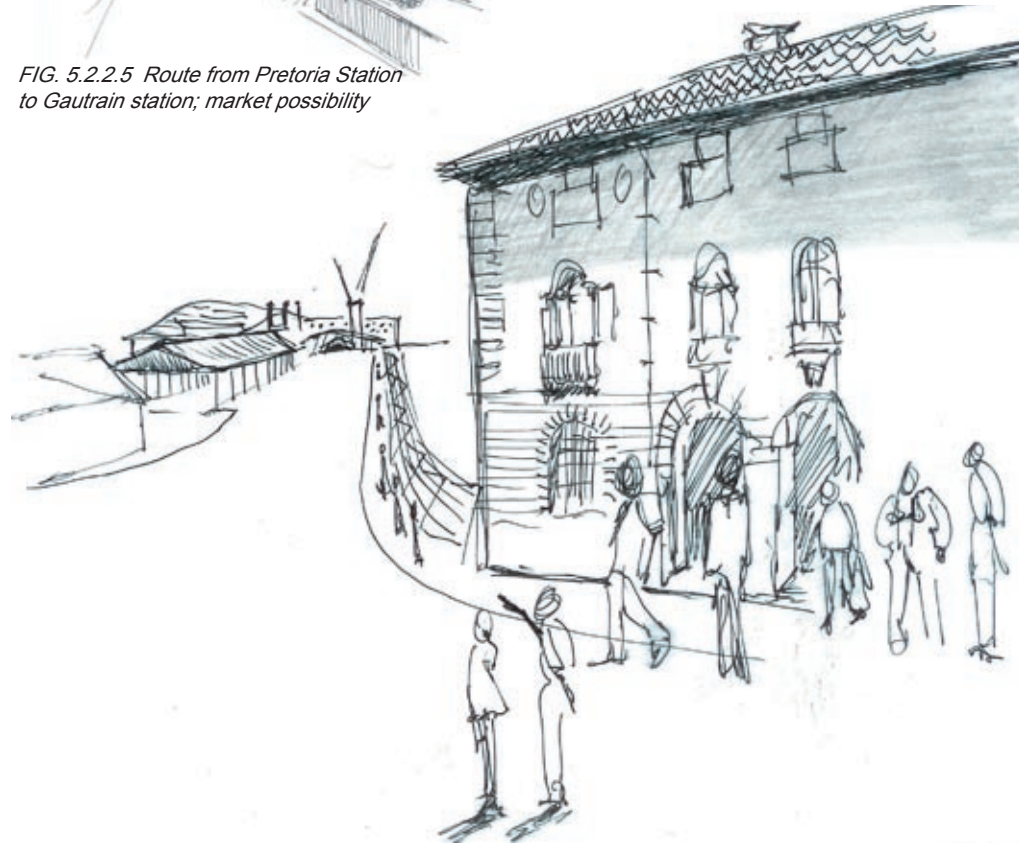


FIG. 5.2.2.7 Sketch depicting clear visual connection from Pretoria Station to the Gautrain Station terminal

5.2.3. REINFORCE IMPORTANT PHYSICAL CONNECTIONS TO NEARBY FACILITIES AND NODES, IN TERMS OF HISTORICAL, EXISTING AS WELL AS THOSE RESULTING FROM THE DEVELOPMENT OF THIS BROWNFIELD SITE

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LINKAGE

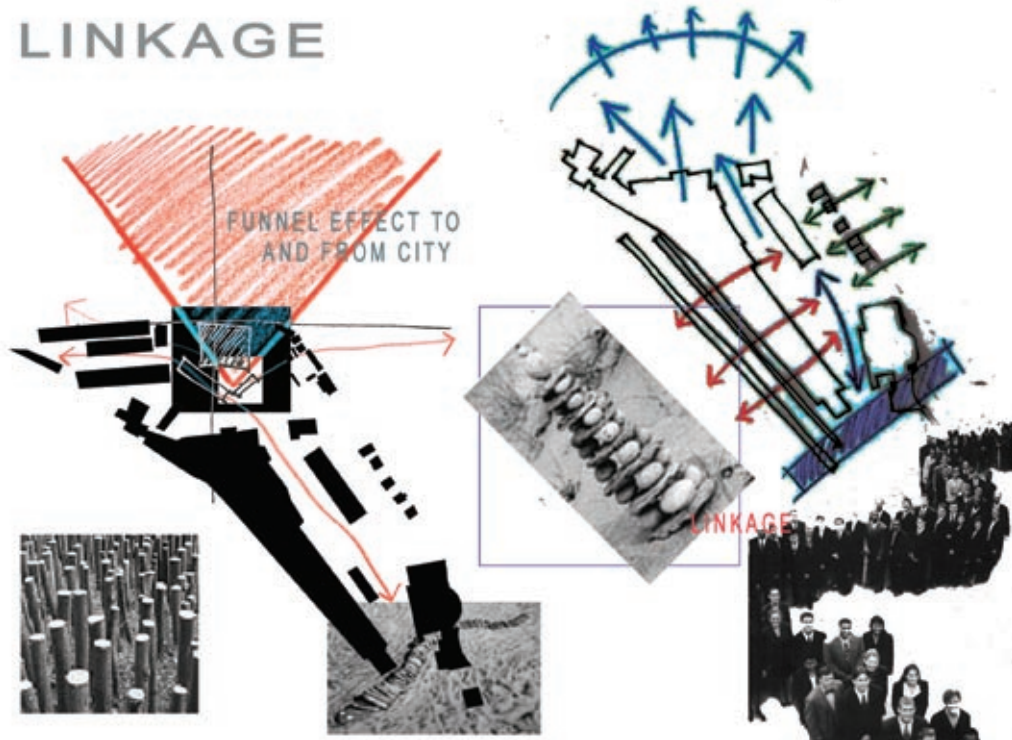


FIG.5.2.3.1 Conceptual collage depicting linkage and connectivity

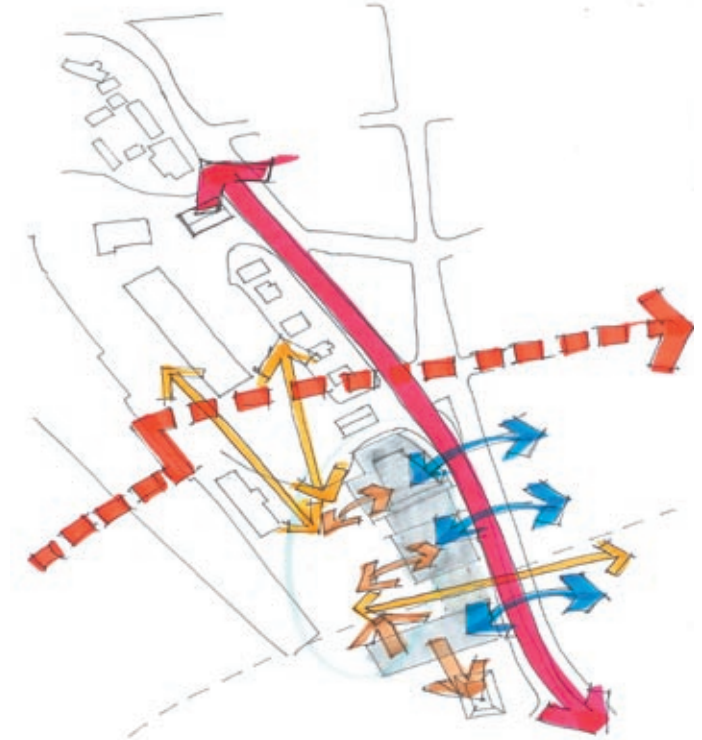


FIG. 5.2.3.2 Informing lines of connectivity

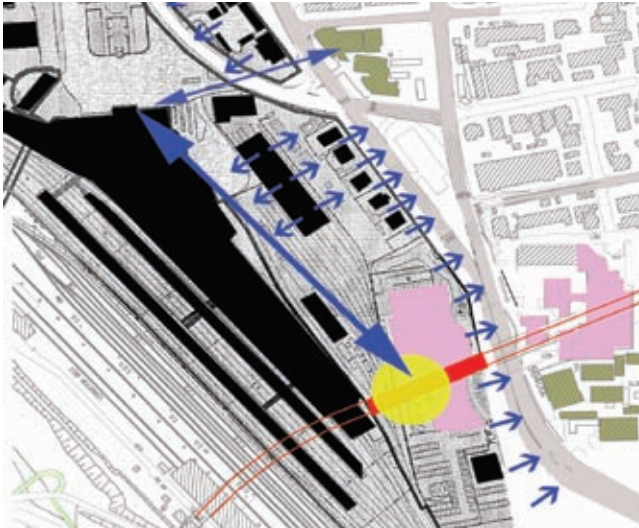


FIG. 5.2.3.3 Sketch depicting important connections of the site

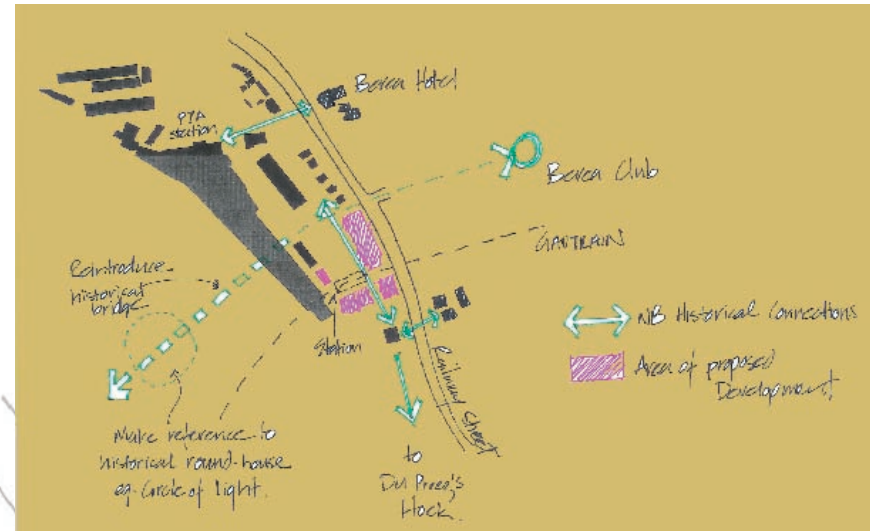


FIG. 5.2.3.4 Sketch depicting important connections to the context

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The integration of the proposed development with the Gautrain terminal allows for the establishment of clear routes and connections that reinforce relationships to local amenities and nodes of attraction. These include connections to:

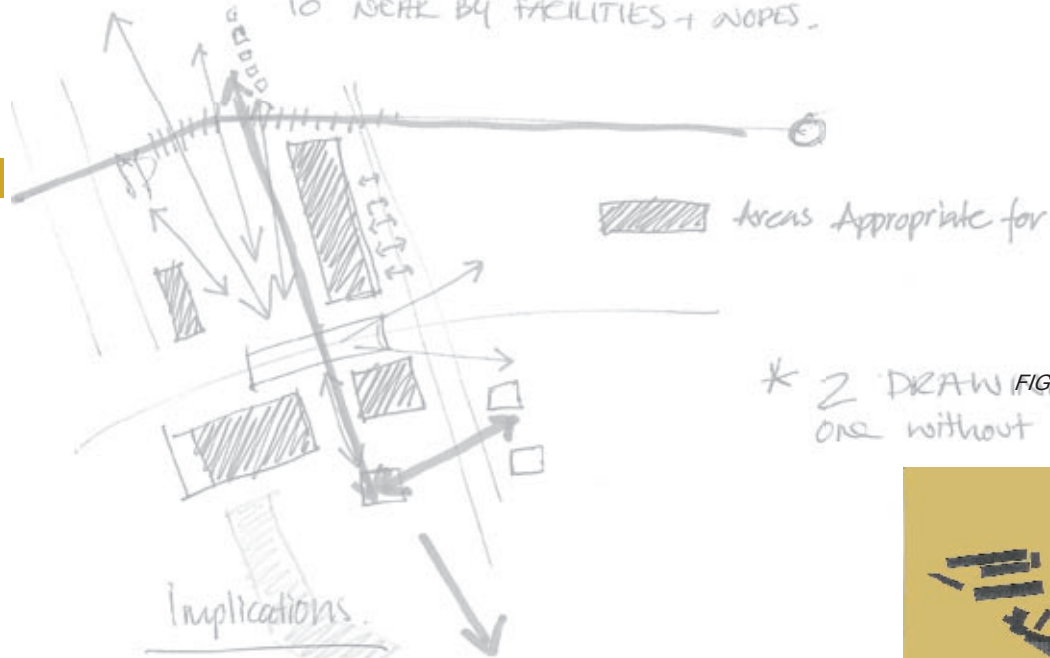
- _Pretoria Station Building on axis with Paul Kruger Street for connection to the Metro Rail system and the CBD;
- _Proposed new terminal for long distance bus facility at existing shed-structure;
- _Historical buildings in the precinct and local vicinity; and most importantly

_The proposed reintroduction of the pedestrian bridge over Salvokop (that connected the Berea Sports Club) could serve as a direct connection to the ceremonial route to Freedom Park and reconnect the Berea Club with the Station Precinct via Clara Street.

2. Design Objective.

- Reinforce important connections - EXISTING + HISTORICAL TO NEAR BY FACILITIES + NODES.

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* 2 DRAW FIG. 5.2.3.5 Sketch depicting anticipated lines of movement one without built form areas.

Implications

THE OVERLAPPING OF IMPORTANT CONNECTION PATTERNS AND FORMS THAT BECOME RESPECT + REINFORCE THESE CONNECTION

ACC : SAME AS ABOVE.

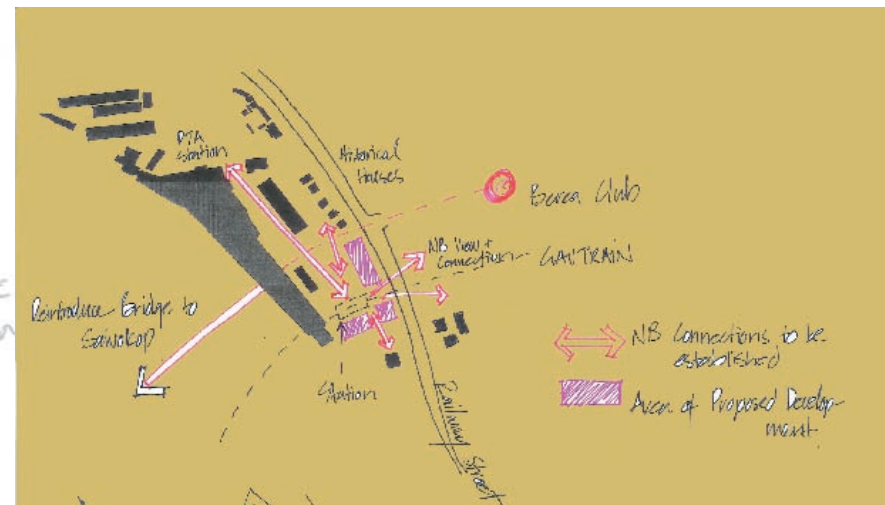
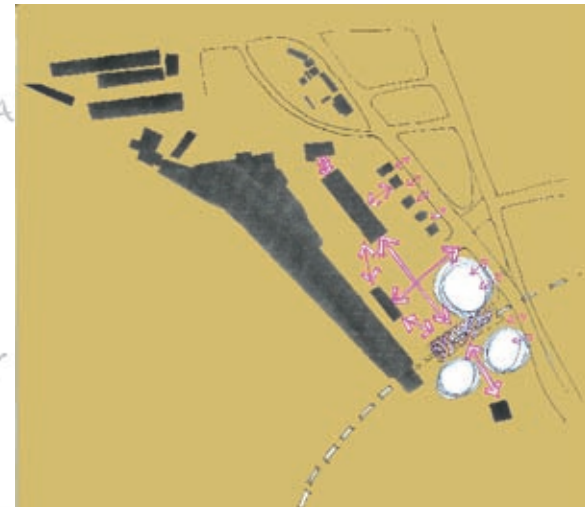


FIG. 5.2.3.6 Sketch depicting important pedestrian movement with proposed forms



FIG. 5.2.3.7. Proposed private and public transport routes through the precinct

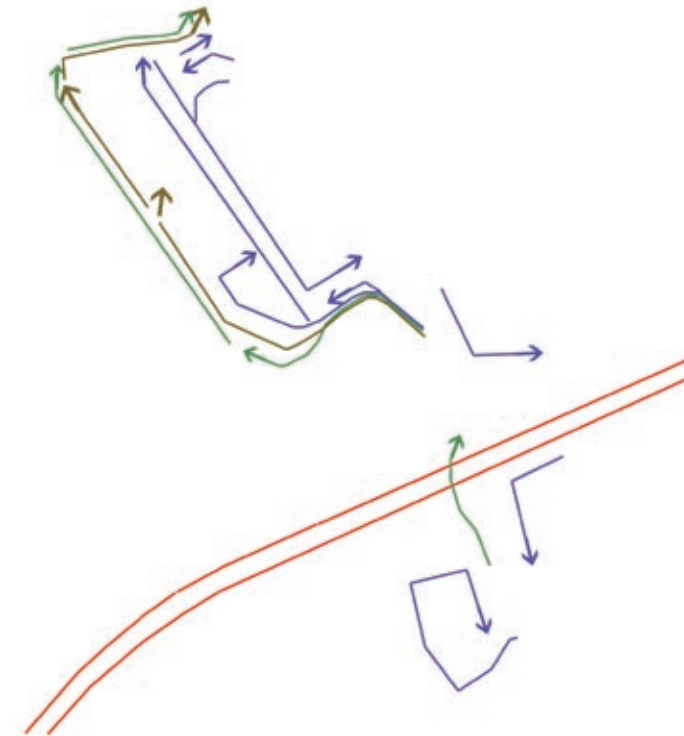
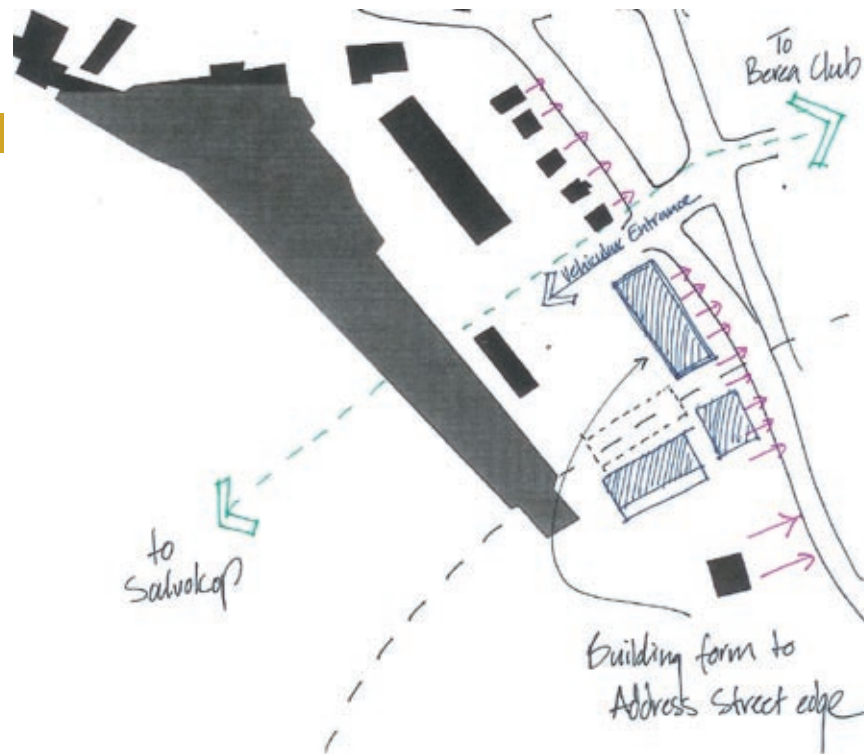


FIG. 5.2.3.8 Diagram isolating the proposed private and public transport routes through the precinct

5.2.4. ADDRESS THE STREET EDGE AT RAILWAY STREET

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The form of the building begins to address the street edge at Railway Street with retail activity located on the ground floor relating to both the street itself and the public square behind it. Placed on active movement routes, these edges attract attention and encourage pedestrian movement. Here the opportunity to include colonnades reinforces the edges by providing comfortable walking environments and defined routes, whilst providing maximum exposure of the retail activities. The colonnades in turn provide shading along these edges to the retail zones and opportunity to cantilever the upper floors.

The historical "Five Railway Houses" along Railway Street can contribute significantly to the establishment of an active street edge by acting as an extension of the route from the proposed development. Although still residentially occupied, these houses should be reused for functions that would benefit the nature and character of the precinct, and be exposed to the street edge and to each other in order to create an open movement system between them and to the precinct behind them. These houses could be converted into small museums that show-case the history of the precinct, or form a small retail village with a coffee shop, a restaurant, a boutique clothing store, a health pharmacy, etc.

FIG. 5.2.4.1 sketch illustrating how built forms are to address the street edge



FIG. 5.2.4.2 Graphic depicting a retail edge



FIG. 5.2.4.3 Graphic depicting an arcade typical to Pretoria



FIG. 5.2.4.4 Colonade at the new DTI Campus in Sunnyside



FIG. 5.2.4.5 Street edge address at the new DTI Campus in Sunnyside

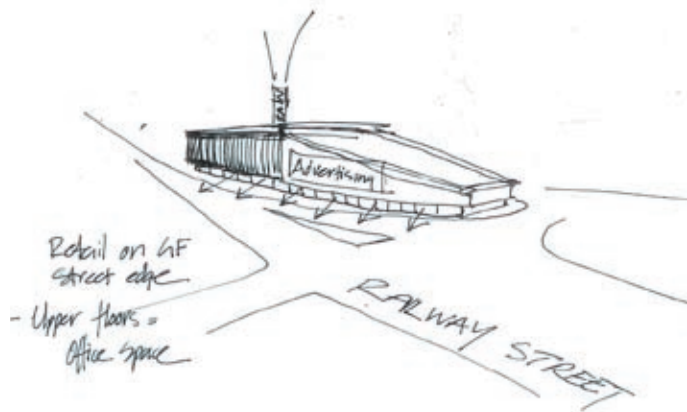


FIG. 5.2.4.6 sketches illustrating how built forms are to address the street edge



FIG. 5.2.4.7 sketch illustrating how colonades can be used at the street edge

5.2.5. PROVIDE A PUBLIC URBAN OPEN SPACE FOR PHYSICAL ORIENTATION AND SOCIAL INTERACTION

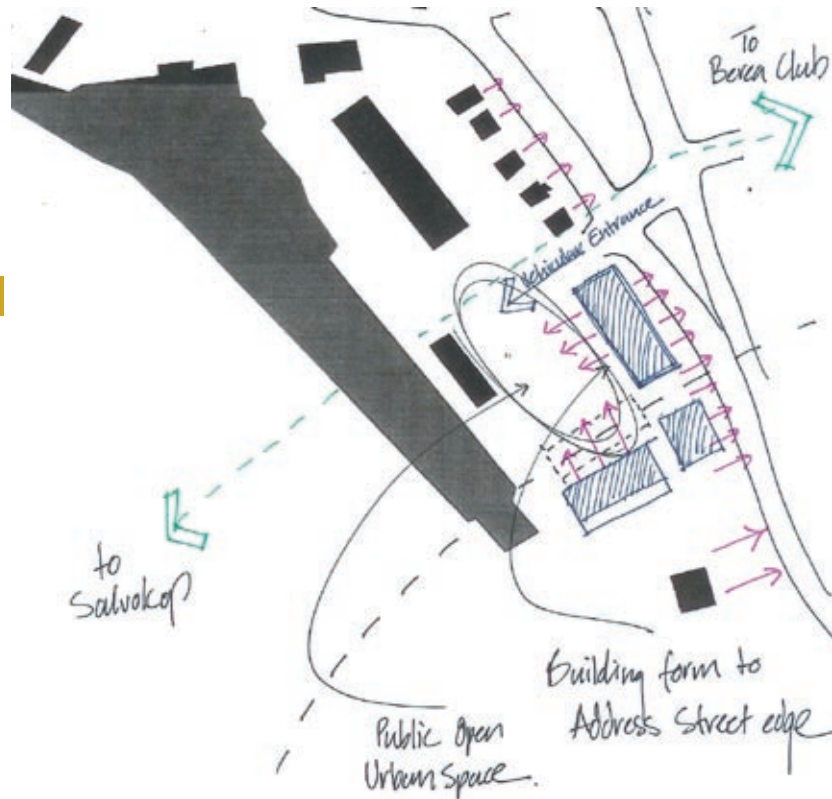


FIG. 5.2.5.1 Sketch showing creation of public square



FIG. 5.2.5.3 Public square as form-giving element to the urban landscape environment

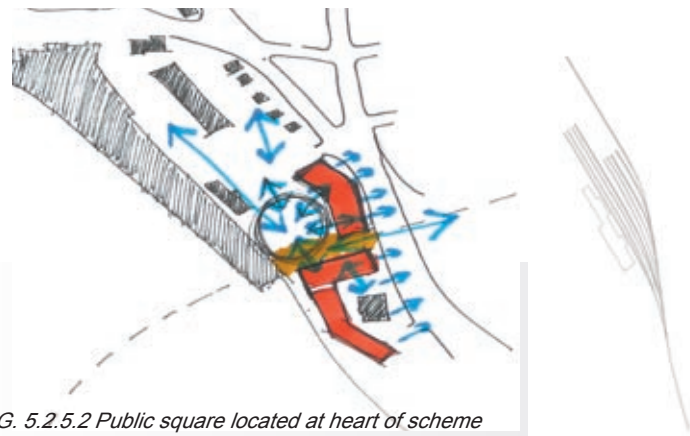


FIG. 5.2.5.2 Public square located at heart of scheme



FIG. 5.2.5.4 Existing rail on site



FIG. 5.2.5.5 Trolley on site. This can be used by traders from the market area on site

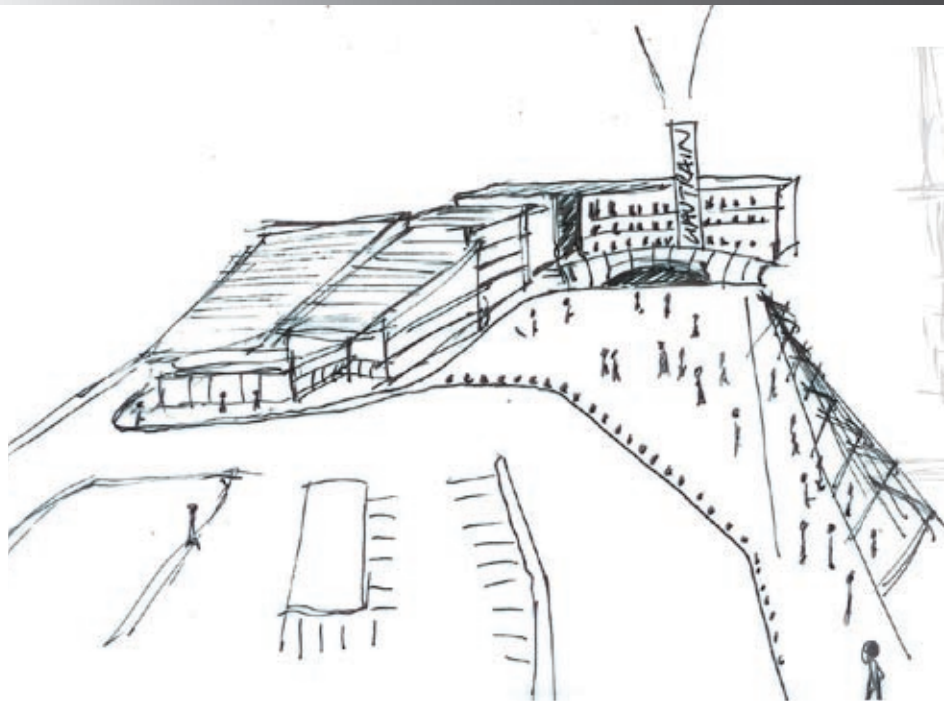


FIG. 5.2.5.6. Public square as an important orientation device



FIG. 5.2.5.7 Graphic of a public open space



FIG. 5.2.5.8 Graphic of a public square

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Making place; design of the square

By addressing the street edge along Railway Street in a linear fashion, opportunity is given to address the square behind it. The southern arm of the proposed development further defines the square and the location of the Gautrain Station whilst maintaining an important open space to the precinct.

This positioning of the building allows the public square to act as an orientation device, locating the Gautrain Station at its heart and encouraging major movement either northwards across the square toward other modes of transport or

connections to places of interest, or eastward through the building access routes toward the retail street-edge activities. This is an important aspect to the design, as orientation needs to be an obvious experience for tourists and the general public as to where movement patterns are, and where they direct ones attention.

The existing rail on site that runs from the square and tapers outward and away from the square towards the proposed bus terminal and market area can be used as a directing device to guide movement in that direction and provide an opportunity to bring market stalls out into the square on rail-mounted trolleys. This in turn adds to the historical nature of the site, the symbolism and character of the precinct, distinguishing it as unique to any other place-forming space within the city.

5.2.6. RESPECT HISTORICAL BUILDINGS AND THEIR SIGNIFICANCE, THEIR RELATIONSHIPS TO THE PHYSICAL ENVIRONMENT AS WELL AS THEIR SCALE

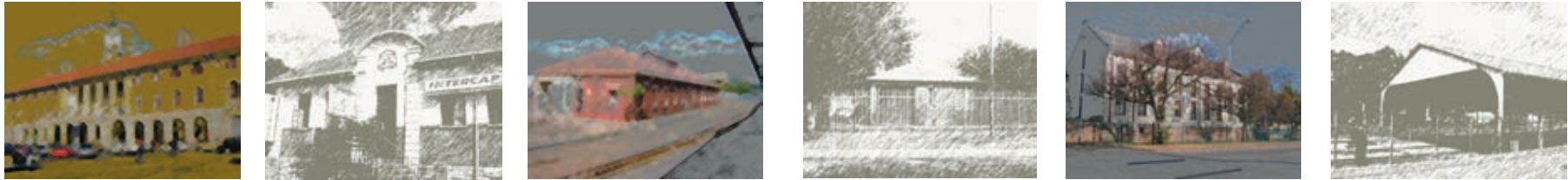


FIG. 5.2.6.1 - 6 Graphic sketches of historical buildings in the Pretoria Station Precinct

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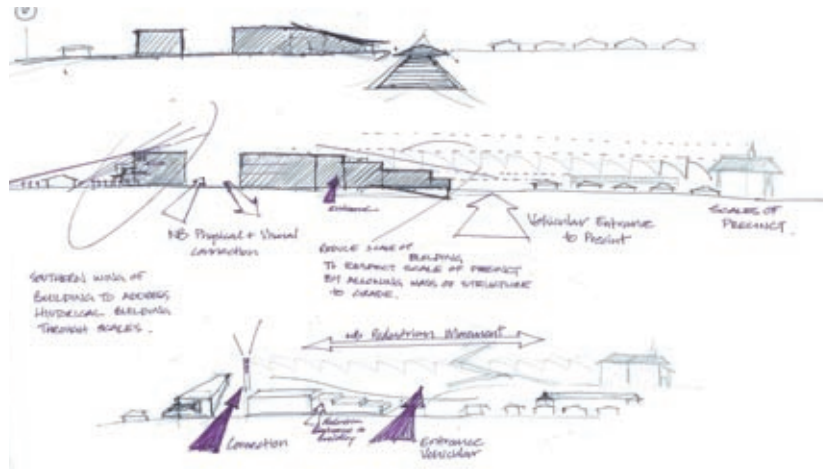


FIG. 5.2.6.7 Sketches establishing important relationships and scales of the precinct

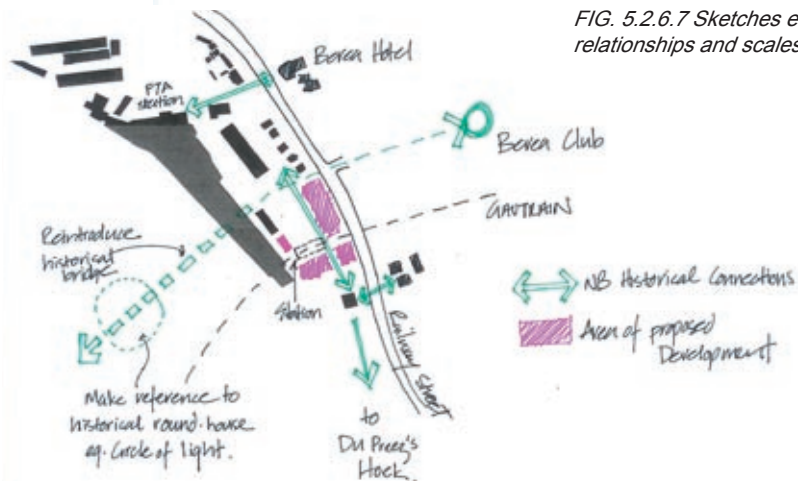


FIG. 5.2.6.8 Sketch of precinct showing important historical connections and area of proposed development

Layers of historical meaning can be established in the precinct that would add value and character to the development. The adaptive re-use of building structures and structural elements ensures the memory of the precinct be kept, whilst providing an authentic character to a revitalized Brownfield site. New life can be borne from these structures of the past, to provide a new layer of meaning to the precinct. The industrial character of the precinct provides the opportunity to express and adapt the structures relatively easily through the selective use of materials and the simplicity of combining modern materials to these buildings in order for them to be reused without destroying their character and significance.

An important conceptual proposal to this development is the re-use of the old washing shed into a new bus terminal and market area. This shed can be connected to the 1928 Audit building (which is currently the long-distance bus ticket office and waiting room) through the establishment of a new link between the two. This link can be constructed from glass and steel, to enhance the qualities of the older structures, and provide improved facilities to this service.

The reestablishment of historical connections plays an important role in adding value to the precinct and surrounding amenities and nodes, by creating lines of movement between them that reinforce their significance. These connections reinforce the position of the

proposed development within its landscape and its relation to surrounding important places and landmarks, such as the historical Pretoria Station building with its forecourt on axis with Paul Kruger street toward Church Square, Museum Mall, NZASM Printing store (current Intersite Office), Berea Club, Du Preez's Hoek, the 1928 Audit building with the old washing shed, and the historical "Five Railway Houses" in front of it. Most importantly, the reestablishment of the pedestrian bridge to Salvokop will provide a direct link between the public square in front of the Gautrain Station to Freedom Park, providing tourists with a clear and direct route between the two.

The scale of historical buildings plays an important role in defining the form of the proposed development to this precinct. The proposed development needs to respect and address these scales as not to over-power or dominate important buildings, but rather contribute to their enrichment. This is achieved by the following:



FIG. 5.2.6.9 - 10 Investigation of building scales in area

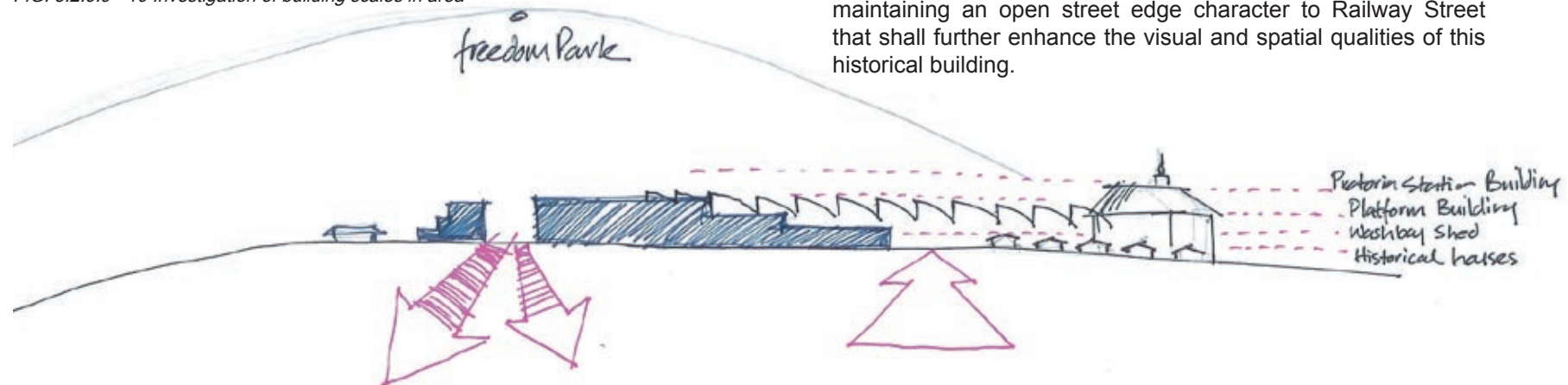


FIG. 5.2.6.11 Establishing the street-edge elevation of the proposed development

_the height of the building is kept below that of the historical Sir Herbert Baker-designed Station Building as not to overpower or dominate its importance to the precinct.

_The horizontality of the existing Platform Building provides a backdrop for the elongated nature of the proposed development with its northward-sloping roof structure relating the building mass to that of the washing-shed and "Five Railway Houses" on Railway Street by bringing the height and mass to the precinct level.

_The southern arm of the building initiates an address to the historical Signaling and Telegraph Building by retaining an acceptable distance from it that attempts to isolate the historical building and emphasize its importance. Furthermore, the inclusion of balconies and architectural forms that penetrate and cantilever from the structure, begin to relate horizontal and vertical elements of each building to one another, whilst the inclusion of trees on the street edge brings about continuity between the two.

_Additional development is suggested by this study to occur around historical Signaling and Telegraph Building, forming a backdrop that relates both to the proposed development and the historical building itself in terms of scale and mass. This is envisaged to house residential and retail activities, whilst maintaining an open street edge character to Railway Street that shall further enhance the visual and spatial qualities of this historical building.

5.2.7. POSSIBILITY OF CHANGING LINES

The positioning of the proposed development addresses a long-term vision that connects that Gautrain terminal building to the southern area of the existing Pretoria Station platform building. This connection will provide a direct link to the Metro Rail services and those of the Gautrain instead of having to move people across the precinct to the front of the Pretoria Station building to access the platforms. This vision is the result of the fact that Pretoria Station is a poorly functioning station due to the nature of the existing rail network that terminates under the platform building, with adjacent rail continuing over to Bosman Street Station instead. These circumstances prove difficult for trains to continue on the Maputo line, having to reverse some distance out the station, and then continue on the adjacent rail.

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Jack Prentice, former managing director of Intersite, points out that the greatest problem with Pretoria Station is the archaic signaling system that needs urgent upgrade in order for the station to function successfully. If this were the case, opportunity arises to redirect some of the rail that Pretoria Station may act as a highly efficient station along all routes passing through it. This would result in the current platform building functions moving deeper into the rail reserve, providing a redevelopment opportunity of the platform building into a modern train station with new concourse levels, large open spaces for movement, as well as rentable office and retail space. The concourse of the Gautrain Station can then connect directly to this development, which would highly benefit the connectivity and accessibility of the City to a national and international realm.

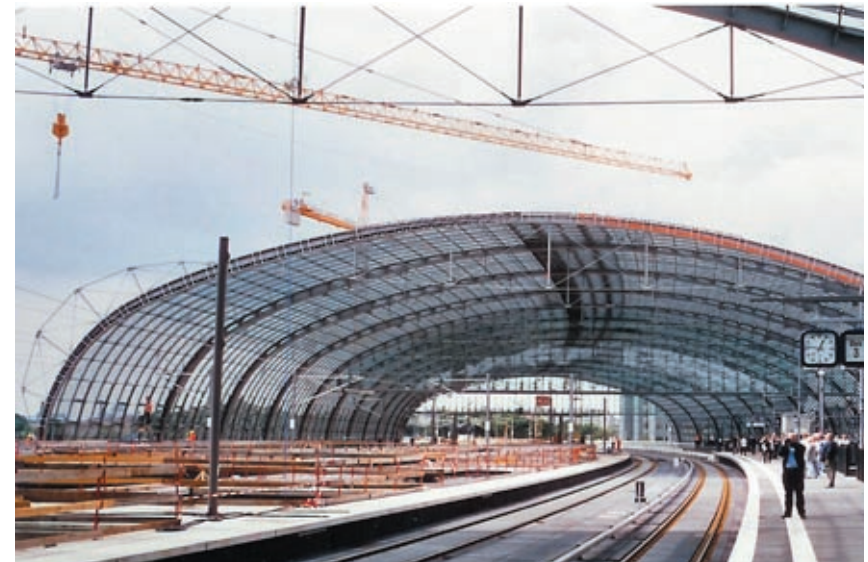


FIG. 5.2.7.1 The recently completed Lehrter Stadt Bahnhof in Berlin from the exterior



FIG. 5.2.7.2 The recently completed Lehrter Stadt Bahnhof in Berlin from the interior

_DESIGN PROPOSAL

TO FOLLOW...

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DESIGN DEVELOPMENT

5.3 _DESIGN PROPOSAL

5.3.1. FORM FOLLOWING FUNCTION

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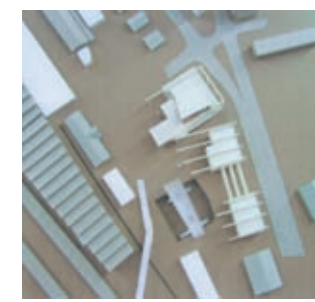
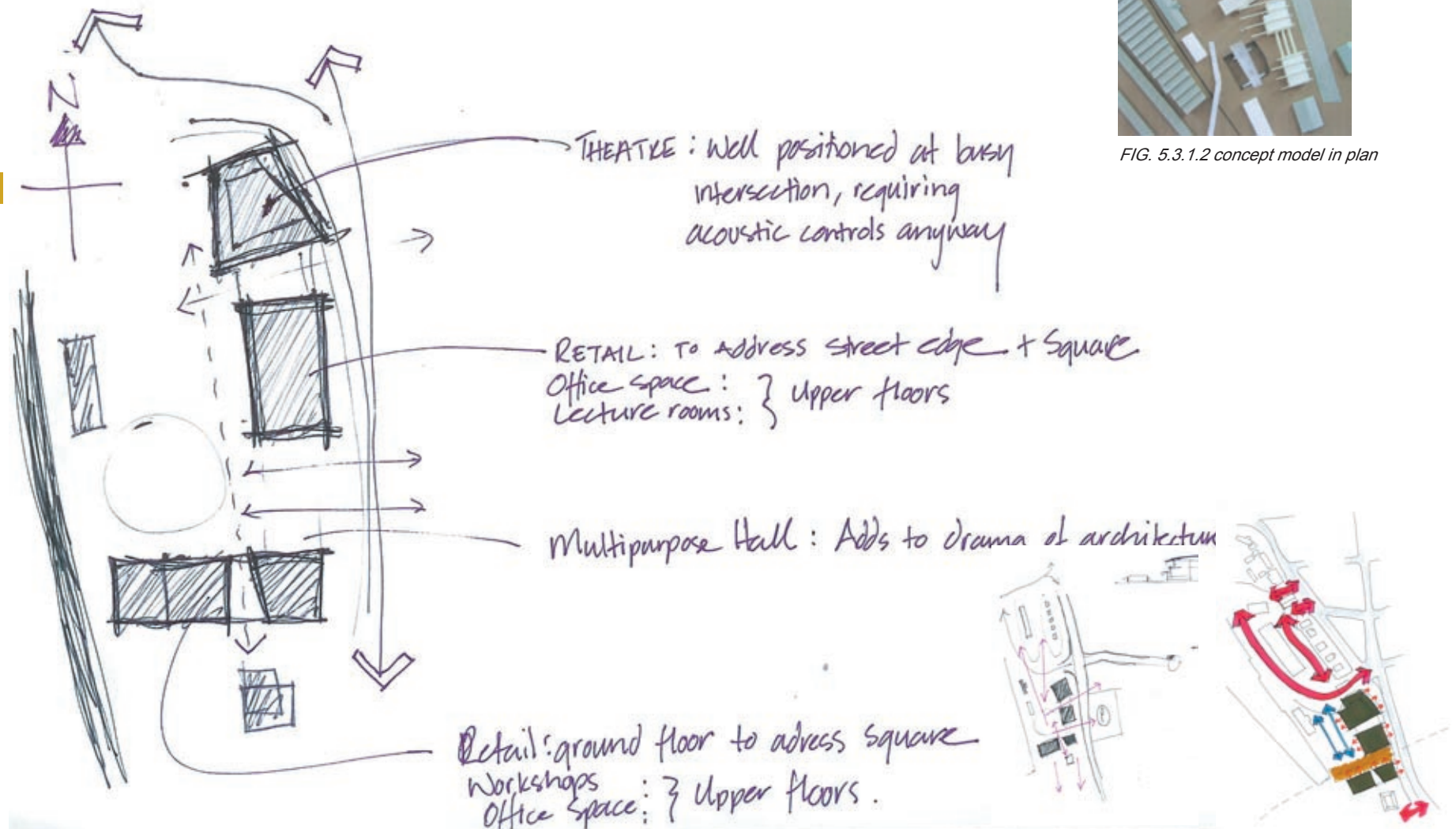
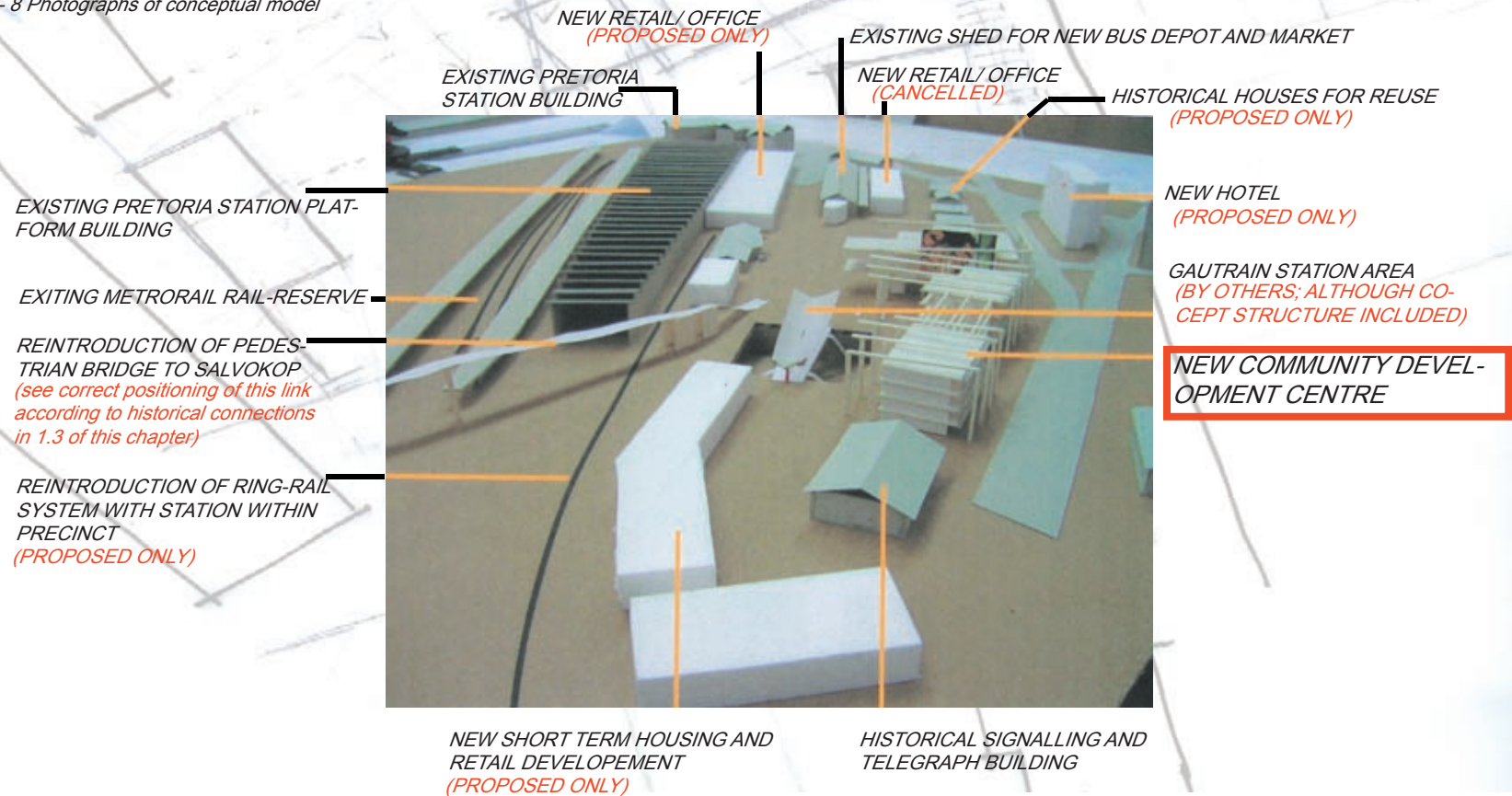


FIG. 5.3.1.2 concept model in plan

FIG. 5.3.1.1 Functions of building giving form



FIG. 5.3.1.3 - 8 Photographs of conceptual model



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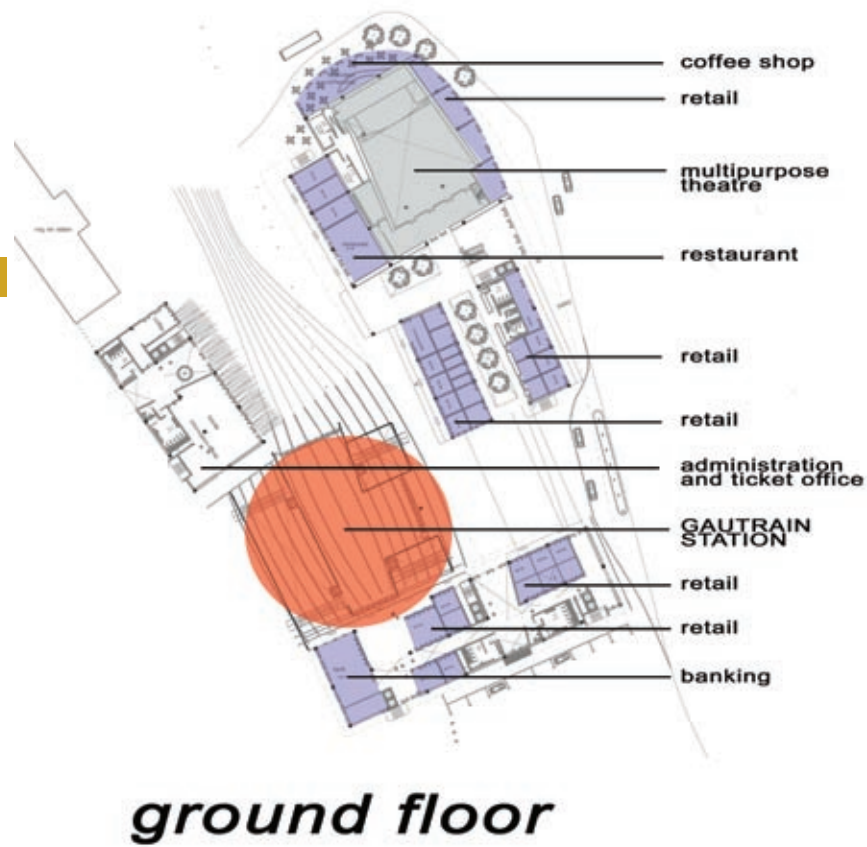


FIG. 5.3.1.9 Ground floor functions

FIG. 5.3.1.10 First Floor functions

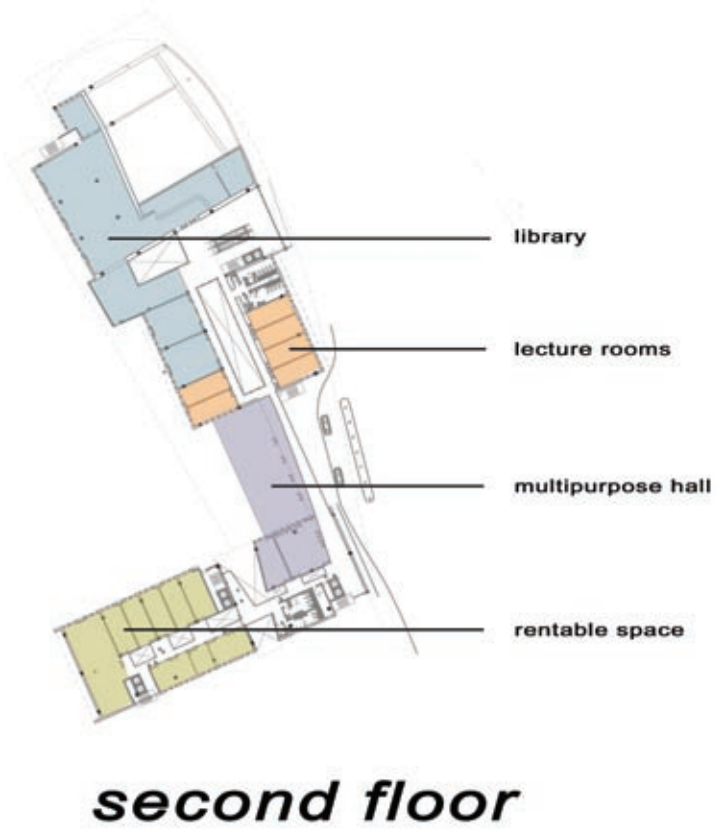


FIG. 5.3.1.11 Second Floor functions

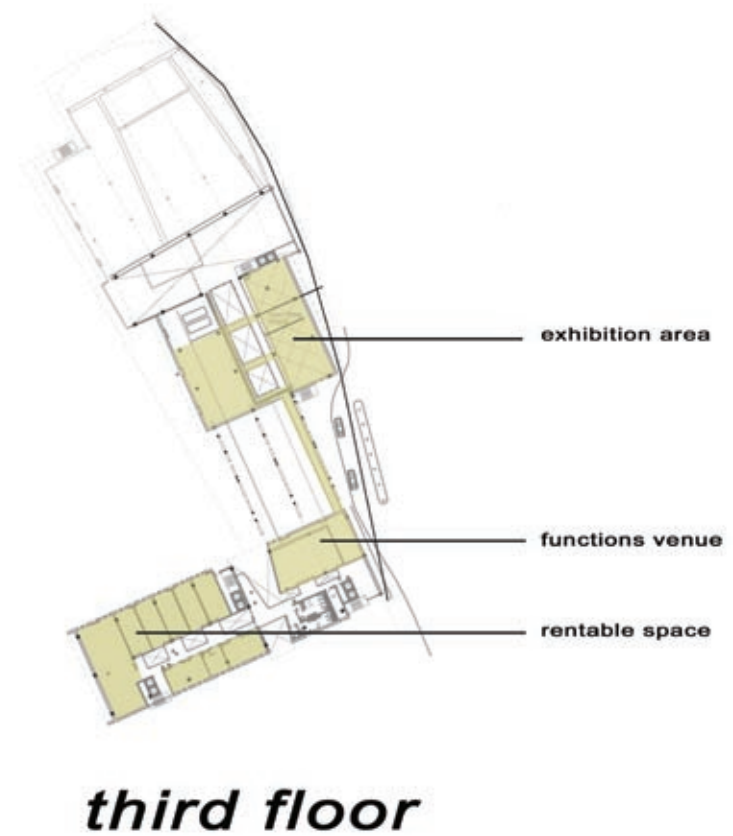


FIG. 5.3.1.12 Third Floor functions

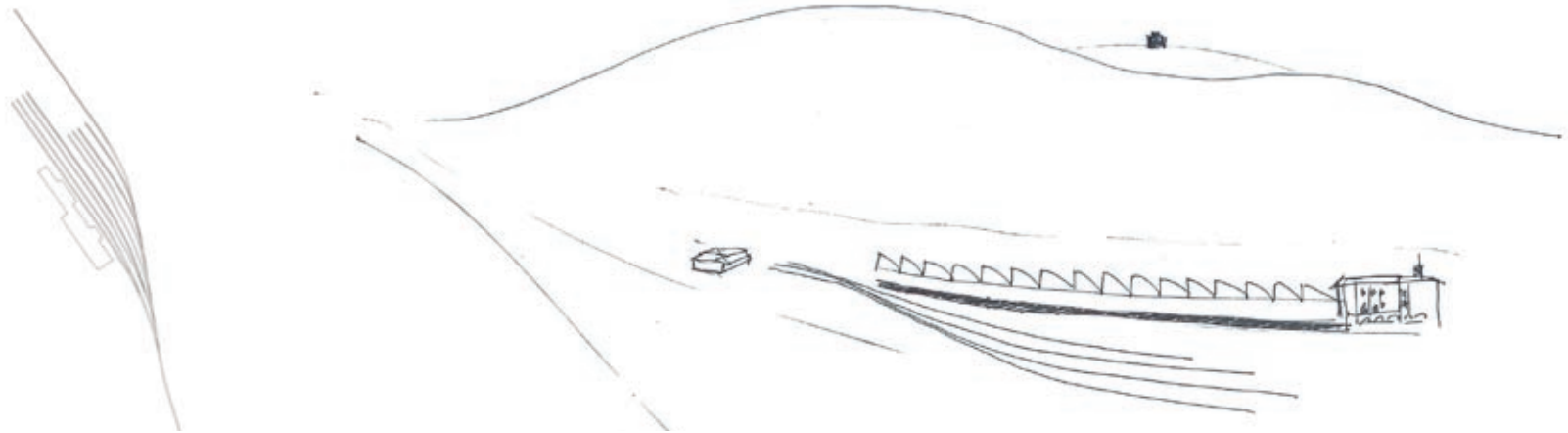


FIG. 5.3.1.13 Shape of existing rail on site used as design influence

FIG. 5.3.1.14 Surrounding landscape forms used to influence the design for the site

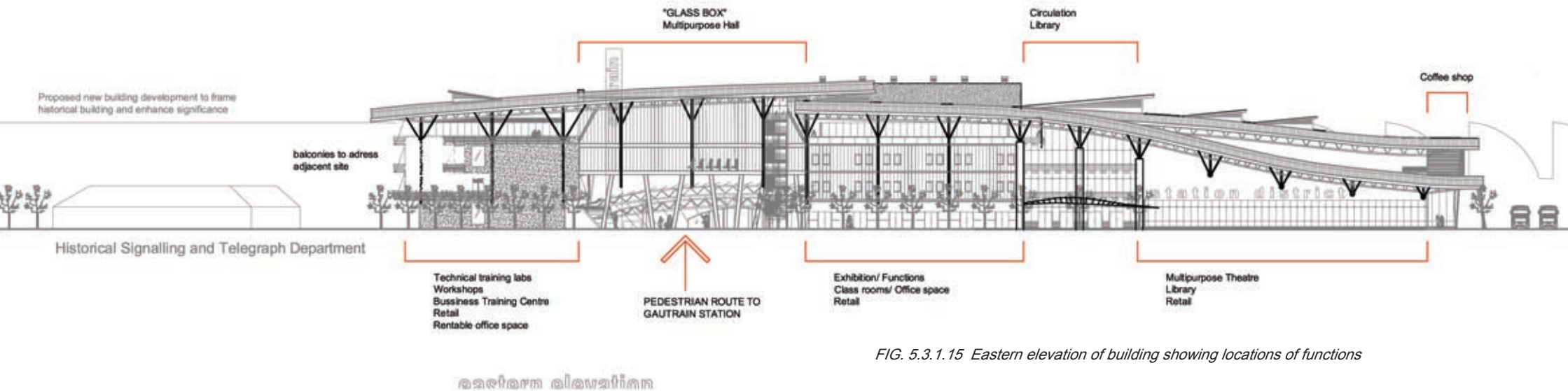
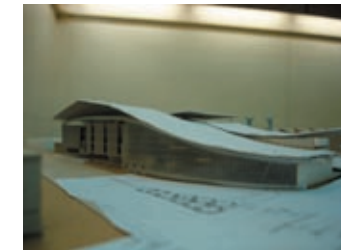
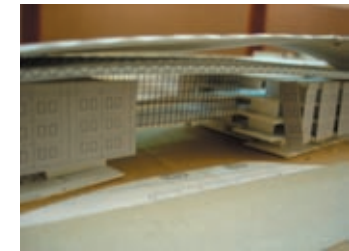
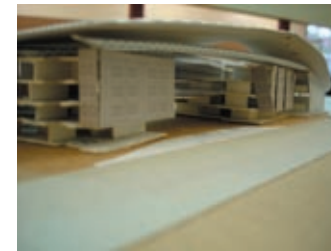


FIG. 5.3.1.15 Eastern elevation of building showing locations of functions

The most important form-giving element to the design is the roof structure, which has a myriad functions incorporated into its form. The form of the roof was derived from site-specific criteria, such as the existing rail network across the site and the form of the surrounding landscape within which the site exists.

Not only does the roof provide the protective element to the building and symbolically holds the fragmented forms together as a whole, it brings about a lightness to the massing of the structure, which sequentially aids reducing the building scale to that of the precinct. Furthermore, it provides ample shading to the upper floors, while providing good natural day lighting through north-facing clerestory windows to other areas of the building including the interior atrium, the circulation zone and the library. The shape of the roof structure is also designed in the longitudinal and cross-section such that it acts as a natural ventilator, in its shape, by allowing hot air to rise against it and flow freely to the higher areas where it can escape through louvers at the clerestories. Covering a large portion of the building, the roof also acts as a collector of rainwater, which is then stored and re-used for irrigation purposes within the atrium itself.



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FIG. 5.3.1.16 - 20 Images of second conceptual model



5.3.2. STRUCTURE

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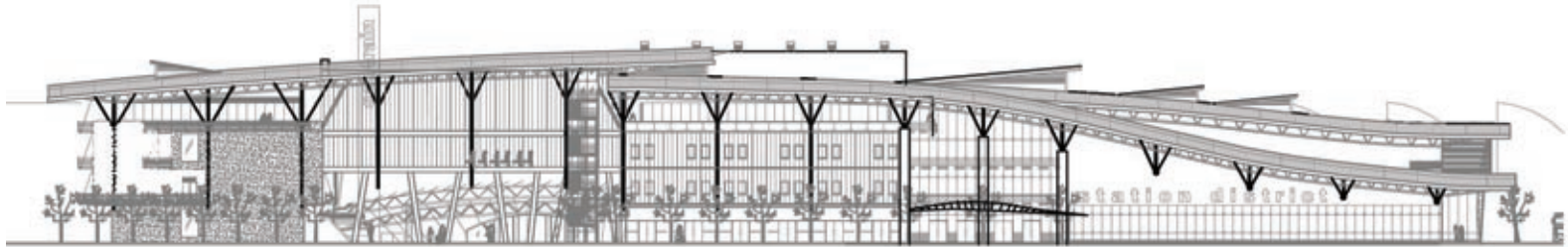


FIG. 5.3.2.1 Eastern elevation of design proposal

The structure of the building consists of a reinforced concrete and steel frame to support upper floors. For contextual and historical reasons, the façades are orange-red face brick and sometimes plastered, with sandstone corners and horizontal bands along vertically proportioned openings. This provides a layer of thermal control through the use of massing between the exterior and interior, and with using materials that are locally available and widely understood by the local construction industry for their applications.



FIG. 5.3.2.2 CSAR Chief Mechanical Engineers Office of 1909. Massing of the structure provided thermal control by keeping the building cool in summer and relatively warm in winter

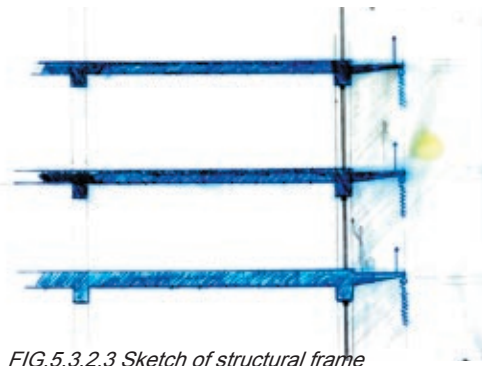


FIG. 5.3.2.3 Sketch of structural frame

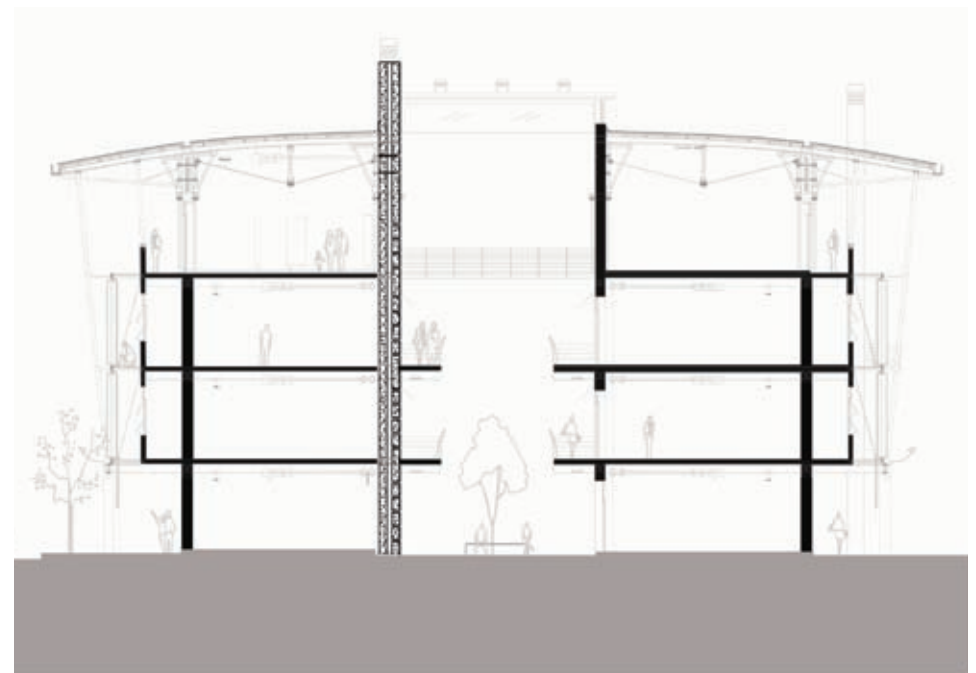


FIG. 5.3.2.4 Northern section through building illustrating structural elements



FIG. 5.3.2.5 Wall textures at the new DTI Campus in Sunnyside, Pretoria: symbolism

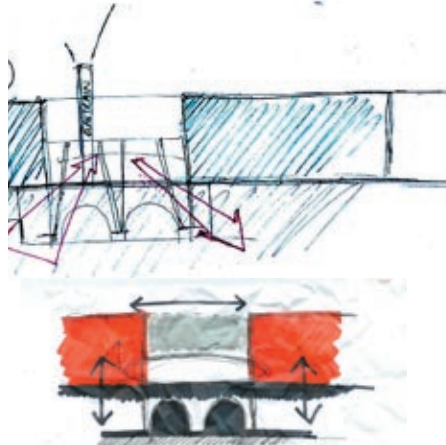
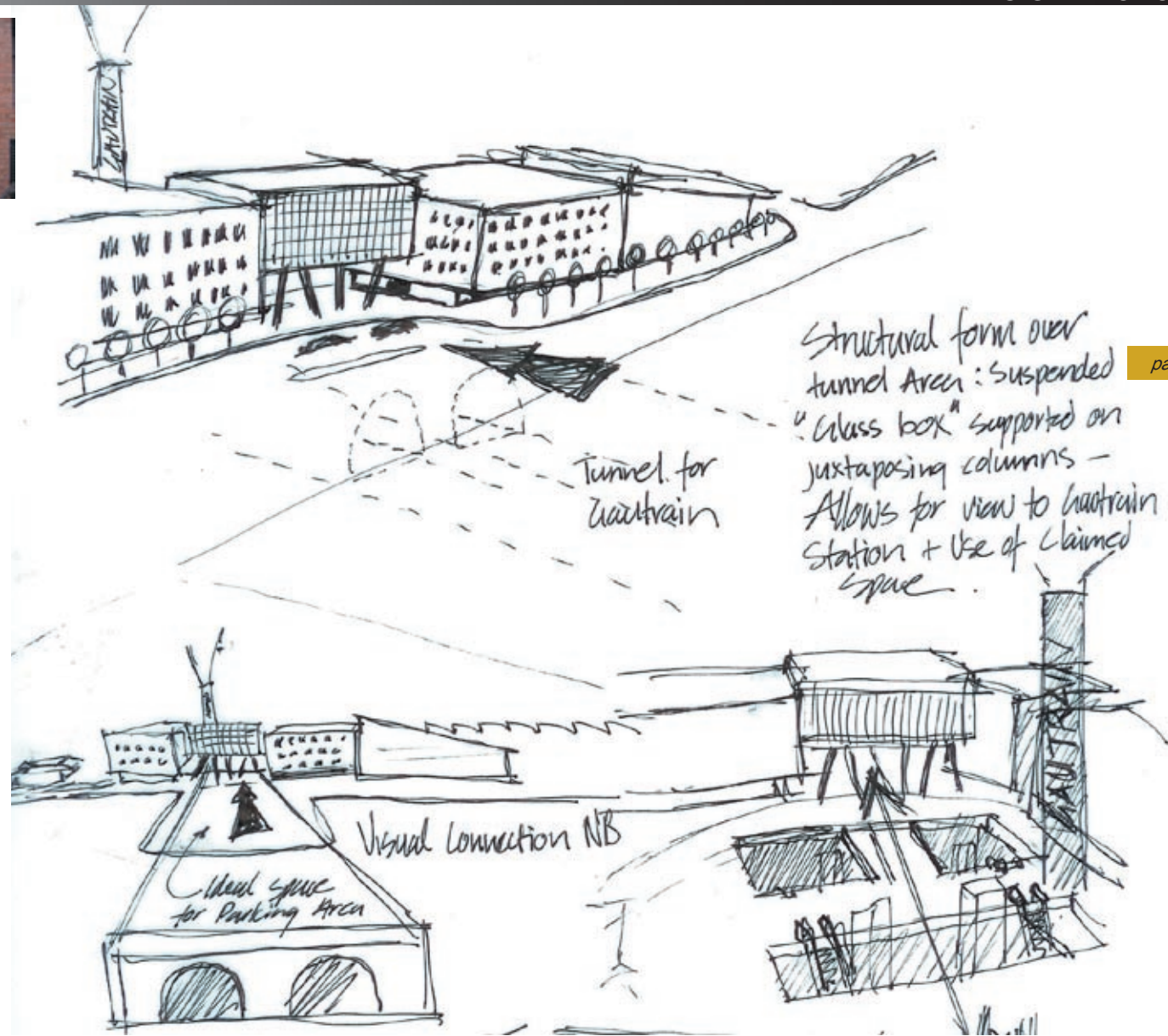


FIG. 5.3.2.6 structural challenge of design



FIG. 5.3.2.7 NZASM Apies River bridge on the Eastern Line east of Salvokop



5.3.3. MOVEMENT PATTERNS

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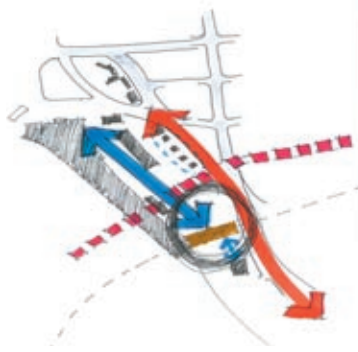
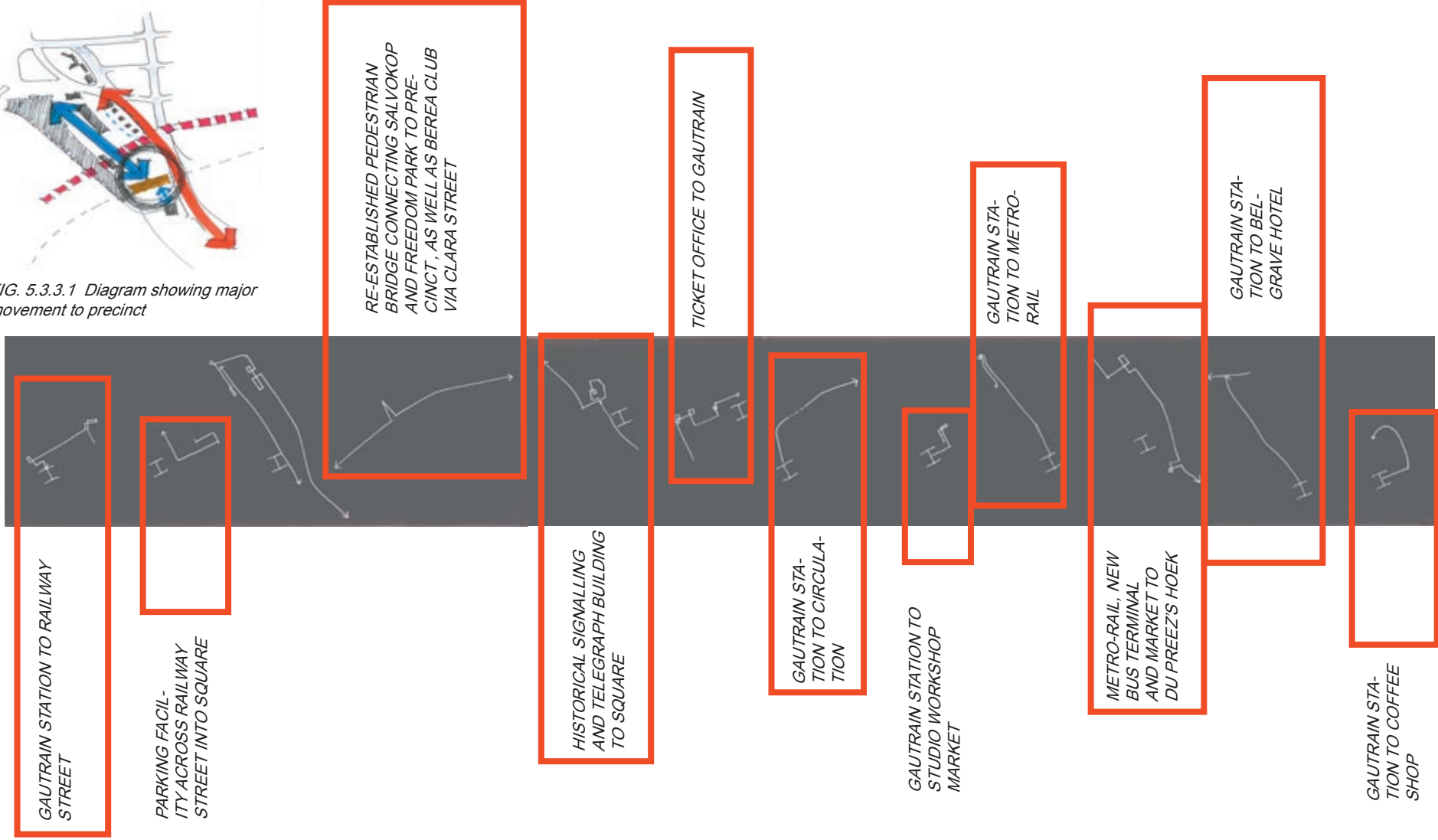


FIG. 5.3.3.1 Diagram showing major movement to precinct



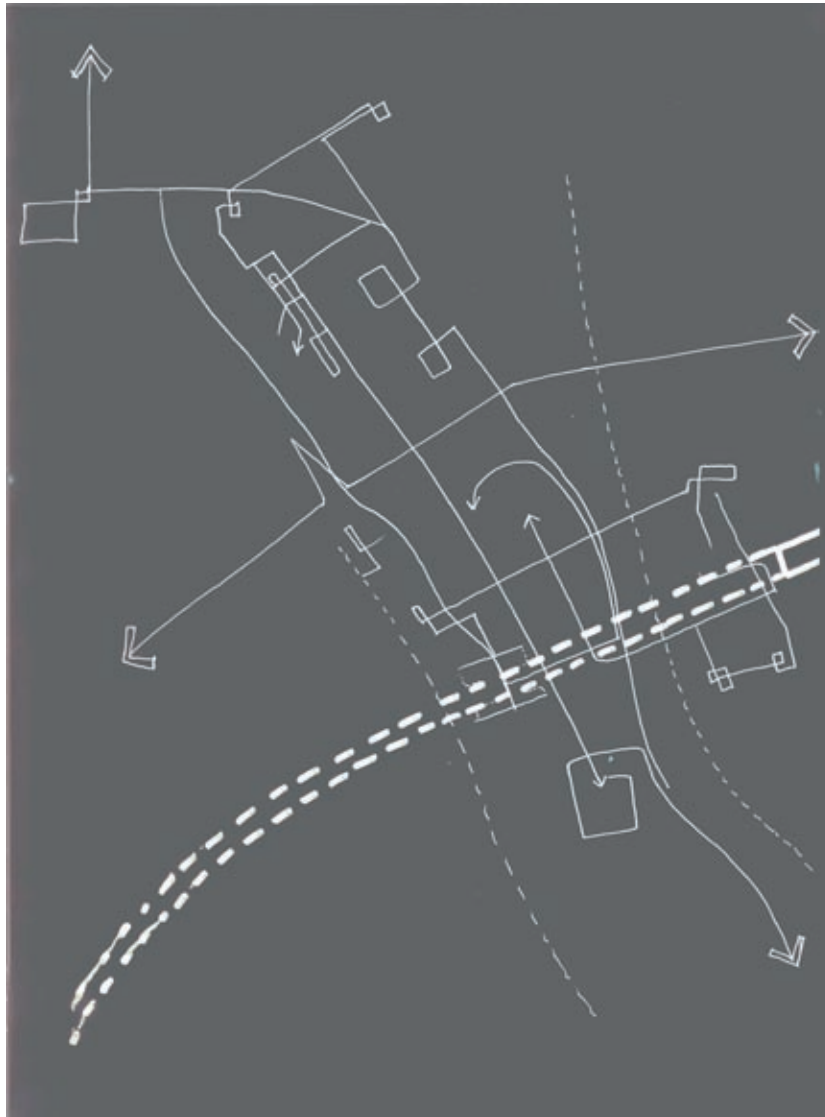


FIG. 5.3.3.2 Diagram showing movement patterns through and across the precinct



FIG. 5.3.3.3 Movement around and through building

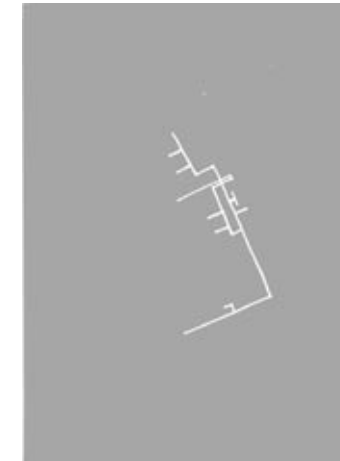
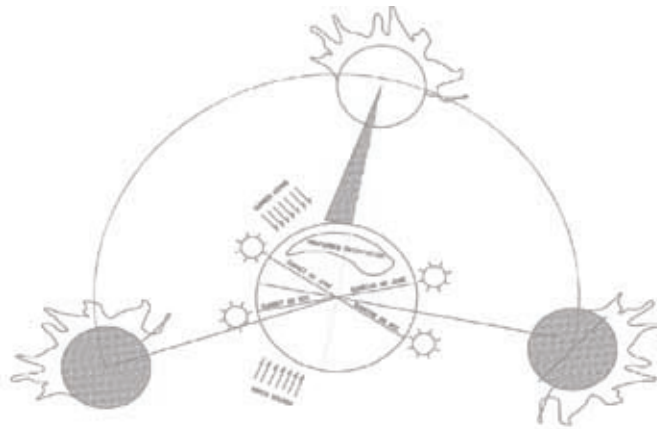


FIG. 5.3.3.4 Movement through building

Movement patterns are extremely important in public facilities, especially when masses of people are expected to be in this space at one given time. With a scheduled arrival and departure of the Gautrain, many people will move through the precinct en route to nearby attractions and facilities. These routes need to be clear and directional, allowing the visitor to immediately acquaint themselves with the immediate surroundings and be aware of the myriad possibilities of direction.

The public square needs to be designed for this purpose, to allow a person to immediately orientate themselves in the precinct, achieved through the use of clues in the urban landscape. These would include the re-use of the existing rail combined with textured paving to highlight these routes. Linear market stalls along the routes indicate and define that line as one of movement, while more obvious elements such as bollards and signage can also be implemented into the urban landscape to provide a physical directing tool.

5.3.4. RESPONSE TO ORIENTATION AND CLIMATIC CONDITIONS



The east-west orientation of the building that addresses Railway Street and the public square needs vigilant attention to the harsh sun-angles in the morning and afternoon conditions. For this reason, certain design directives were implemented to deal with the extremities and minimize the effects on the building. Most importantly, the materials were selected to benefit the building in the long-term whilst maintaining a sustainable approach to their applications. These include the following:

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- _ The creation of an external skin on the eastern and western facades*
- _ The inclusion of an atrium to create an internal environment*
- _ Heat-stacks on western and northern facades to extract unwanted warm air from the building interior*
- _ Massing of the atrium wall to absorb radiant energy and act as an extractor of unwanted warm air*
- _ Sunscreens on the northern facade that consist of photo voltaic ceels*
- _ Provision of high ceilings to interior spaces to create greater depth for air to move through*
- _ Roof design to aid in the natural movement of extracting warm air*
- _ Centralized Chilled Water handling units with VAV (Variable Air Volume) diffusers.*
- _ Rock-store located in basement to provide 10% fresh air intake for the chilled water handling units*

5.3.4.1 VERTICAL LOUVRES AS SECONDARY SKIN

A thermal control strategy has been adopted on the exterior of the building, where a structural curtain wall has been added as a second skin or layer to deal with the east-west orientation condition. This layer comprises of a system of vertical louvers assembled in frames for support and connected back to the main structure via steel connectors. These louvers are operated through the use of solar control mechanisms that orientate the louvers for optimum effects, however an over-ride mechanism is also available for human control and comfort.

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This secondary layer is vital to the success of the building, by ensuring that radiant energy does not come into contact with the main structure or glazing of the façade, to prevent unnecessary heat gains. Another advantage of the secondary skin is one of operation

and maintenance, where a walk-able surface is created between the main structure and the external skin that can be used to maintain the building exterior, clean windows efficiently, as well as service the louvers themselves with ease.

The louvres are each made of 2 natural anodised aluminium layers that contain a heat absorbing insulation material and supported on an anodised centre post. This centre post is connected to a small motor, which is powered through the photo voltaic cells to control their orientation. Although believed to be an unsustainable material due to the embodied energy used to produce aluminium, the material has far greater benefits;

_The essential characteristics of aluminium make it an ideal material for construction.

_It is light, strong, durable and requires minimal maintenance.

_It is flexible and easy to handle - this gives it tremendous potential for design.

_It can be curved, tapered, welded and cut to the most challenging and dynamic geometries. Where it is cut, the metal's innate resistance to corrosion means that the trimmed edge does not need to be protected.

The recyclability of aluminium - one of its unique properties along with strength, durability and corrosion resistance - has led to its increased use in construction over recent years. Used aluminium is valuable and is easily and endlessly recycled without quality loss. The material is very rarely 'lost' entirely because of this. Important issues to note are:

_The quality of aluminium is not impaired by recycling, endlessly Remelting aluminium saves up to 95 per cent of the energy needed to produce the primary product

_It is the most cost-effective material to recycle

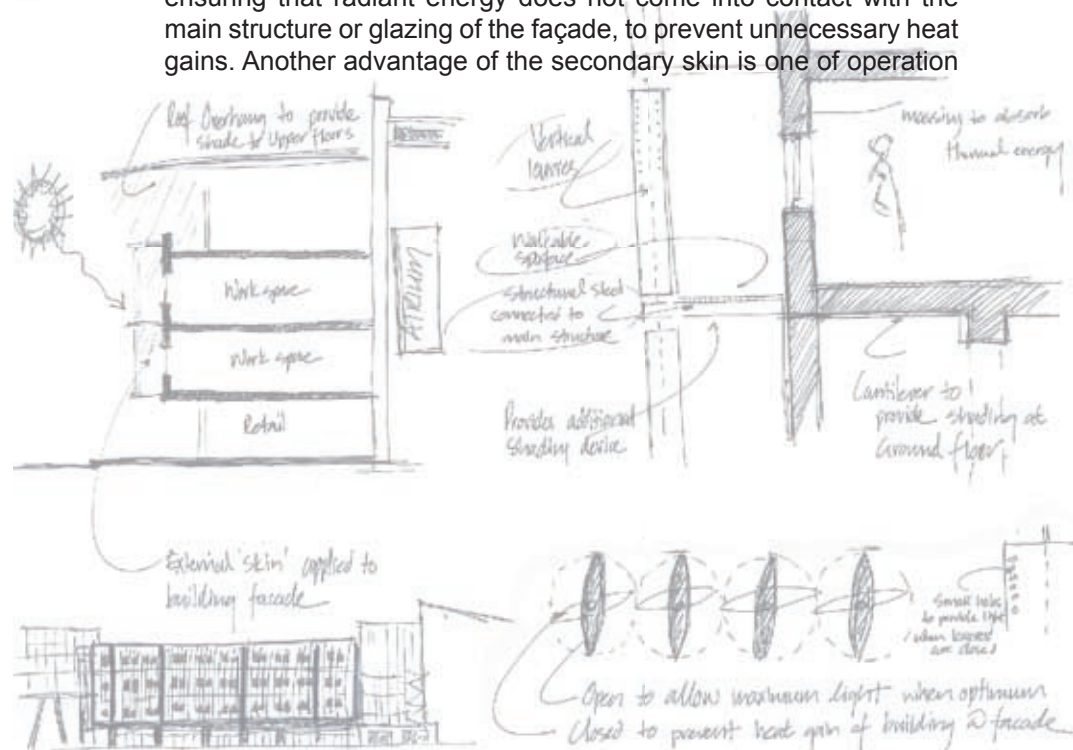


FIG. 5.3.4.1.0 sketches of east/ west facade design

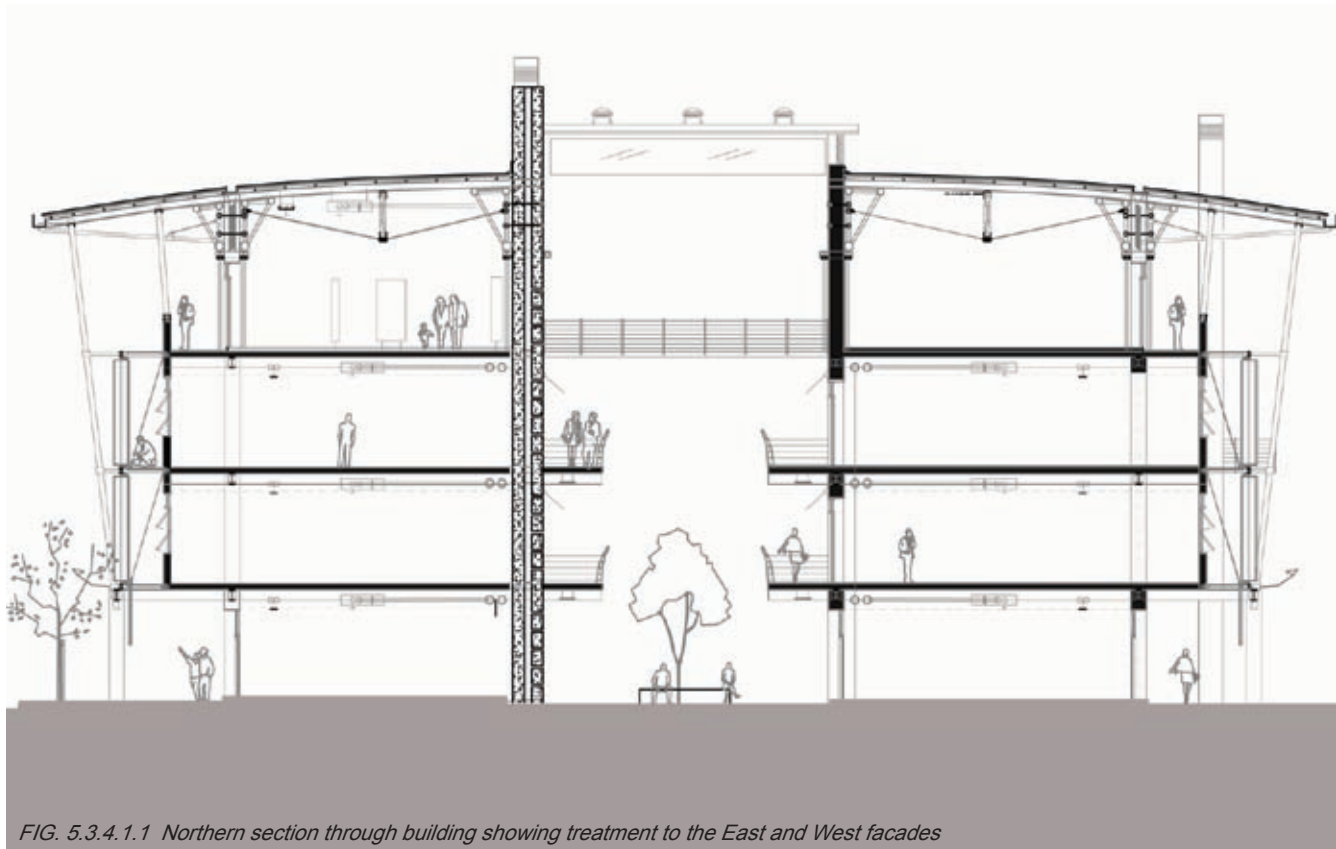


FIG. 5.3.4.1.1 Northern section through building showing treatment to the East and West facades

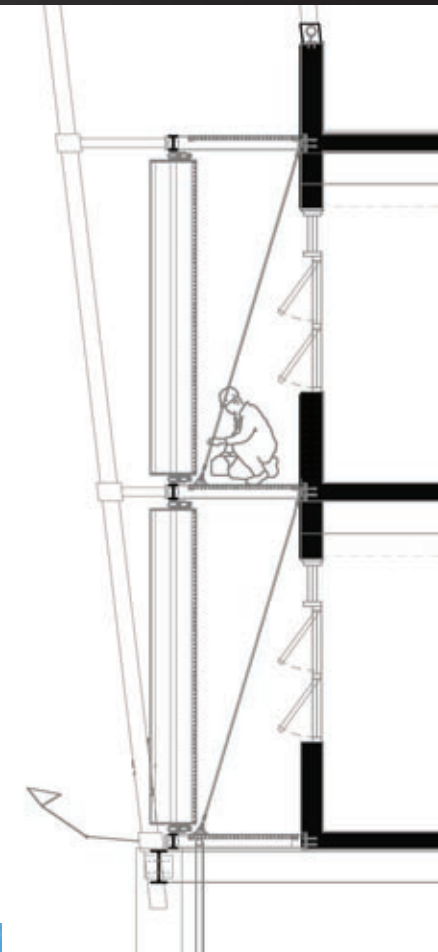


FIG. 5.3.4.1.3 Enlargement of the East facade showing vertical louvres connected to a steel frame as a second skin

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DESIGN DEVELOPMENT

_The overall market for used aluminium is steadily growing, so the more aluminium there is in a product, the more chance it has of being recycled

_The recycling rate of used aluminium products in building is over 80 per cent (over 95 per cent in transportation and 30 per cent in packaging.

_30 per cent of the 1.9 million tonnes of aluminium used in Europe in 1997 came from recycling.

source: http://www.materials_environment/aluminium.org



FIG. 5.3.4.1.2 example of vertical louvres on the exterior of a building

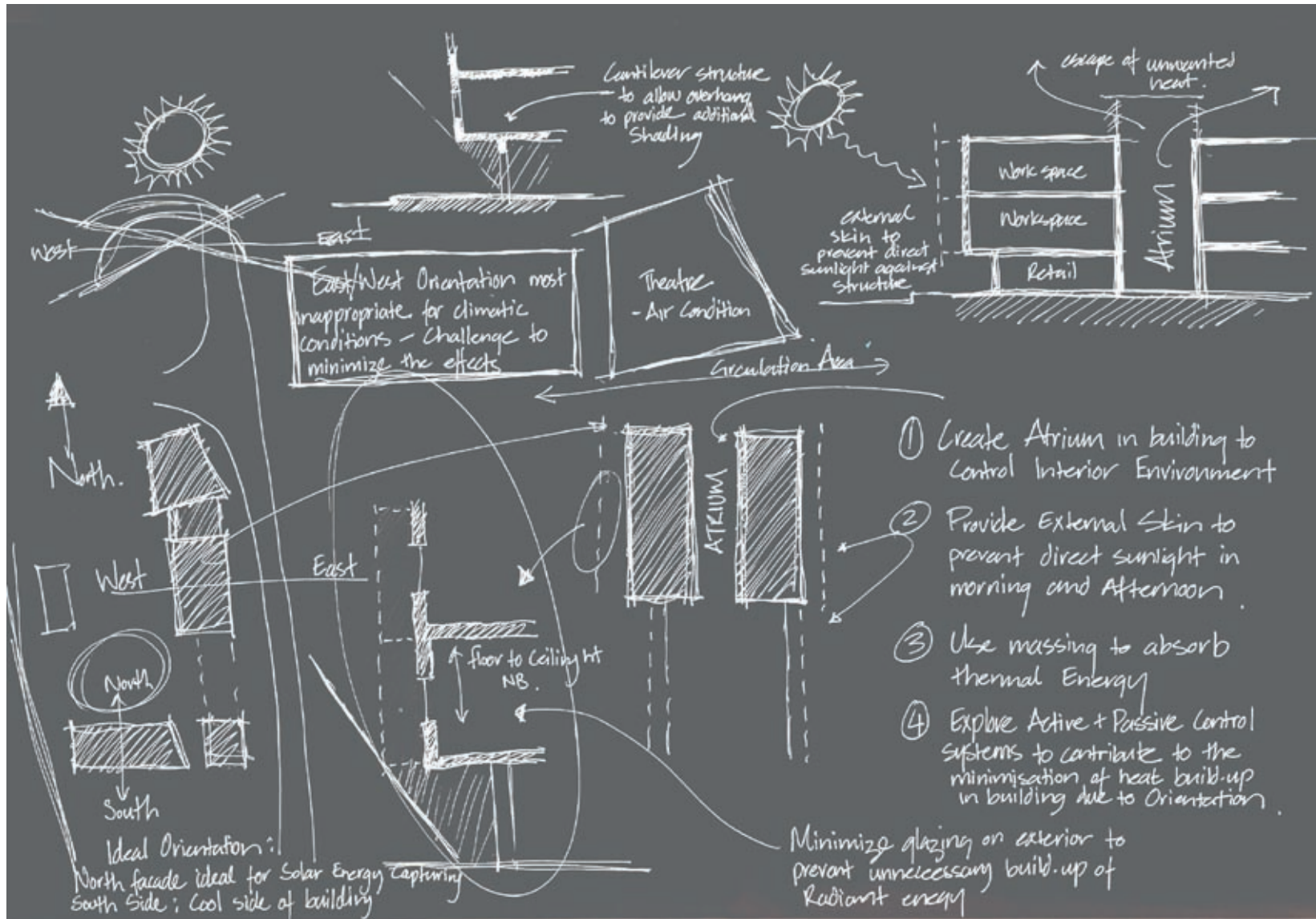


FIG. 5.3.4.1.4 Design sketches for climate control systems for building

5.3.4.2 AN ATRIUM AS AN INTERNAL ENVIRONMENT

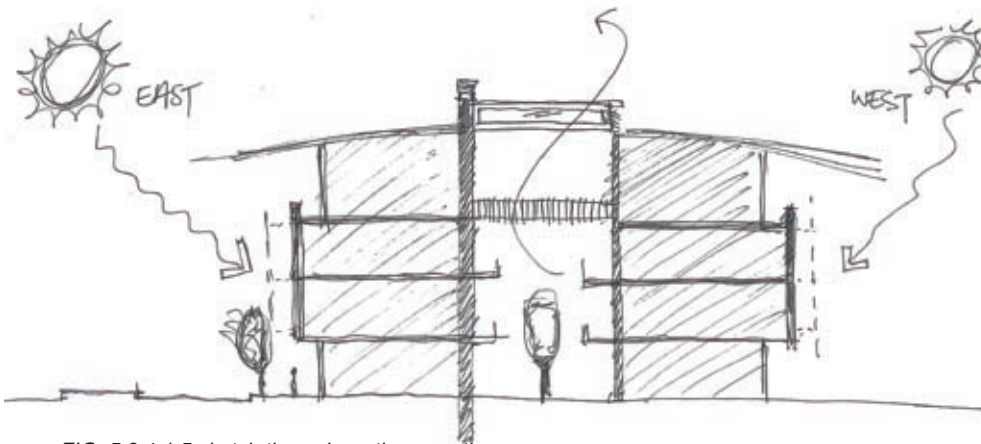


FIG. 5.3.4.1.5 sketch through northern section

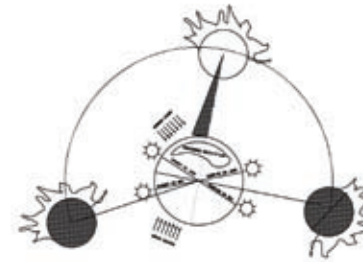


FIG. 5.3.4.1.7 interior atrium of Cape Town Convention Centre - see Precedent Study Analysis

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The cross-section of the building is comprised of three main spatial zones: the east facing zone, the west facing zone and a wide internal atrium between the two that acts both as a thermal control device as well as a circulation zone. The atrium supplies natural day-light through north-facing clerestory windows and allows the escape of unwanted air through louvers near the roof in summer, while maintaining a relatively warm environment in winter by closing the louvers and retaining much of thermal energy generated by the building. The atrium acts as a supplier of cool air to the eastern zone in the morning when the sun is exposed to the eastern façade. The vertical louvers of the external skin help to prevent direct radiant energy penetrating the building interior, thus allowing for the cooler atrium air to cross the zone and escape through openings above the windows. In the afternoon the atrium's role is reversed, where it now acts as a supplier of relatively cooler air for the western zone when the sun is exposed to the western façade.

FIG. 5.3.4.1.6 Northern section of building showing the positioning and temperature gradient of the atrium

_MORNING CONDITION

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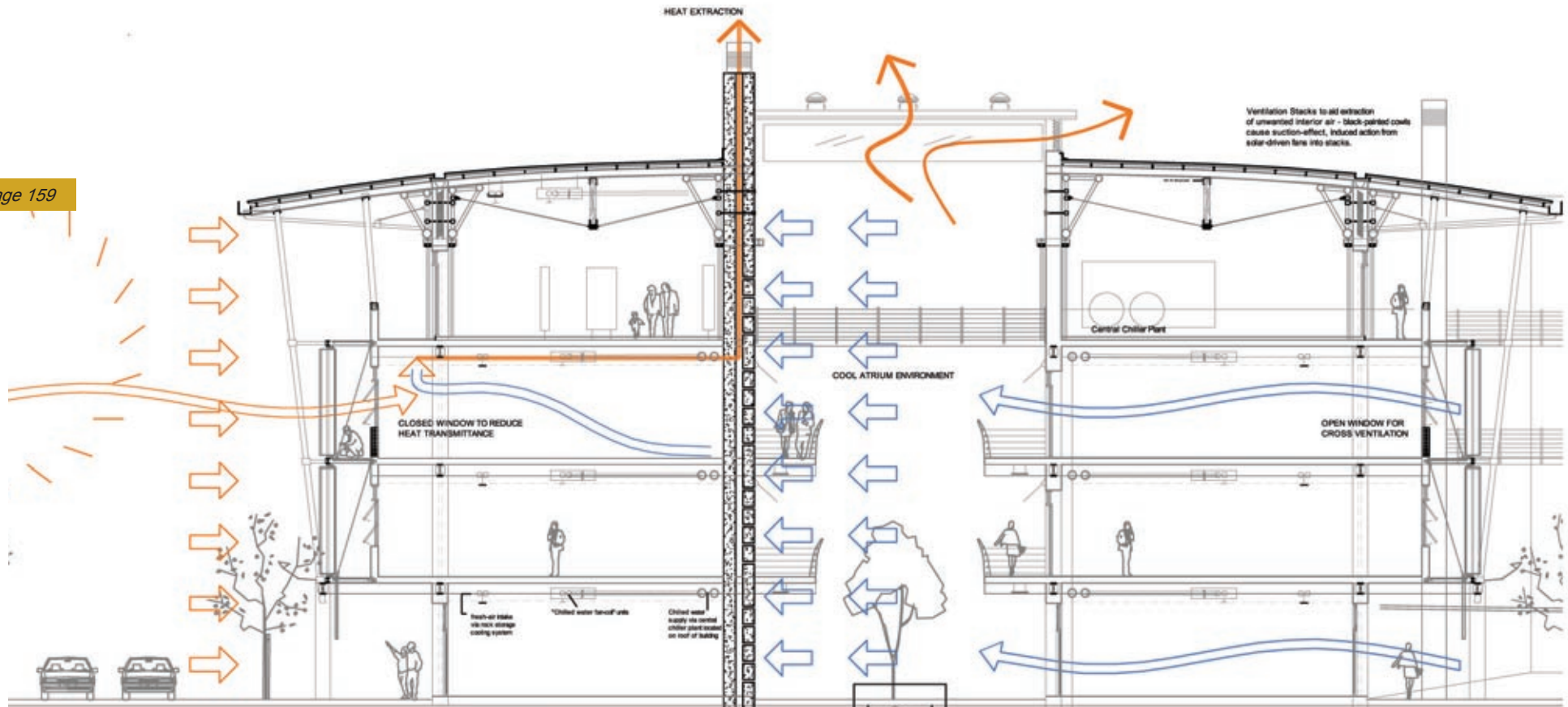


FIG 5.□
 as an internal environment when the sun is exposed to the eastern facade

uence of the atrium

_AFTERNOON CONDITION

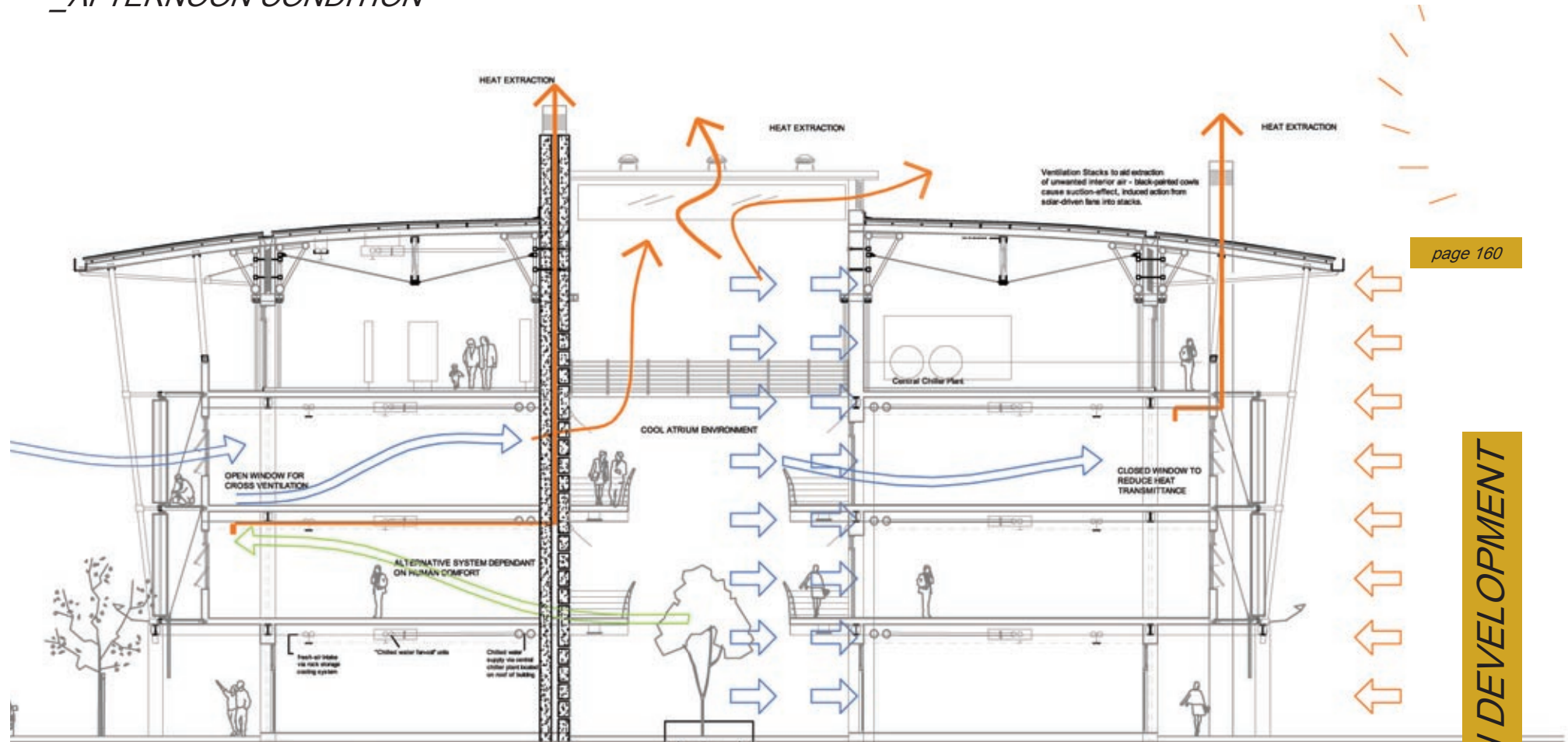


FIG 5.4. □
 atrium as an internal environment when the sun is exposed to the western facade

uence of the

5.3.4.3 VENTILATING HEAT-STACKS

The western facing façade, which is most affected by the orientation of the building, includes an additional thermal control mechanism i.e. ventilation heat-stacks. These aid the removal of unwanted warm air from the western zone through the stack-effect, which is achieved through the process of bouyant warm air rising upwards in a building and exiting through high level openings. The air is then replaced by cooler air drawn into the building through low-level openings such as louvres or doors. Additional mechanical fans connected to polar voltaic cells will aid this motion and serve as a back-up system in order for the stacks to operate effectively.

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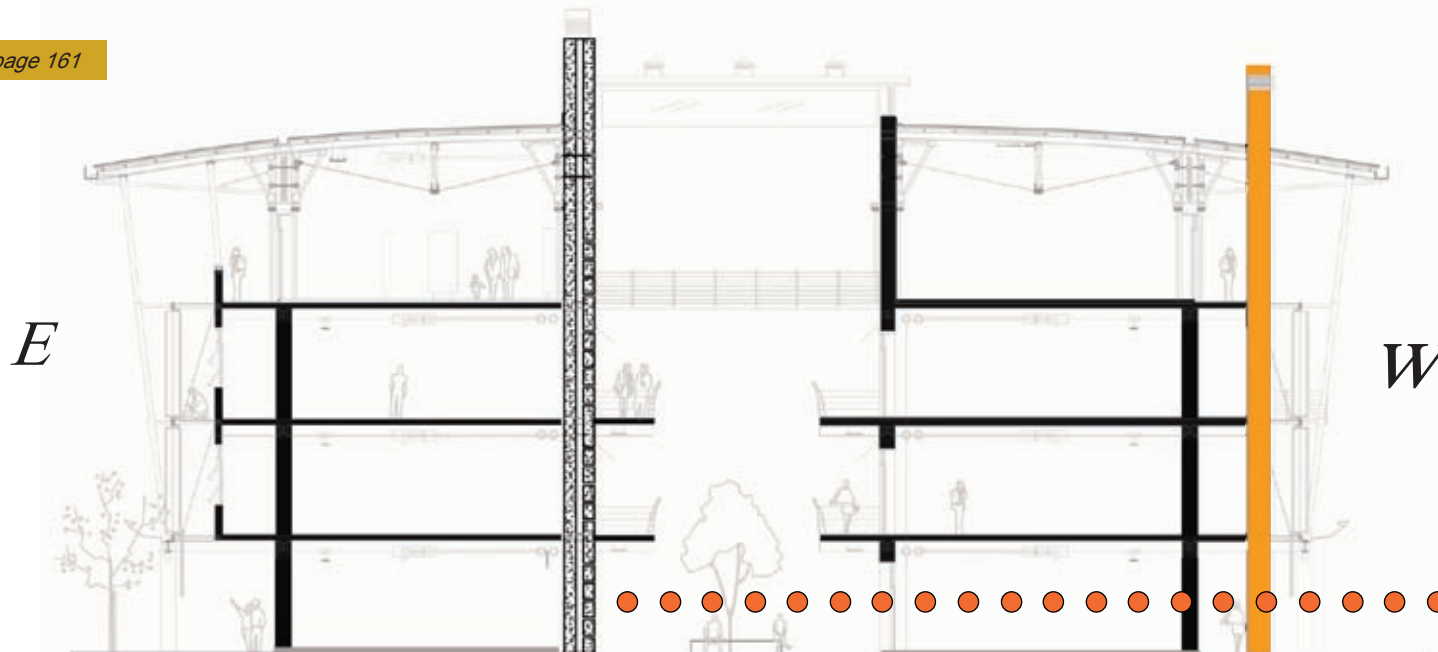


FIG. 5.3.4.3.1 Northern Elevation showing structural system and ventilation stacks on western facade

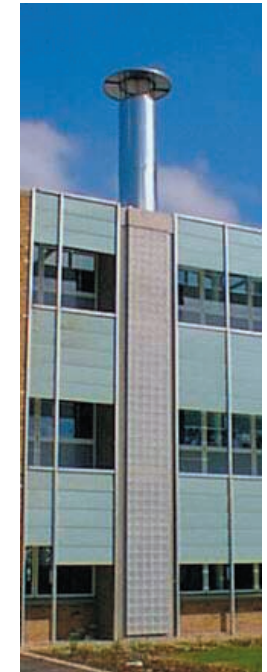


FIG. 5.3.4.3.2 Ventilation Stack of the BRE Low Energy Building - see Precedent Study Analysis

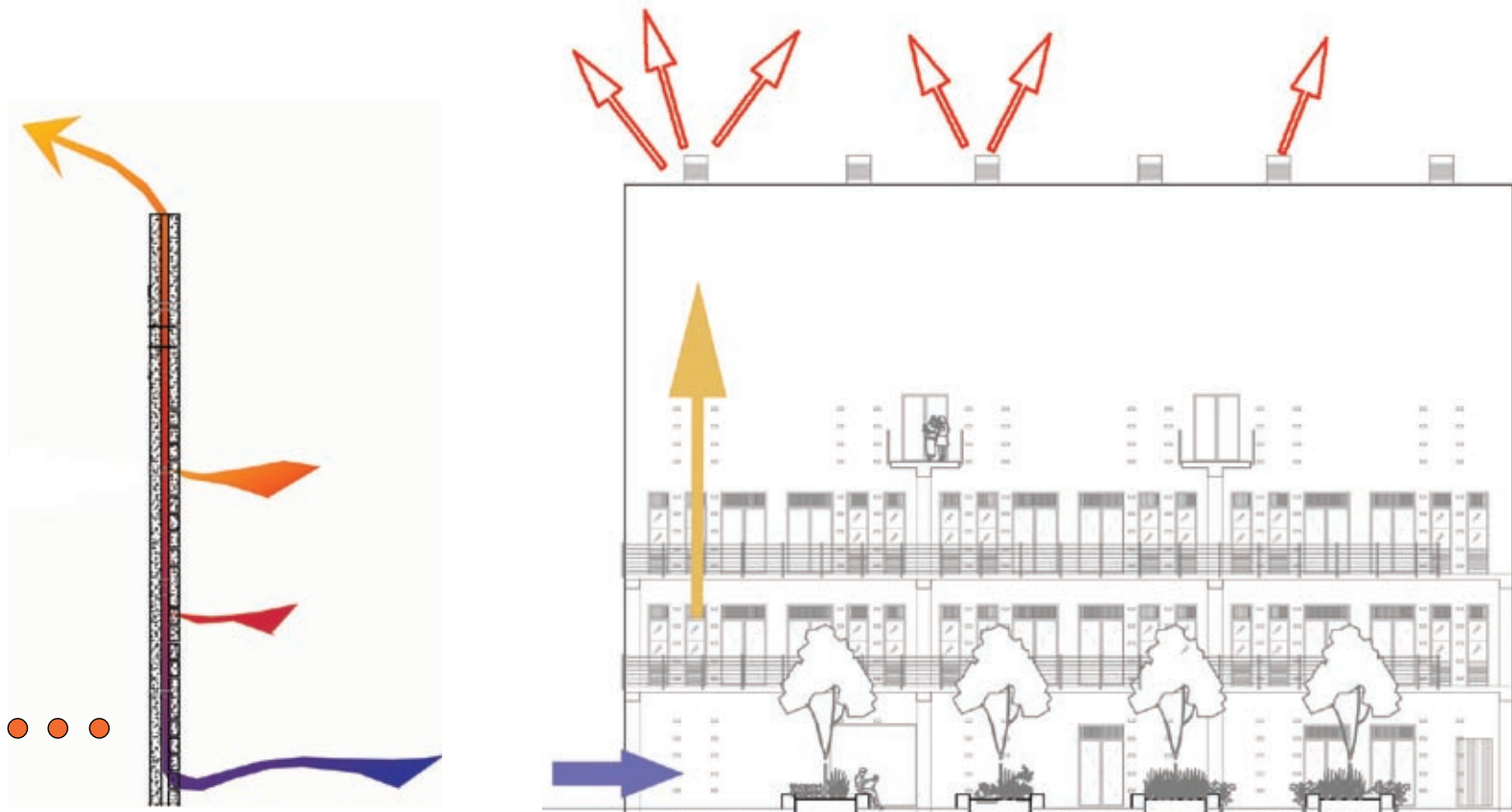
KEY POINTS:

- _Temperature is the driving force and is therefore not reliant on wind speed and direction to operate efficiently.
- _Particularly effective for night-time cooling when there is the greatest difference between internal and external temperature

LIMITATIONS:

- _Only effective when outside air is cooler than the internal air.
- _A relatively clear path without obstructions is required for air to travel from the low-level openings to the high-level openings

5.3.4.4 MASSING OF THE ATRIUM WALL



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FIG. 5.3.4.4.1 Section and elevation of Atrium wall as a massing element to absorb thermal energy and act as a ventilator

The eastern side of the atrium comprises of a thermal wall that acts both as a ventilator of unwanted air from the eastern zone, as well as an absorber of thermal energy from the atrium itself and from the eastern zone space. Ventilators on the exterior on top of this wall aid the removal of unwanted warm air. In winter, this wall has the reverse effect by supplying absorbed thermal energy to the building and maintaining a relatively stable environment.

5.3.4.5 AIR-CONDITIONING : CENTRALIZED CHILLED WATER AIR-HANDLING UNIT

Combined with these passive systems of thermal control, a centralized chilled water-handling unit located on the roof, with fan-coil units in separate zones, is incorporated into the design. The system consists of a central chiller plant that generates cold water (to 6 deg. C) which is circulated throughout the building in pipes and connects to fan-coil units located in the ceiling void/ plant rooms. Supply air from the fan-coil units is ducted to the air-conditioned zone.

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The system is suitable for multiple zones e.g. an office building with floor areas ranging from 15m² to 60m² if the fan-coil units are located in ceiling void and upto 600m² if the fan-coil units are located in floor plantrooms. There is no limitation on number of zones served.

The effects of the passive systems minimize the energy required to cool the air within the building by this system, although these alone would never be sufficient for the harsh climatic conditions that Pretoria can experience in summer. An additional passive system, known as a rock-store, is incorporated in the basement to supply the fresh air intake to the separate zones required for the fan-coil units to operate effectively. This rock-store is comprised of a bank of rocks over which cool filtered water is passed to effectively cool the air, which is then passed via ducting to the various zones. Air supply to this system can be incorporated through the design of the Gautrain tunnel, where cool air from the base of Salvokop Hill can be filtered and fed to the system for distribution.



FIG. 5.3.4.5.1 Chiller plant on roof of new Law Faculty, University of Pretoria

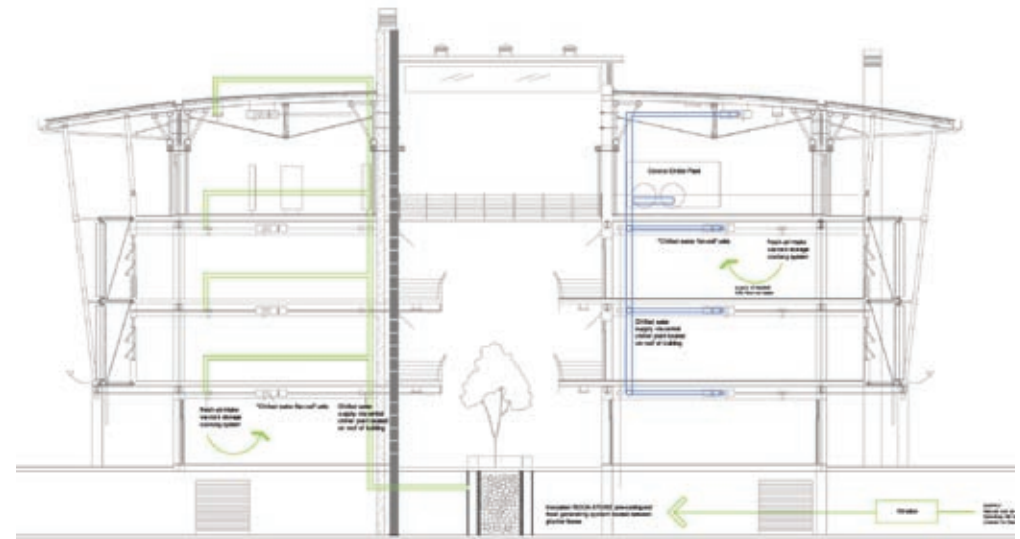
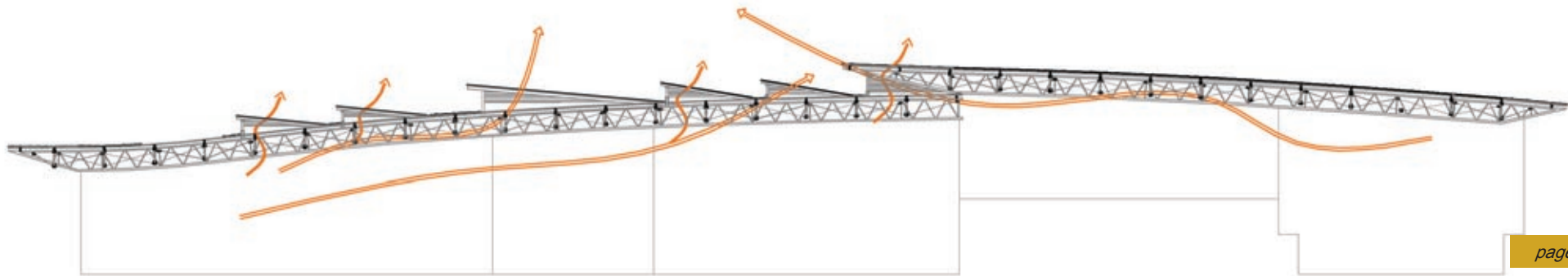


FIG 5.3.4.5.2 Diagram represents the air-conditioning system consisting of a centralized chilled water-handling unit with VAV (Variable Air Volume) diffusers located in the roof space of the building, and fan-coil units in each zone. Fresh air is supplied via a rock-store in the basement to each zone.

5.3.4.6 ROOF STRUCTURE AS A NATURAL VENTILATOR



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FIG. 5.3.4.6.1 Western section of roof structure showing how the design of the form acts as a natural ventilator

The form of the roof structure allows the natural movement of buoyant air to rise against it and flow toward the higher regions where openings allow the escape of unwanted warm air, thereby acting as a natural ventilator.

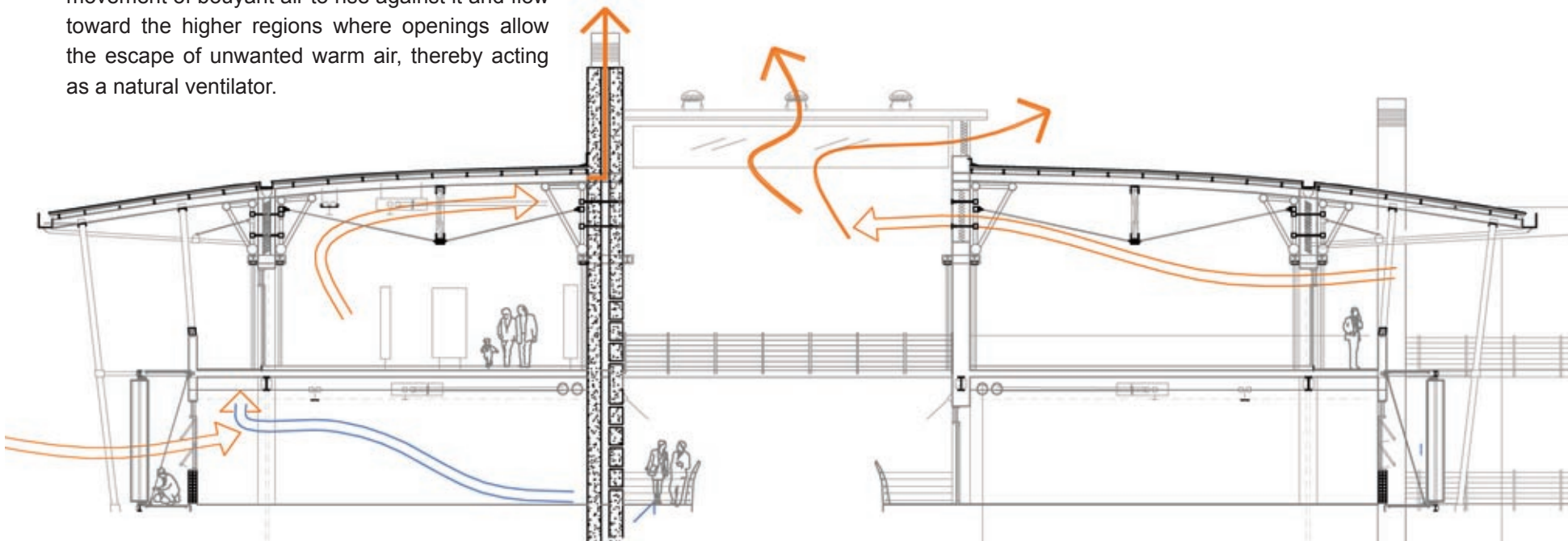


FIG. 5.3.4.6.2 Northern section through roof structure, also designed to act as a natural ventilator through its form