

The Afterlife of Megastructures

In the Aftermath of Mega-Events: The Case of Cape Town Stadium

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Aftermath of Mega-Events:
The Case of Cape Town Stadium**

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MWDALI001

Adapt! Studio supervised by
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University of Cape Town, 2017

THE AFTERLIFE OF MEGASTRUCTURES IN THE AFTERMATH OF MEGA-EVENTS: THE CASE OF CAPE TOWN STADIUM

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SUPERVISORS: STELLA PAPANICOLAOU AND MIKE LOUW, ADAPT! STUDIO

This dissertation is presented as part fulfilment of the degree of Master of Architecture (Professional) in the School of Architecture, Planning and Geomatics, University of Cape Town.


6 November 2017

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A.M.D.G.

Abstract

Large scale global spectacles such as the FIFA World Cup and the Olympic Games demand infrastructure of a suitably grand magnitude — the stadium being the centre-piece of this infrastructure. However, because the mentioned events are hosted in a different location each time they take place, the stadia they leave behind often face uncertain futures, as the events and capacity for which they are originally designed are difficult to maintain following the spectacle. The intention of this dissertation is to explore how adaptive reuse can be considered as an approach towards stadia in the aftermath of global mega-events. This exploration focuses on Cape Town Stadium, a venue for the 2010 FIFA World Cup hosted in South Africa.

The dissertation engages Cape Town Stadium in terms of an exploration into understanding the nature of stadia as very large buildings, and the challenges and opportunities adaptive reuse presents to their continued use. Cape Town stadium is understood as a robust concrete structure with a high embodied energy and a variety of spatial and environmental conditions created by contrasting deep and shallow spaces, and different engagements with external environments. These conditions present a challenge to providing the spatial and environmental requirements of an alternative programme, especially where spaces are deep, isolated, inappropriately scaled or articulated by structure. Informed by Metabolist megastructure thought, adaptive reuse is explored in an approach that regards the existing as a robust permanent structure and introduces a secondary order of architecture: more delicate and less robust — that augments the existing structure to provide for the spatial and environmental requirements of a new programme — an educational campus — introduced to occupy the underutilised portion of the Stadium.



Figure 1 Cape Town Stadium viewed over the Green Point Park pond

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Introduction

Large global mega-events have a habit. Sporting spectacles such as the Olympic Games and the FIFA World Cup are hosted every four years, in a different location on each occasion. The scale of these events is vast, requiring the construction of enormous amounts of infrastructure to facilitate every aspect of spectators' and participants' experience, all towards the short-lived moment of spectacle accompanied by the hope of leaving an enduring legacy of national pride and human achievement. Included in the infrastructure are stadia: the pinnacle of these mega-sporting events. Yet beyond those few months of event, the legacy of stadia is often uncertain: some host local teams while, failing this, they are frequently underutilised, neglected, financially burdensome or they are demolished. This dissertation argues for adaptive reuse as an alternative option to be considered toward stadia. This is demonstrated in a design proposal for the partial adaptation of Cape Town Stadium — formerly used in the 2010 FIFA World Cup in South Africa — into an educational campus and series of public galleries and amenities.



Figure 2 Adaptation is proposed as an extension of the options available to stadia following large spectacles such as the Olympic Games and FIFA World Cup

Images: (Dunne & Train, 2017) (Pack & Hustwit, n.d.) (Knowlton, 2016)

ISSUE

A study of 75 stadia in 20 countries used in global events found that a majority struggled to attract large crowds and their attendance figures were generally low considering their capacity, citing the lack of a suitable anchor tenant (usually a local sports team) as a reason for their financial difficulties (Alm, 2012). The report observed that as these stadia are often built to satisfy external requirements and not local ones, they are not suited to daily activity and local needs thereafter. Also alleged is that the legacy of stadia in the aftermath of these events is not well-considered by the cities and countries that host them, who ultimately bear responsibility for them. The issue is certainly coming to the attention of potential hosts of these events who, in the examples of some stadia built for the London 2012 Olympic Games and the 2014 FIFA World Cup in Brazil, have built stadia designed for disassembly capable of reducing to a scale more appropriate to local needs. The issue of stadia that have been built without these considerations, however, needs to be engaged with, and this is the concern of the dialogue that follows.

LEGACY

The 2010 FIFA World Cup was the first in Africa. South Africa's ambition was to prove to the world that the prestigious event could be carried out on African soil, showcasing ten stadia in nine provinces in South Africa, including 5 brand-new facilities. Indeed, this was accompanied by much hype and speculation, building up to a fever pitch when 32 teams and over 3 million spectators would attend, culminating in victory for Spain over the Netherlands at Soccer City Stadium in Johannesburg.

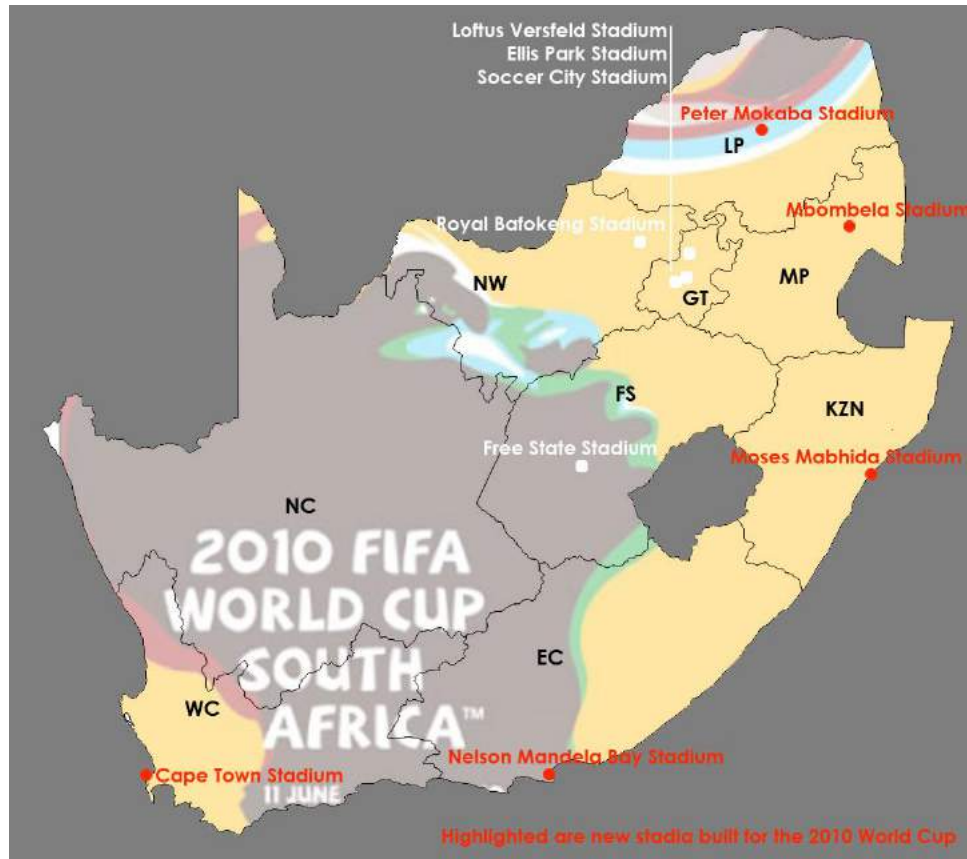


Figure 3 Distribution of 2010 FIFA World Cup stadia in South Africa by province

Poster by author with sourced images: (La Historia con Mapa, 2015) (ESPN FC, n.d.)

Not long after the event, however, the legacy of the 2010 World Cup came into question. Relating to stadia, an overwhelming concern was that they would become “white elephants” and come to be associated with a legacy of underutilisation and financial burden (AFP, 2014; Collins, 2010). This was a particular concern for Cape Town Stadium, as initial plans to have a private operator or host rugby teams (which bring greater audiences) fell through (Mail & Guardian, 2010). Financially, the underutilisation of the Stadium has resulted in an annual deficit of R39 million to the City of Cape Town and, therefore, to taxpayers (Vidamemoria Heritage Consultants, 2015).

Introduction to Cape Town Stadium

Cape Town Stadium was newly built in Green Point, Cape Town, for the 2010 FIFA World Cup, following the design of a consortium — Point Architects and Urban Designers — led by German architecture firm von Gerkan, Marg and Partners. The Stadium is located on the Green Point Common, a public sporting and recreational precinct below the Green Point neighbourhood on the slopes of Signal Hill, 3km from Cape Town city centre and close to the South Atlantic ocean.



Figure 4 Aerial image showing Cape Town Stadium's context

(von Gerkan, Marg and Partners, n.d.)

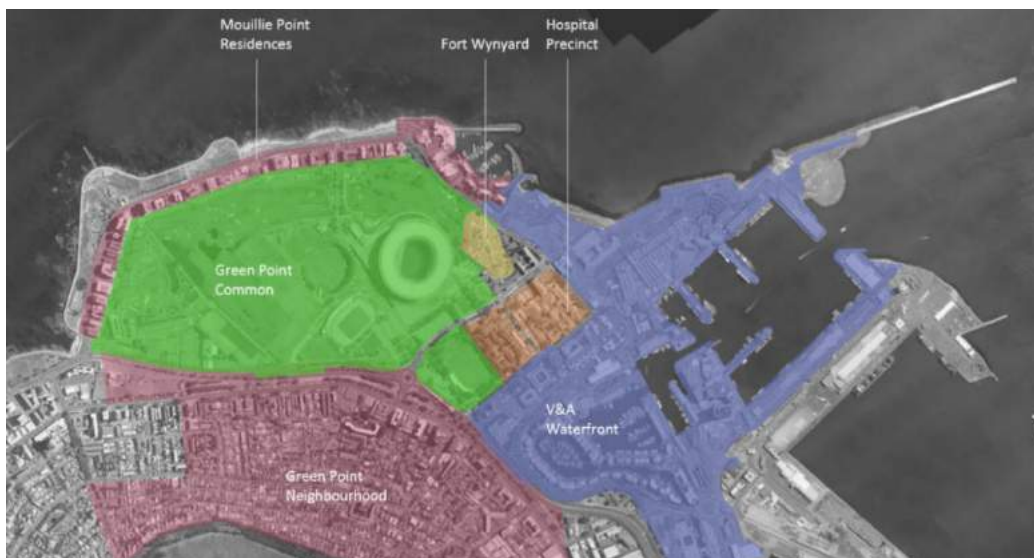


Figure 5 Aerial image showing the context of the Stadium and Green Point Common

Image by author with background map sourced: (Google Maps, 2017)

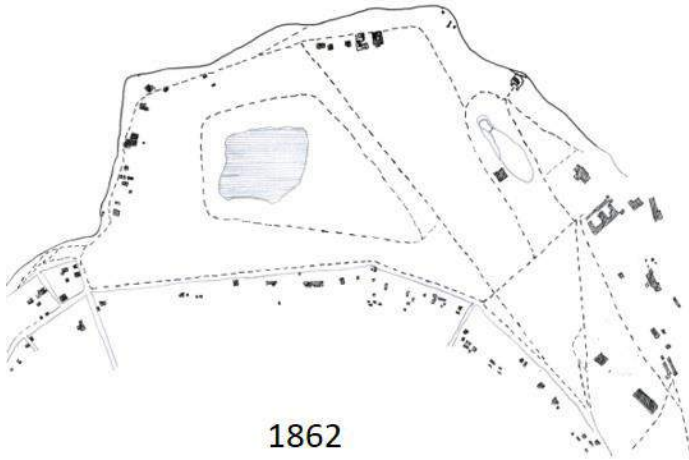
The Green Point Common is understood to have been a coastal plain containing a seasonal freshwater vlei used by Khoi / San communities for grazing and habitation. Following European settlement of the Cape beginning 1652, the Dutch trading company, VOC, used the Common for cattle grazing. Later, Green Point was recognised as a defensive asset to colonialists and the 'Kijk-in-de-pot' Battery (later known as Fort Wynyard) was built on the site in 1795. Sporting activity on the Common was intensely pursued by the British, becoming first formalised with a track for horse racing built in 1806, accompanied by other activities as cricket, soccer, bowls and athletics that gradually parcelled the Common.

The military function of the Common was continued in the construction of the Breakwater prison (today the University of Cape Town Graduate School of Business) in 1860 to incarcerate British convicts; the use of the Common as encampments for African and Boer prisoners, and as war parade grounds for the British military from 1899-1902. South Africa's first rugby match, taking place in 1862, was played on the Common between a civilian team and the military.

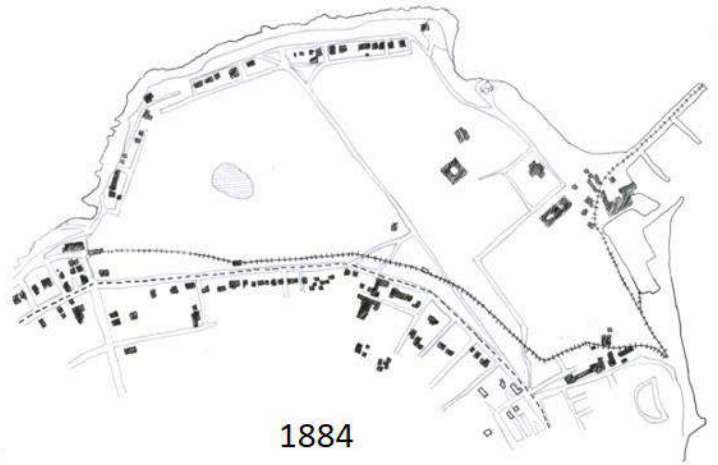
Over time, developments around the Common came to include the New Somerset Hospital precinct, the growth of Mouillie Point and the Victoria and Alfred (V&A) Waterfront development. Ultimately, the sporting use of the Common overshadowed all other activities. In 1923, King George V granted the 110ha area of Green Point as a commonage to the people of Cape Town for sporting and recreational use.

A history of segregation is pronounced on the Common: in 1883 and 1886, whites-only and blacks-only rugby unions were formed respectively, while in 1891 the Industrial Breakwater Prison became the first in South Africa to segregate black and white prisoners. When the 1950 Group Areas Act was passed the Green Point Common was used as a site of protest but subsequently entrenched greater forms of segregation when the 1951 Separate Amenities Act designated separate facilities for Coloured and White sportsmen on the Common (Green Point Track and Green Point Stadium respectively).

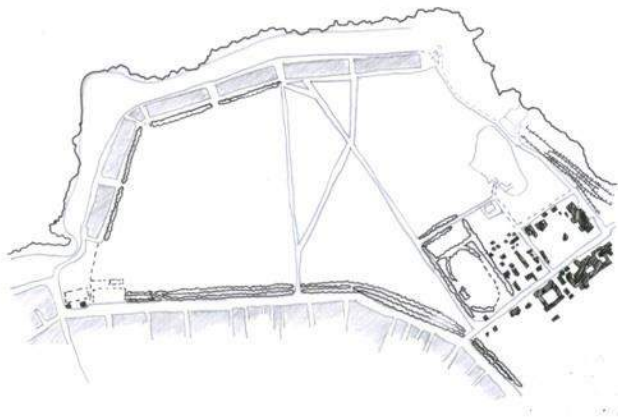
Finally, the athletics facilities of the Common have been of use to schools and educational institutions around Cape Town. The Cape Peninsula University of Technology has had an athletics club on the Common since 1920 and takes pride in the accomplishment of one CPUT student, Ewald Bonzet, who broke the South African 10 000m record at the Green Point Stadium in 1972. The continuation of sporting excellence and enjoyment at the Common no doubt strikes resonance with the showcase of the World Cup in 2010 and the presence of Cape Town Stadium on the Common.



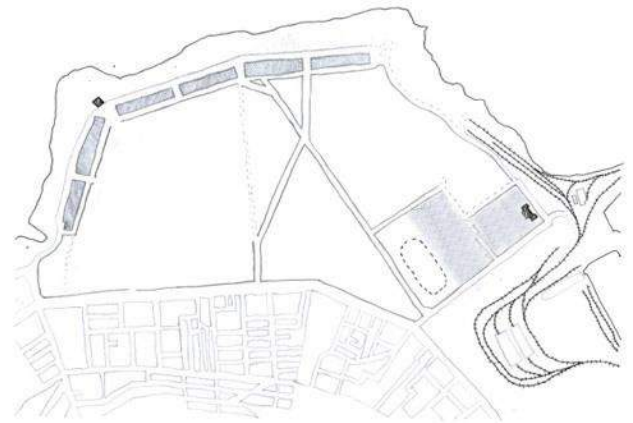
1862



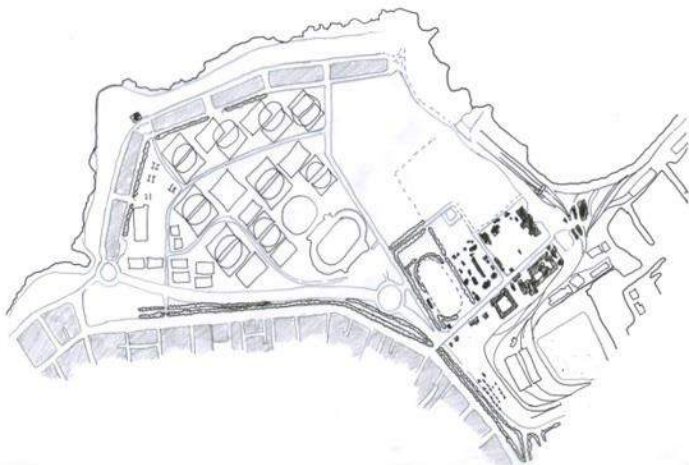
1884



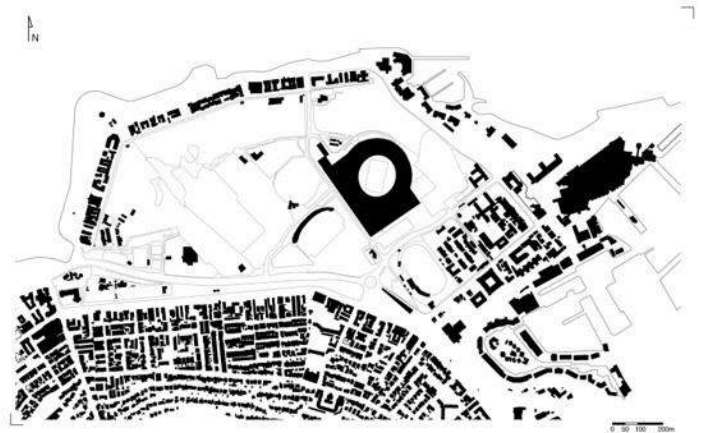
1930



1939



1964



2017

Figure 6 Historical development of Green Point Common, which has become more fragmented over time

Tracings done by author from source maps:
(Vidamemoria Heritage Consultants, 2015) (Murray, 1964)



Figure 7 The Common today consists of several fenced parcels of sport and recreational activity. Fort Wynyard and Victoria Hospital are adjacent historical landmarks while some academic and retail activity is also nearby

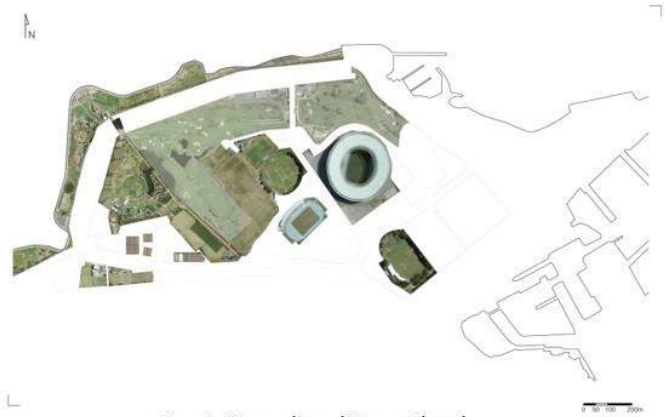
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URBAN ANALYSIS

The Green Point Common today is characterised as isolated parcels of activity that have resulted from the Common's subdivision over time (Figure 6 and Figure 8). The precinct has the character of being desolate, especially due to its sparse, expansive profile and lack of interaction between the amenities that are meant to be public and the more truly public space of pedestrian-ways and streets around them. The extent of enclosure by barriers such as fences and the social barrier of membership isolate activities from each other (Figure 9). The highway separates the activity of the Green Point neighbourhood from the Common. The result is a 'no man's land' of space that is common to all activities at the Common and yet desolate.



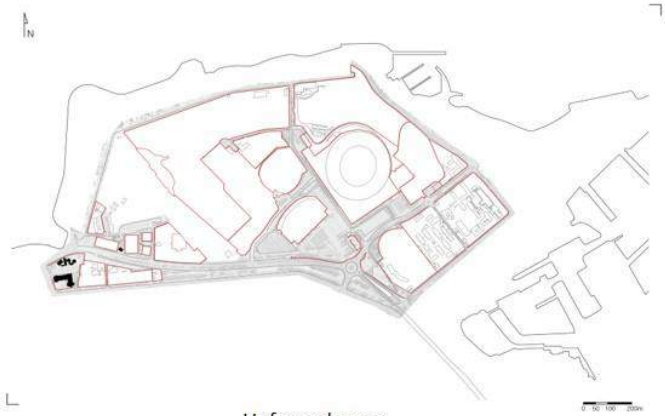
Sports Grounds



Sports Grounds and Recreational Areas



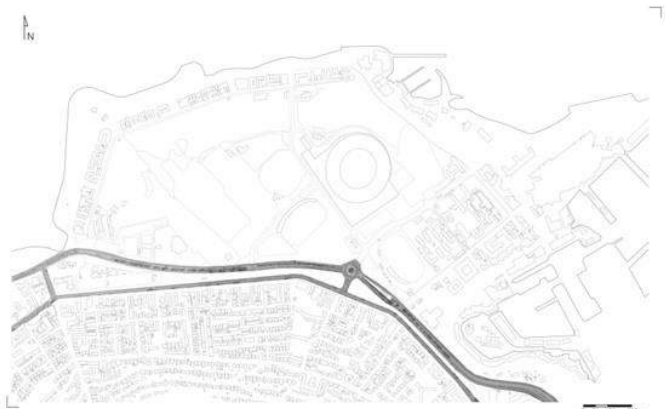
Extent of fencing



Unfenced areas



Movement routes



Main Rd and Helen Suzman Boulevard

Figure 8 Urban analysis revealed a great extent of parcelling and isolation at the Common, aggravated by extensive fencing and major roads

Images produced by author based on aerial imagery: (Google Maps, 2015)



Figure 9 Fences and other barriers including the Green Point park pond separate activities and create an alienating public realm at the Common

The Stadium's participation in this is in the inaccessibility of large areas of it to the non-ticket holding public, including the podium, pitch and vast areas of underutilised internal space (Figure 11). As a very large building, the Stadium has an unrelenting set of long linear edges to the street that contribute to the alienating effect of Fritz Sonnenberg road to pedestrians (Figure 10).



Figure 10 The perimeter of the Stadium has a sense of desolation and an unrelenting linearity

Top: (Google Maps, 2015)

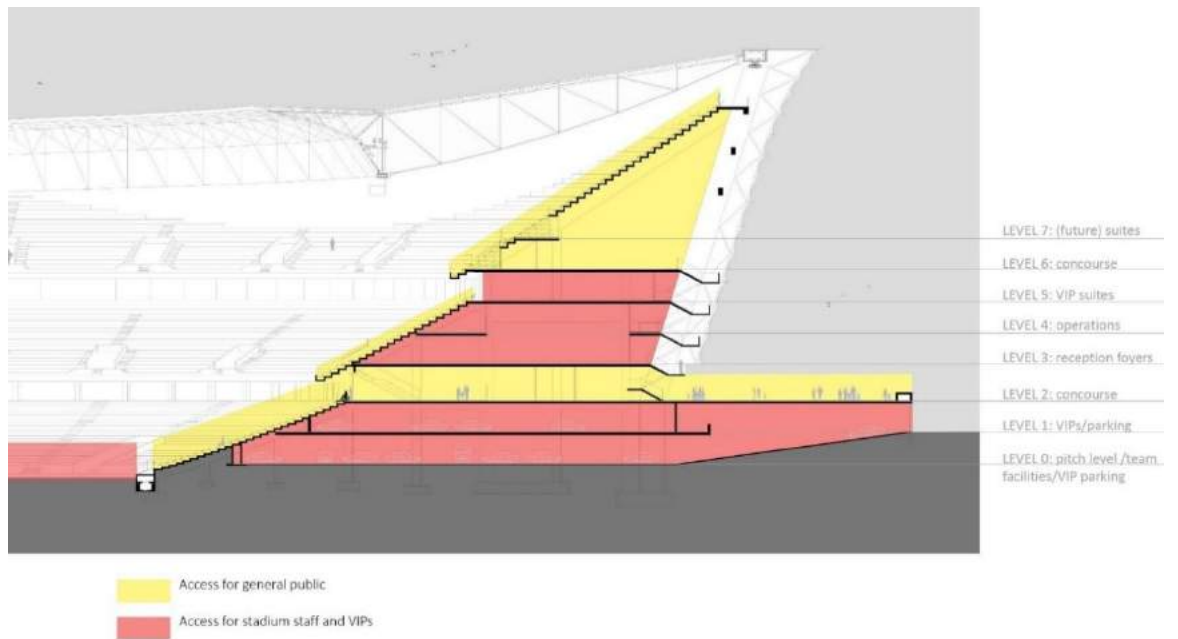


Figure 11 Section showing areas of the Stadium accessible to the general public during events. Outside of event times no areas of the Stadium are accessible to the general public

Theory

This dissertation engages with theory in order to consider what it means for Cape Town Stadium to be understood as a very large building. The question of what the properties of very large buildings are is discussed from four theoretical viewpoints:

- 1. Megastructures** *Rayner Banham*
Banham describes a condition of very large building as ‘megastructure’: made possible by technology and consisting of changing smaller functional units that may ‘plug in’ or ‘clip on,’ for example, within a more stable larger framework.
- 2. Megaform** *Kenneth Frampton*
Frampton puts forward an understanding of very large buildings as relating to their landscape and context, and having a duty to contribute towards place-making in their urban environment.
- 3. Big** *Rem Koolhaas*
A very large building is regarded as ‘Big’, achieved by technological advancements, independent of its context, requiring urban planning and architectural competencies, and producing artificial internalised environments divorced from the external environment.
- 4. Big and Green** *David Gissen*
Gissen sees very large buildings as having a responsibility to maintain and promote relationships between occupants and the external environment and to be responsible for the impact of their demands on the natural environment.

The relationship that very large buildings ought to have with their environments as regarded by Gissen and the understanding of very large buildings as ‘megastructures’ that Banham presents are compelling. Gissen’s position that buildings ought to relate to their environment provides the position of enquiry for the analysis of Cape Town Stadium, while Banham’s discussion on megastructures informs the adaptive reuse strategies that result. The relevant aspects of both viewpoints are here summarised.

Big and Green responds to the growing precarious imbalance between human settlement and the natural environment in the USA attributable to intense urban expansion. The author notes that environmentally conscious design has tended to be applied to small-scale buildings, where their impact is small. By contrast, large buildings are especially valued as an opportunity to make large scale environmentally positive impacts. Large buildings have properties that can be problematic: they have large spans, deep spaces and high occupancy that create challenges for providing a comfortable internal environment. Gissen’s position is that by imbuing a ‘big’ building with ‘green’ qualities (such as daylighting, natural ventilation and low energy consumption), these present an opportunity to make large-scale positive environmental impact.

It is noted that large buildings by virtue of their scale are prone to exacerbated environmental challenges that include:

- Consumption of large amounts of energy
- Release of large amounts of CO²
- Use of the most wasteful construction practices
- Poor air quality leading to illness

A major contributing factor to these challenges in the 19th and 20th centuries has been the use of mechanical means for ventilation and lighting necessitated by the high rise and long spans of these large buildings. Gissen is not satisfied with replacing contact with the natural environment with an artificial environment, finding that air conditioning and other artificial technologies have been taken for granted and that there is a wide dependence on fossil fuels to light, heat and cool buildings.

Instead, the author advocates an approach to large buildings that can be “... a celebration not simply of human intelligence but of our kinship with all of life.” (Gissen, 2003). Gissen demonstrates that architects can design large buildings to have a more positive relationship to their environment:

“An ecologically aware architect would design those buildings differently. She would immerse herself in the life of each place, tapping into natural and cultural history, investigating local energy sources, the availability of light, shade, and water, the vernacular architecture of the region, the lives of local birds, trees and grasses.” (Gissen, 2003)

Meanwhile, in *Megastructure: urban futures of the recent past*, Banham explores the idea of megastructure in modern architectural works and discourse. Banham narrates the progression of megastructures from early concepts that preceded the title, to the first use of the word by Japanese architects, through to the variety of conceptual and built expressions of megastructure in different parts of the world. Of particular value to this dissertation is Banham’s description of the Metabolist view of megastructure.

A ‘megastructure’ was understood by Metabolists as a construction of large scale that had a robust structure serving as a framework into which smaller scale units could be independently placed. When the Japanese urban situation of their time is understood, these qualities can be appreciated. Japanese architects of the mid-20th century noted conditions of overwhelmingly crowded Japanese cities that distanced a person from their place of employment, resulting in long travel times. Architects further perceived differences in ‘metabolic rates of change’ of different components in cities. Consequently, architects of the Metabolist movement positioned themselves in seeking to remediate overcrowding and sprawl while creating a city confidently catering to activities of different rates of permanency and change.

What was envisioned, then, was “a large frame in which all the functions of a city or part of a city are housed... made possible by present day technology. In a sense it is a man-made feature of the landscape. It is like “the great hill on which Italian towns were built...” (Maki, 1964) and, as Tange writes,

“The structural element is thought of as a tree — a permanent element, with the dwelling units as leaves—temporary elements which fall down and are renewed according to the needs of the moment. The buildings grow within this structure and die and grow again — but the structure still remains.” (Banham, 1976).

An example is Tange’s unbuilt Boston Harbour Project that featured a repeating triangular structural frame which supported dwellings of a smaller order (Figure 12, Figure 13).

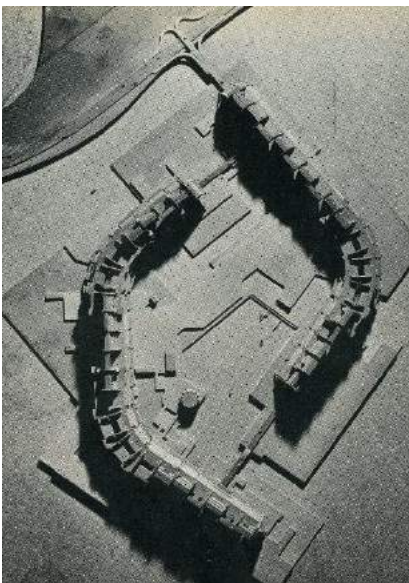


Figure 12 Boston Harbour Project by Kenzo Tange, model

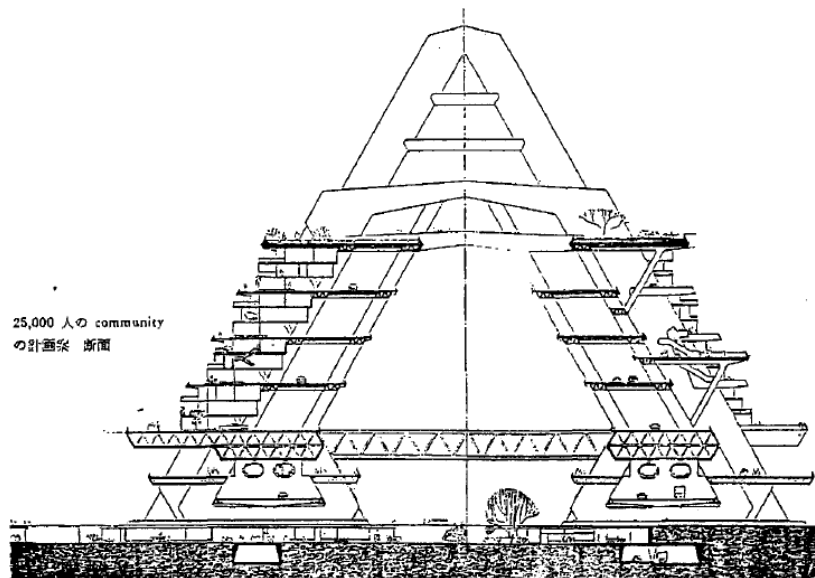


Figure 13 Boston Harbour Project by Kenzo Tange, section. The project proposed a gigantic permanent triangular frame into which more temporary units could be supported

(Banham, 1976)
(Nyilas, 2006)

The above builds up towards Ralph Wilcoxon’s definition of megastructure in *Megastructure Bibliography*, defined as:

“not only a structure of great size, but... also a structure which is frequently:

- Constructed of modular units;
- Capable of great or even ‘unlimited’ extension;
- A structural framework into which smaller structural units (for example, rooms, houses, or small buildings of other sorts) can be built – or even ‘plugged-in’ or ‘clipped-on’ after having been prefabricated elsewhere;
- A structural framework expected to have a useful life much longer than that of the smaller units which it might support.” (Wilcoxon, 1969)

The viewpoints discussed highlight several issues relevant to the Stadium adaptive reuse intention:

(1) Environment: The relationship of a very large building to its environment is seen as a key concern of Gissen, which informs the reading of the Stadium that will follow.

(2) Technology: Banham's description of Megastructure in terms of two different metabolisms — the permanent, robust backbone structure versus the secondary less permanent units it supports — provides an approach that can be related to adaptive reuse and that is tested in viewing Cape Town Stadium as the permanent backbone and the intervention as secondary, less permanent and less robust.

(3) Programme: The authors point to particular uses to which very large buildings lend themselves, including universities, governance, transportation terminals, hospitals and sports facilities.

Stadium Analysis

STADIUM ANALYSIS: OPERATIONS

Methods for investigating the Stadium involved site visits, site analysis, analysis of documentation supplied by architects, photographs, attendance at events at the Stadium and interviews with Stadium management, the Green Point Cricket Club, Jakupa Architects and Urban Designers, and Munnik Visser Architects.

The Stadium currently hosts a variety of activities that range in scale from those that utilise its conference facilities, film and photo shoots in its parking area, to concerts and the two-day Rugby 7s tournament that sell out all 55 000 of its seats. The Stadium hosts football matches played by local teams Cape Town City and Ajax Cape Town. However, while large concerts tend to fill the Stadium, the venue only hosts 3-4 concerts a year; conversely, football matches are more regular (1 to 5 matches a month during the Premier Soccer League): these have an attendance from 5000 to 30 000. This means that apart from 6 days of the year, the Stadium is significantly underutilised in terms of seating (Figure 14). From events attended at the Stadium this year, the first tier was observed to be the most valuable for the matches that the stadium does host, while the upper two tiers were vacant (Figure 15). Cape Town Stadium's pitch, therefore, is seen as the most valuable component in the events it currently hosts, whether to an audience of 5 000 or one of 55 000. It is also valued as the events it hosts bring in audiences from all walks of life, across regions of South Africa and the world to Green Point.

Large events themselves at the Stadium take place during evenings and weekends, leaving opportunity for weekday activity at the Stadium during non-event times. This opportunity has been recognised by Stadium operators recently, who are looking into the possibility of converting some space on the premises to rentable offices.

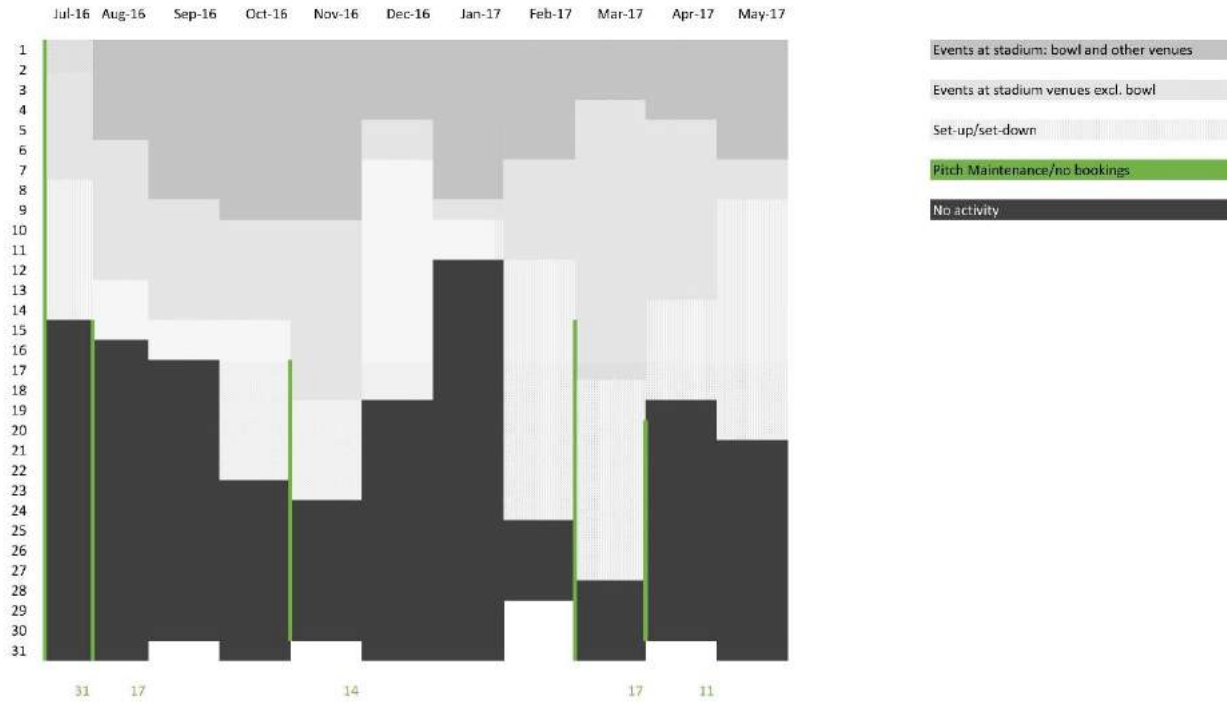
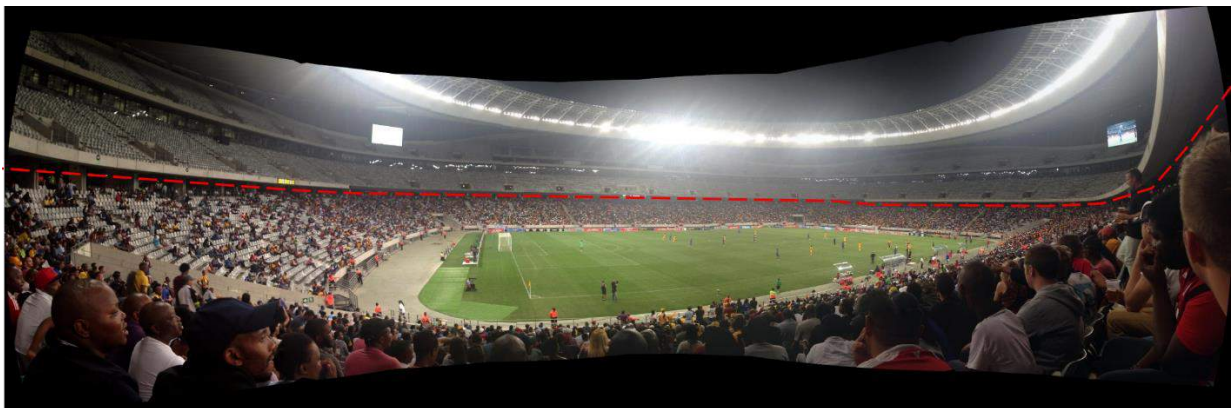


Figure 14 Activity at the Stadium over a year, revealing underutilisation of the stadium bowl



Spectator Capacity

General Seating	50 593	Disabled and buddy	256
Lower tier	23 020	VIP Hospitality seating	7 716
Middle tier	15 594	Business Lounge	1 000
Upper tier	11 723	Suites	1 357
		Networking lounges	1 227

Figure 15 Photograph from match attended on 25 April 2017, showing the vacancy of the upper two tiers

STADIUM ANALYSIS: ORGANISATION AND MATERIAL

Cape Town Stadium is organised as a tapering bowl rested on a 2-storey concrete plinth, measuring 305 metres at its widest and 365 metres at its longest, towering to a height of 55 metres above the ground (see Figure 16).

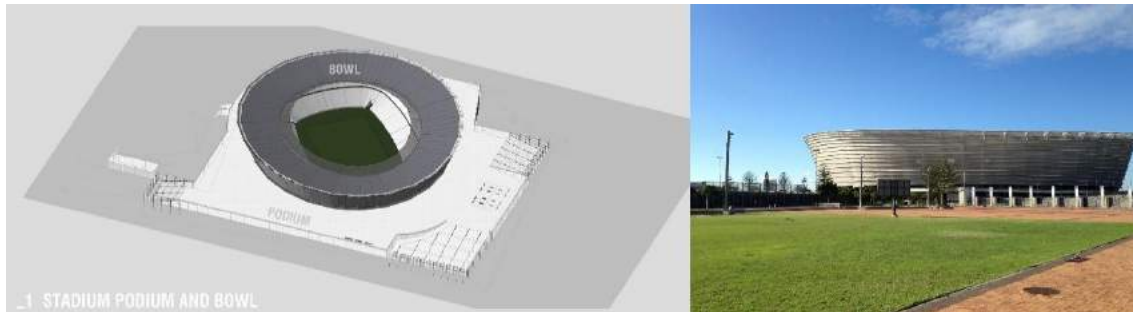


Figure 16 The Stadium is organised as a large bowl on a plinth

Diagrams 0-6: adapted from Sketchup model created by Google Geo Models on the SketchUp Warehouse online

The construction is thoroughly reinforced concrete for the Stadium structure. Seventy-two 3000x800mm tapered reinforced concrete columns radiate as the perimeter of the Stadium bowl's structure (Figure 17), accompanied by a second order of 600x100mm columns providing support to precast concrete seating and floor slabs within (Figure 18).

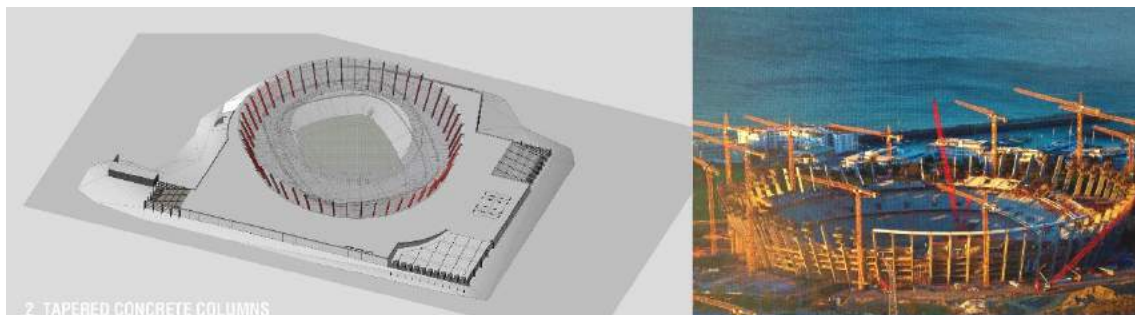


Figure 17 Tapered concrete columns radiate around the Stadium bowl

Photograph: (Nicol & February, 2010)

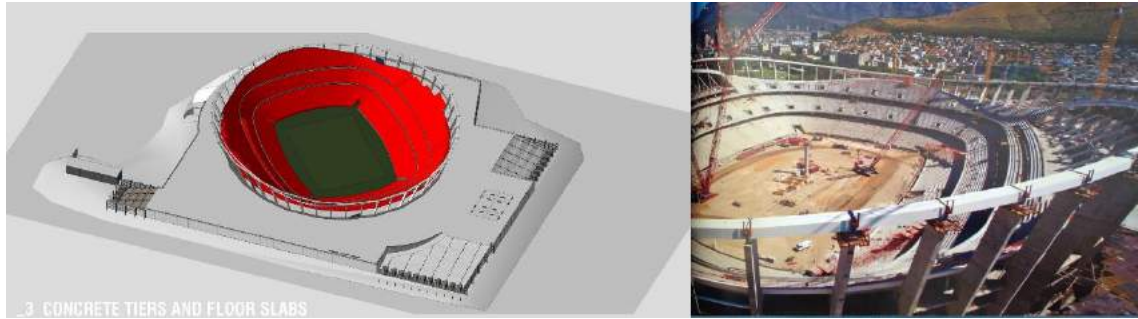


Figure 18 The Stadium has 3 concrete seating tiers

Photograph: (Nicol & February, 2010)

Brick and glass infill complete the enclosure while a fabric façade on a steel substructure wraps around the entire exterior of the Stadium bowl (Figure 19). The Stadium’s fabric screen is a silver pigmented “translucent fabric mesh, made from woven fibreglass coated with Teflon” (Glancey, 2010). According to its manufacturer, the fabric has a solar transmission of 34% — a reduction in the amount of light and heat that would be therefore be transferred to the Stadium interior.

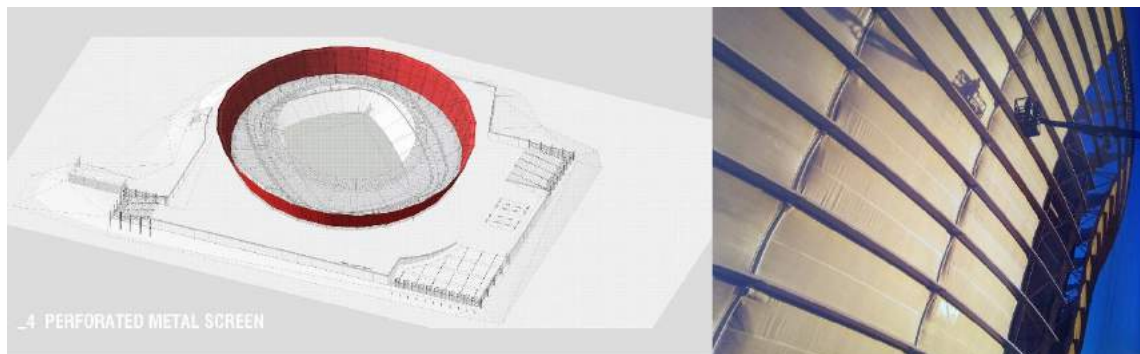


Figure 19 A PTFE fabric skin wraps around the Stadium bowl

Photograph: (Nicol & February, 2010)

A compression ring rests on the tapering perimeter columns and is tied to a second tension ring of steel cable that hovers over the edges of the Stadium pitch (Figure 20). Finally, the Stadium is partially roofed by a grid of glass panels that rests on steel trusses between the two rings (Figure 21).

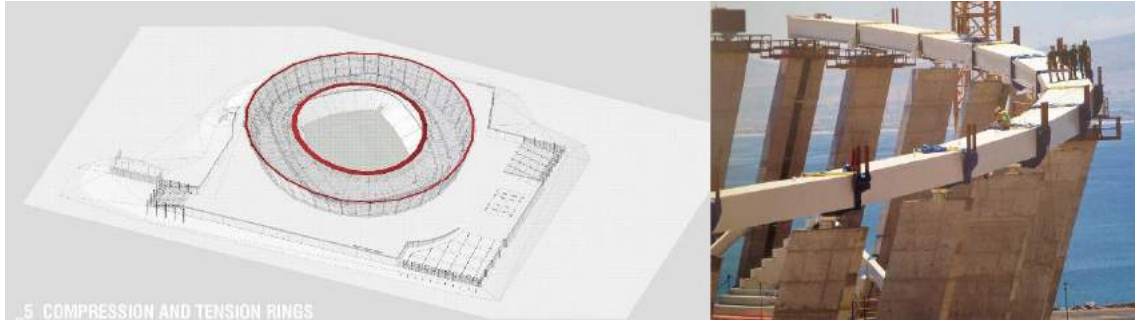


Figure 20 An inner steel cable tension ring and outer steel compression ring (photographed) support the Stadium's glass roof

Photograph: (Nicol & February, 2010)

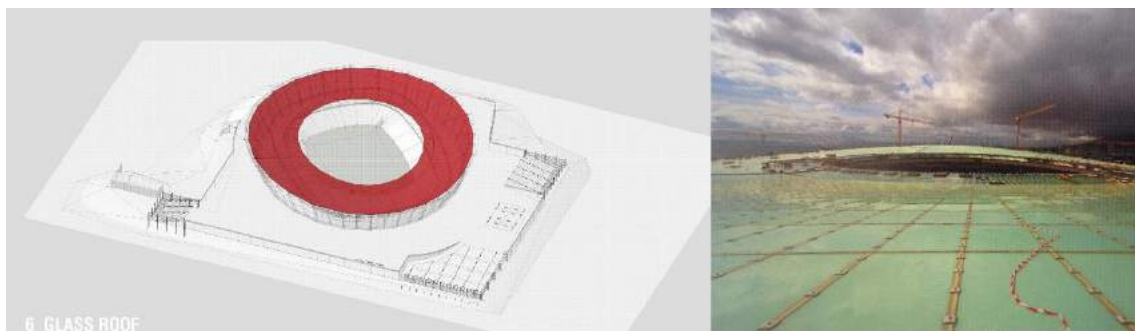


Figure 21 A glass roof partially covers the Stadium

Diagrams 0-6: adapted from Sketchup model created by Google Geo Models on the SketchUp Warehouse online
 Photograph: (Nicol & February, 2010)

The Stadium has seven floors (Figure 22) which read as closed, complete elliptical forms. Floor to ceiling heights range between 2.8 and 8.5 metres, and up to almost 15 metres on topmost levels. The base of the Stadium is deep and broad, with an internal floor area of approximately 42 200m² at ground level. The floor areas of the bowl are much shallower by comparison, reducing to less than 10 000m² (shown on Figure 23).

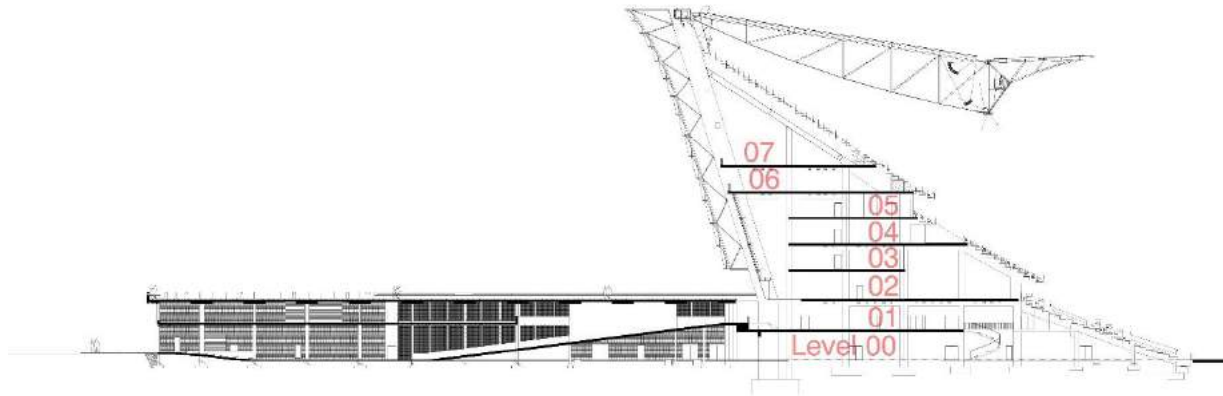


Figure 22 Section showing the organisation of Cape Town Stadium into seven floors underneath the seating tiers and podium

Adapted from drawing supplied by Jakupa Architects and Urban Designers



Figure 23 Approximate floor areas: Levels 0 to 6. Level 7 is largely third tier seating

Finally, the Stadium's large, concrete structure is valuable for its dramatic architectural expressiveness (Figure 24), robustness and – combined with the other material of the Stadium – for its high embodied energy, calculated to be at least enough to meet the energy requirements of 600 homes for 15 years (see Appendix B.2).



Figure 24 The Stadium has a robust concrete structural expression as seen in this image from the Level 2 concourse under the middle tier of seating

(The Guardian, 2010)

SPATIAL AND ENVIRONMENTAL QUALITIES

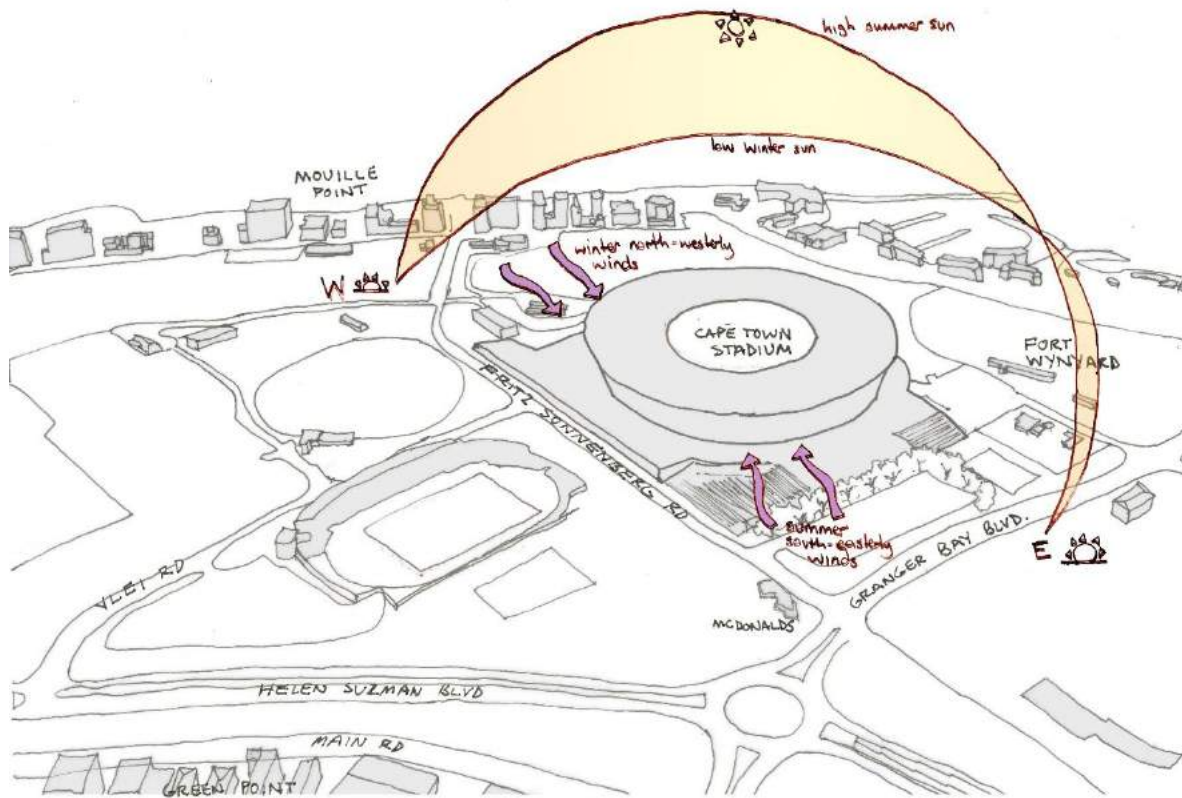


Figure 25 Predominant solar and wind activity at the Stadium

Further analysis of the Stadium is conducted in light of Gissen's assertion that large buildings have a tendency to be artificially insulated from their environmental contexts, which should not be the case (Gissen, 2003). It is of interest therefore to understand the environmental and spatial attributes of the existing Stadium. A sample of three of the stadium's floors were studied in-depth: Level 0 (deep floor plate); Level 4 (shallow floor plate open to one side) and Level 5 (shallow floor plate open to two sides), representing the three prevailing conditions of the Stadium. These were conducted in terms of spatial qualities, light and ventilation. Following this, the visual, wind and acoustic relationships of the Stadium were assessed. Findings are discussed in the dissertation while detailed studies are found in Appendix B.3-5.

The lowest levels (0 and 1) are where team areas and parking are located. These floors have vast amounts of parking space as a deep, tall, dark and continuous bare concrete volume interspersed with columns (Figure 26) that partially interfaces Fritz Sonnenberg through galvanised steel grating fences. These spaces are to a great extent in deep shadow, with limited direct sunlight on northern edges, and are suitable for very limited natural ventilation.



Figure 26 Photograph showing the deep space of the north-west parking area along Fritz Sonnenberg road

Internal spaces above the podium level are much shallower and have more extensive lighting from openings on their edges than lower levels. Level 4 represents a second condition, with openings on one side admitting natural light and the possibility of widespread natural ventilation. In the case of office spaces, however, fitted desks obscure the floor-to-ceiling glazing of the periphery (Figure 27). Passages and services are located on the obstructed pitch-side portions of the floor, which cannot be naturally ventilated. Portions of the deep floor plate on the east require mechanical ventilation.



Figure 27 Photograph of an empty office on Level 4 with openings on one side and a passage to the right

Level 5 has openings to both the external periphery and the pitch, allowing for natural lighting from two sides and widespread cross-ventilation, aside from floor area on the east that requires mechanical ventilation.



Figure 28 Photograph showing the lounges on Level 5

(City of Cape Town, 2017)

VISUAL, WIND AND ACOUSTIC RELATIONSHIPS

Cape Town Stadium has strong visual relationships throughout. All areas accessible to the public have views to the pitch (Figure 29) while there are extensive views out to the Stadium's surroundings (see Appendix B.1), mediated by the Stadium's translucent fabric façade (Figure 30).



Figure 29 View of pitch from top of lowest tier during a match



Figure 30 Daytime view over Fort Wynyard through the Stadium screen from Level 6



Figure 31 Daytime view of the Stadium showing the facade as opaque



Figure 32 Night-time view of Stadium from outside — showing interior visible through the screen

(Mike Hutchings/Reuters, n.d.)

Interviews with Stadium staff revealed that the Stadium's fabric membrane appears to do little to insulate sound from the Stadium out, and from outside the Stadium in. They reported that while there are virtually no areas of complete sound isolation when the Stadium's full audio systems are in use, on occasions when audio emanates from one side of the Stadium, the concrete seating on the corresponding opposite side is effective at dampening the noise. The fabric and the Stadium's glass roof and concrete bowl shelter spectators and players from the wind.

SUMMARY OF ANALYSIS AND ADAPTIVE REUSE VALUE

Cape Town Stadium is evidently underutilised. However, the pitch and lower seating tier remain valuable as they are suited to demand for football and local events in Cape Town. The upper seating tiers and corresponding internal spaces are not as well-utilised. The predominance of night and weekend events at the Stadium opens the opportunity for weekday activities. The upper tiers are therefore regarded as the best opportunity for an adaptive reuse exploration.

Secondly, the Stadium's virtues as a structure of high embodied energy, iconic and dramatic architecture with remarkable views, usable internal space and robust concrete structure motivate for its adaptive reuse. The proportions of the floor plates of internal spaces are to a good extent suited to the human scale and to natural light and ventilation, while variation in volumes creates interest and drama. The east region of the Stadium, however, features deep floor plates that do not have satisfactory natural ventilation opportunity and would make daylighting challenging. Meanwhile, the Stadium's closed and cohesive elliptical form, and large areas of underutilised accommodation lend themselves to occupation by a large programme.

PROGRAMME

The Stadium's participation in the FIFA World Cup and thereby the sporting history of the Common are especially pertinent. In recent times, the Stadium's striking concrete architecture has invited use for exhibitions, film shoots and music performances in spaces such as its parking areas and conference facilities. Meanwhile, the Stadium hosts large spectacles including sports and music performances in its bowl.

The Stadium is in close proximity to a range of activities including education, sports, residence, heritage, commerce and a hospital. In particular, education strikes resonance as a primarily weekday activity and as there is a cluster of disparate educational communities in the Stadium's vicinity (Figure 33), including the University of Cape Town's Graduate School of Business — adapted from what was formerly the Breakwater Prison; and the Watershed's Business Incubator — formerly an electrical repair workshop. The Stadium's dramatic forms first brought to mind the possibility of introducing an arts campus which, coupled with a sports education department inspires an arrangement where the campus can be the means of nurturing skills, knowledge and talent that are showcased in spectacle to the public at the Stadium. Thus, the proposed education programme is refined principally towards providing a university satellite campus for departments in performing and visual arts, and sports education.



Figure 33 Nearby academic and cultural interests

Image by author with background map sourced:
(Google Maps, 2017)

UNIVERSITIES: GLOBAL AND LOCAL

One of the most recognised traditional university campus conventions organises the institution in enclosed quadrangles, such as the University of Oxford, which pioneered the layout in its Merton College, recalling monastic seclusion and protecting students within from the neighbouring townsfolk (Coulson, et al, 2011).

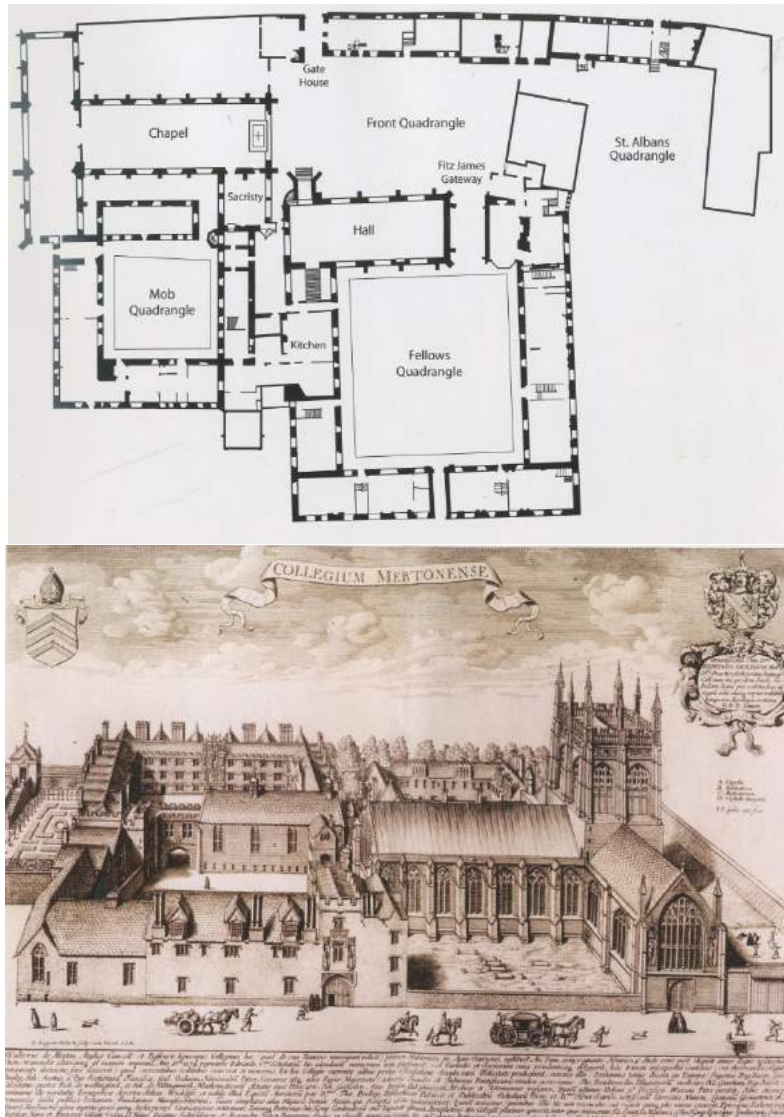


Figure 34 Merton College at the University of Oxford is laid out as an enclosed quadrangle, a common practice of older universities

(Coulson, et al, 2011)

Over time, several campus development forms have emerged, such as the hierarchical and axial campuses employed by Christopher Wren; the picturesque, natural retreats of 19th Century American institutions and their counterparts — the complex, integrated urban campuses that propagated the terms ‘City of Learning’ and ‘Collegiate City’ (Coulson, et al, 2011).

In later times, the integration of academic activities has been pursued in forms of campus that consolidate these into a series of tightly connected buildings or a singular, all-encompassing structure. Examples of the former include the University of Virginia, organised as ten linked pavilions organised around a central recreational area and designed by Thomas Jefferson as an ‘academic village’, and Foster + Partners’ University of Technology Petronas campus, which follows a similar organisational strategy (Coulson, et al., 2011). An example of the latter is the Mode Gakuen ‘Cocoon’ tower designed by Tange Associates, which houses three different teaching departments all internally within a 50-storey tower (Figure 39 and Figure 40).

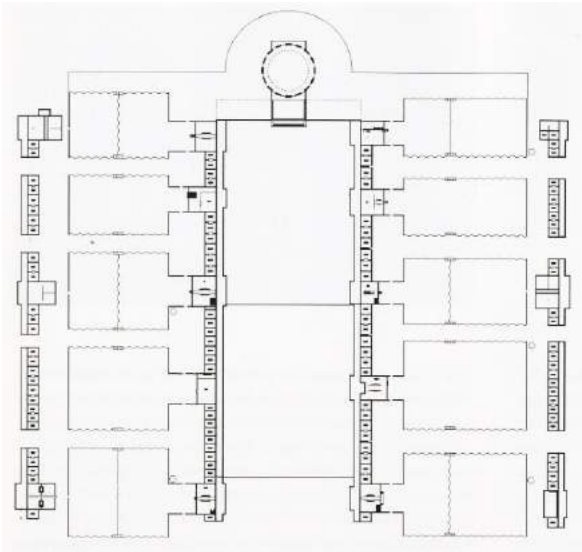


Figure 35 Plan of the University of Virginia campus by Jefferson: a series of closely linked department buildings surrounding an outdoor recreational space



Figure 36 The central recreational courtyard at the University of Virginia

(Coulson, et al., 2011)

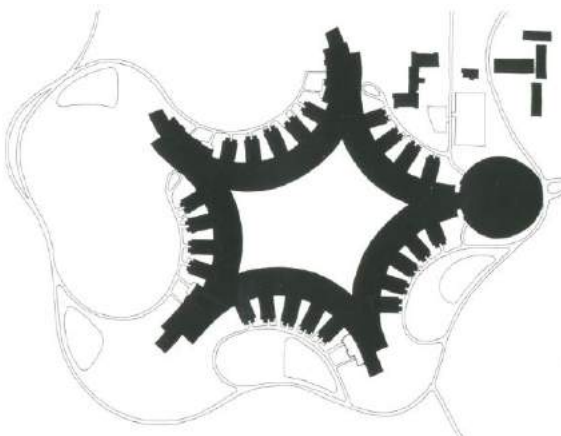


Figure 37 At the University of Technology Petronas campus, a large roof ties together several different buildings around a central green space



Figure 38 Aerial view of the University of Technology Petronas, revealing its central green space

(Coulson, et al., 2011)



Figure 39 The Mode Gakuen 'Cocoon' tower contains multiple educational institutions within a single 50-storey building

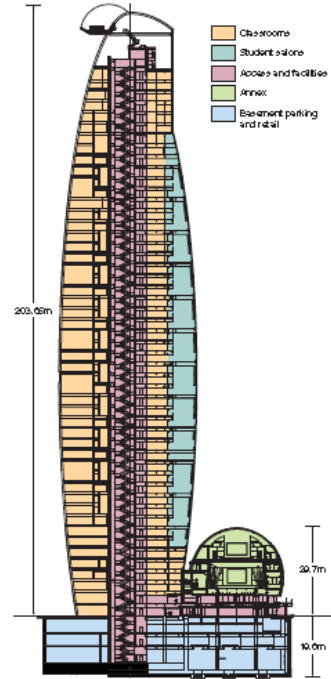


Figure 40 Section through the Mode Gakuen Tower showing its organisation

(The Arup Journal, 2009)

By accommodating 10 000 students in a single tower, the Mode Gakuen building confronts the challenge of providing adequate relief space for students. The tower responds by providing a shared lounge to every three stories (Figure 41 and Figure 42), expressed on its façade.

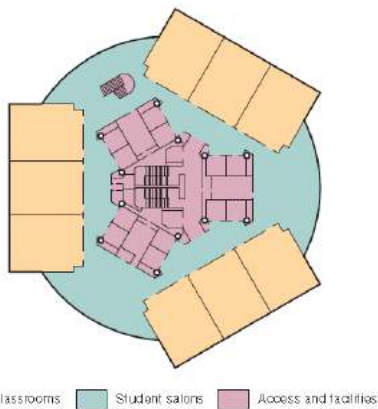


Figure 41 Typical floor plate in the Mode Gakuen Tower, showing how relief spaces (blue) are provided



Figure 42 Triple volume lounges provide relief space and vertical connectivity in the Mode Gakuen Tower

(The Arup Journal, 2009)
(World Architecture News, 2011)

Another notable precedent is the Faculty of Fine Arts campus at the University of La Laguna. The building organises teaching space along a partly covered walkway and uses a play between concrete and translucent walls, as well as volumes to create the series of rooms that come off the main circulation spine.



Figure 43 Courtyard view of the Faculty of Fine Arts, University of La Laguna

(ArchDaily, 2016)



Figure 44 The qualities of teaching space at the Faculty of Fine Arts, University of La Laguna are dramatic double volumes of textured concrete and translucent walls

(ArchDaily, 2016)



Figure 45 A second view into a classroom at the Faculty of Fine Arts University of La Laguna

(ArchDaily, 2016)

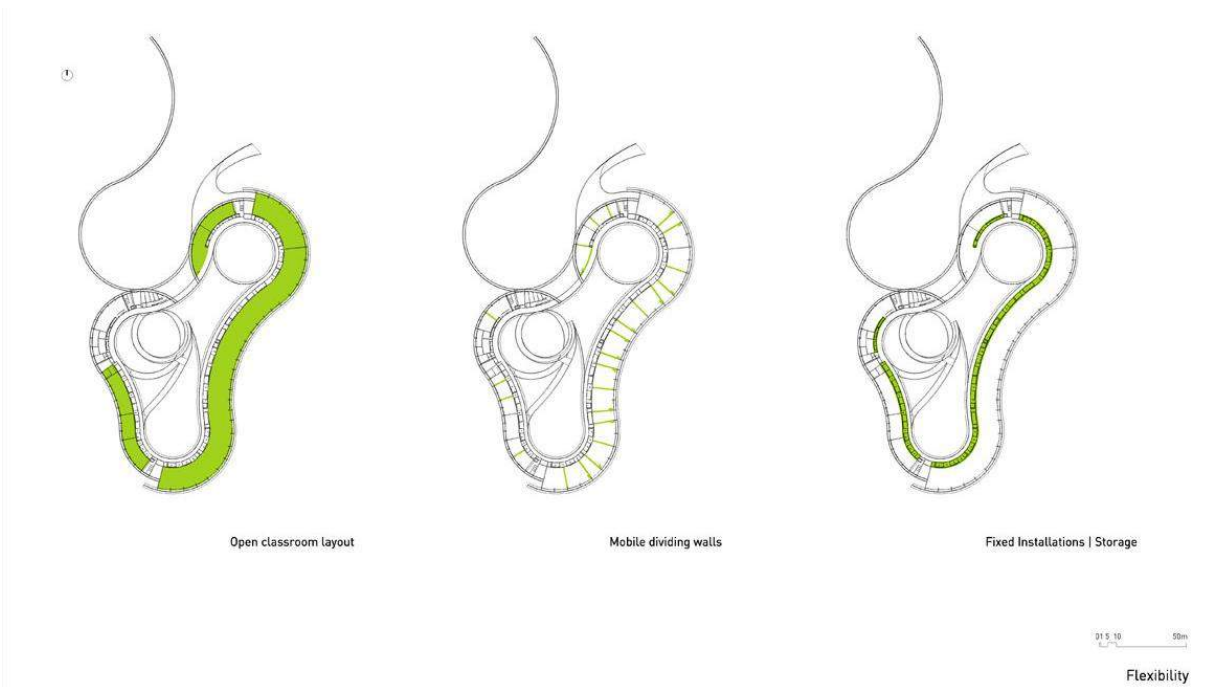


Figure 46 Diagrams showing the classroom layout, division and storage areas of the Faculty of Fine Arts, University of La Laguna

(Open Buildings, n.d.)

Within South Africa, there are presently 23 public universities: 11 traditional universities; 6 universities of technology and 6 comprehensive universities. Public universities typically have the largest enrolments, offering various Bachelors degrees and postgraduate qualifications. Universities of technology offer vocationally oriented diplomas and a Bachelor of Technology degree, while comprehensive universities provide a combination of both (Department: Higher Education and Training, Republic of South Africa, 2012).

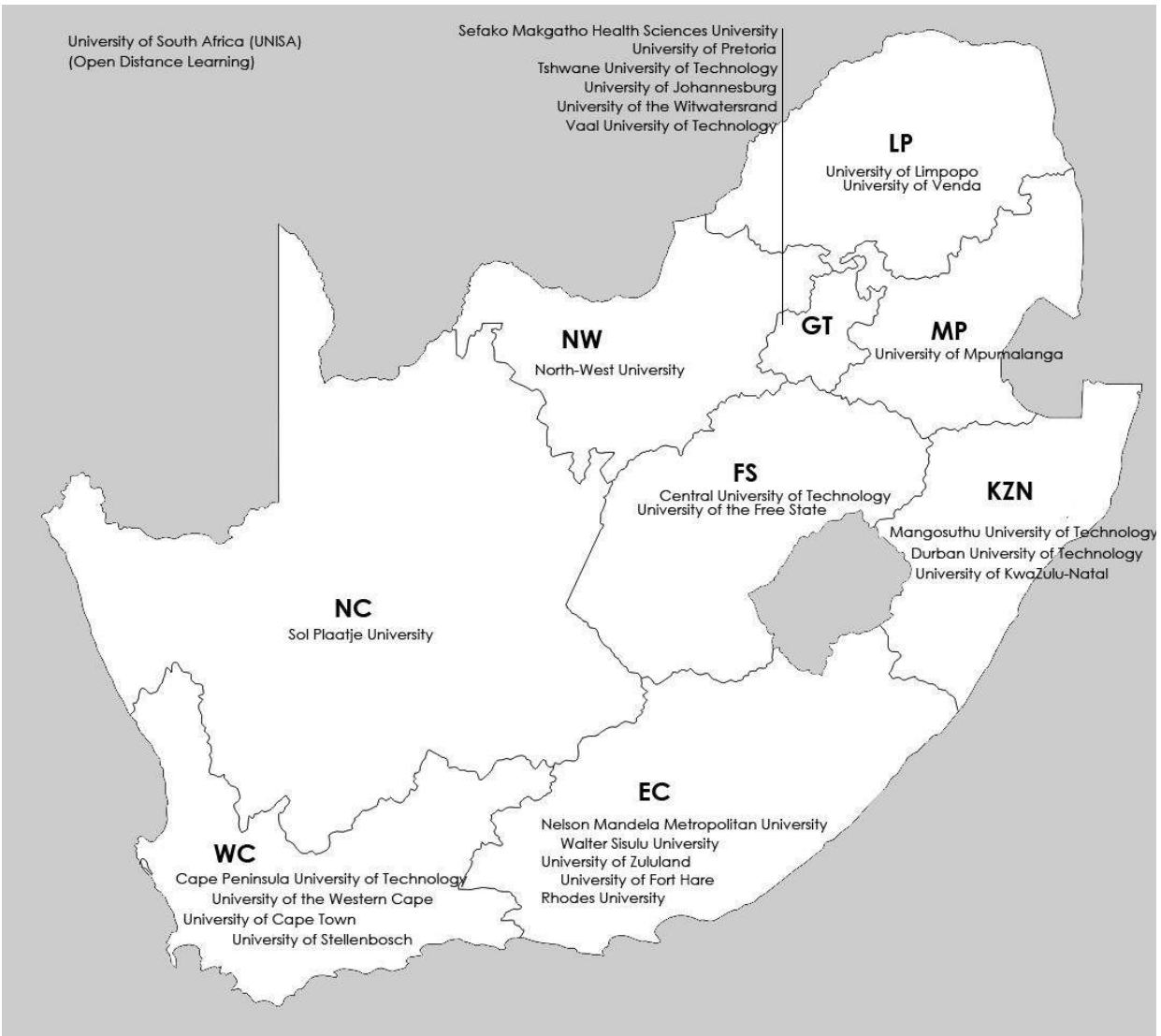


Figure 47 South African universities by province

Poster by author with map sourced from: (La Historia con Mapa, 2015)

Since 2012, it has been the ambition of the South African government to increase university enrolment at universities by 600 000 students by the year 2030, amounting to a total enrolment of 1,5 million students in that year and increasing the participation rate among 18-24 year olds from 16% in 2011 to 23% in 2030 (MacGregor, 2012; Department: Higher Education and Training, Republic of South Africa, 2012).

Expansion of South African universities has taken place previously, characterised by a spreading of campuses across multiple sites. In the case of the University of Johannesburg (UJ), for example, this took the form of the amalgamation of several institutions on different sites into one institution. Universities such as the University of Cape Town (UCT) and Cape Peninsula University of Technology (CPUT) however, have expanded through the acquisition of sites caused by space constraints or as they seek a presence in areas of interest. The most recent examples are the UCT Graduate School of Business's launch of campuses in Philippi, built on the site of a former cement factory; and another as far as Sandton, Johannesburg in 2017 (Swingler, 2017; University of Cape Town News, 2017).

STADIUM TYPOLOGY AND ADAPTATION

The term 'stadium' has its beginnings in ancient Greek sport, where the 'stade' was the venue for running events, originally the only sport of the ancient Olympic Games. The 'stade' was a rectangular track bordered by shallow sloping ground on its long edges, and the venue participated in ancient Greek religious and civic life. Later, the Roman Empire built ever more elaborate 'arenas', used for gladiatorial entertainment. Since then, stadia have continued to grow to cater to larger events with more spectators, made possible by advances in technology.



Figure 48 The Greek Epidauros stadion typifies the early 'stade'

(Department of Archaeology, Boston University, n.d.)

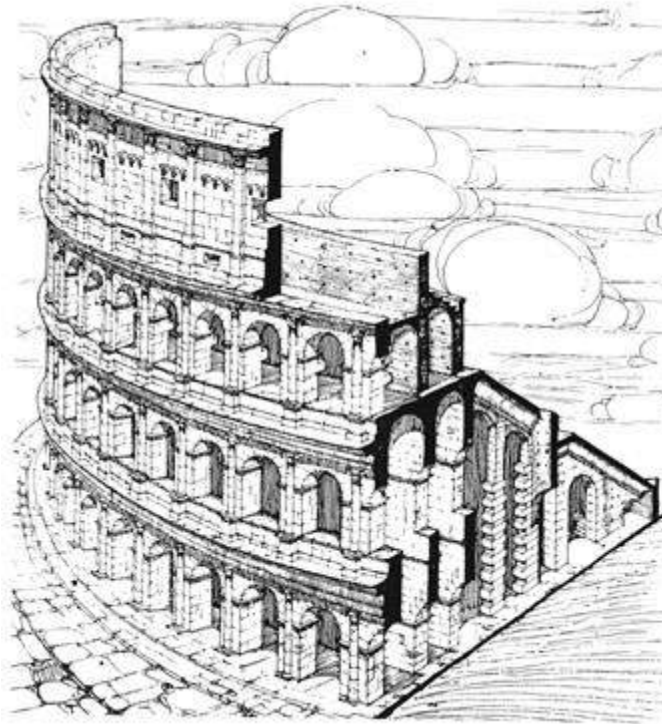


Figure 49 The popularity of events and technology permitted ever more grand arenas, such as the Roman Colosseum

(McGill University, 2005)

The adaptation of stadia also has a long history, going as far back as the Roman Colosseum, which was periodically partially adapted by flooding its floor for mock naval battles (Mueller, 2011). As University of Tokyo Professor Koichi Kato contends, from the 4th to 5th centuries adaptation was employed by European communities towards stadia, which were merged into city walls as fortresses (Kato, 2017). The Arles amphitheatre, for example, was originally a site of battle and bullfighting entertainment but was eventually transformed into a fortified town following the fall of the Roman empire (Figure 51).



Figure 50 Roman stadium incorporated into a city wall

(Kato, 2017)



Figure 51 The Arles Amphitheatre in France was after the 5th Century fortified into a sheltered town

(Academic, n.d.)

In recent times, adaptation of stadia has taken many forms, from simply repurposing the pitch to a different sport to introducing a radically different activity to the stadium. In the UK, Highbury Stadium, former home venue to Arsenal football club, was in 2009 converted to 650 apartments.



Figure 52 Highbury Stadium before adaptation



Figure 53 Highbury Stadium adapted into apartments

(BBC Sport, 2006)
(Lule-Hurtado, n.d.)

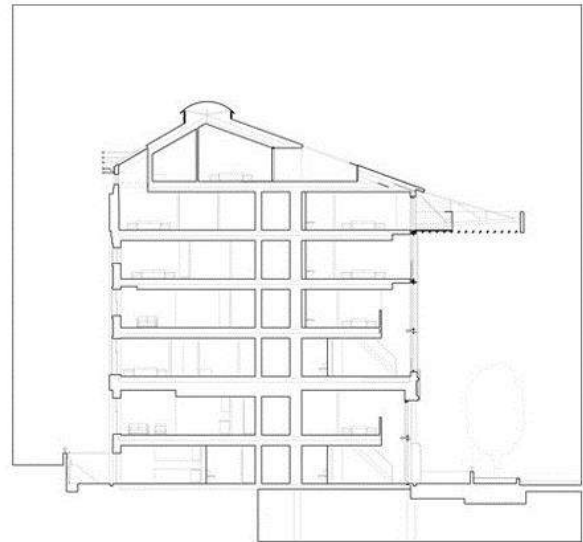
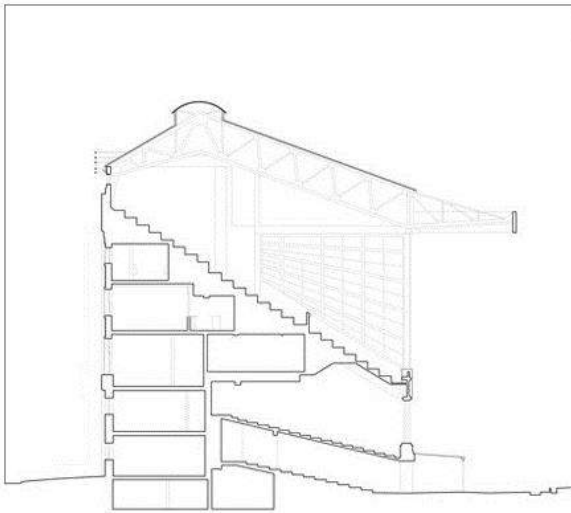


Figure 54 Former section through Highbury Stadium (left) and the adapted section (right)

(Allies and Morrison, n.d.)

In another instance, while Rio de Janeiro's Handball Arena incorporated the intention of dismantling to become schools (Figure 55), artists provoked an impression of Rio's stadia appropriated by housing (Figure 56).

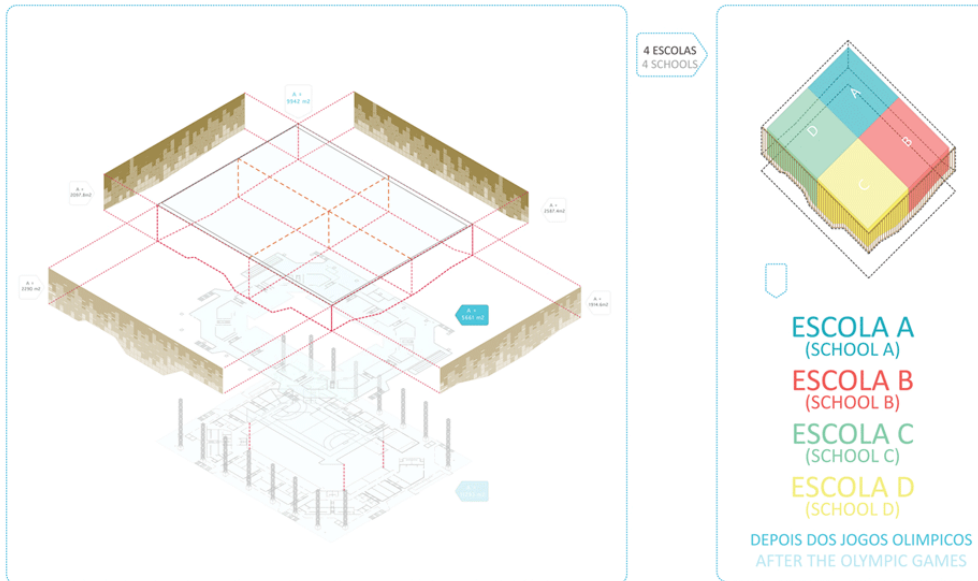


Figure 55 The Olympic Handball Arena in Rio is designed for disassembly into 4 schools

(Mark, 2016)



Figure 56 'Casa Futebol' is a series of imaginings of Rio stadia appropriated as housing

(1 Week 1 Project, 2014)

Finally, the Wits Science Stadium at the University of the Witwatersrand in Johannesburg converted a set of grandstands into science laboratories and lecture venues for students of the University. The structure of the existing grandstands was preserved and internalised, creating a range of interesting spaces within. Adjustments that were made to suit the new programme included detailed environmental studies and the introduction of shallower raking in its lecture venues.



Figure 57 The Wits Science Stadium adapts grandstands into science teaching venues and laboratories

(Savage + Dodd Architects, n.d.)

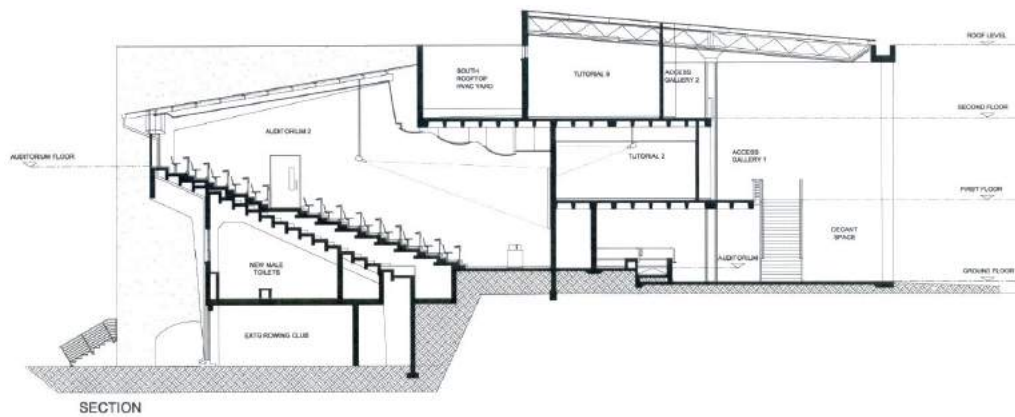


Figure 58 Section through the Wits Science Stadium, revealing the addition of internalised spaces and lecture seating at a shallower rake

(Savage + Dodd Architects, n.d.)



Figure 59 Learning space at the Wits Science Stadium interacts with the former grandstand's volumes and concrete forms

(Savage + Dodd Architects, n.d.)

Design Proposal

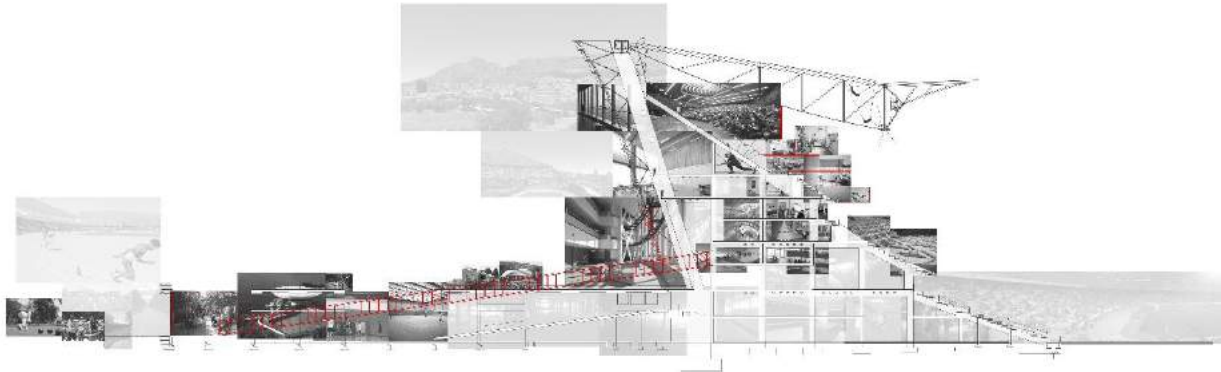


Figure 60 Conceptual collage showing the existing section and preserved activities of Cape Town Stadium as light grey, and the proposed intervention as darker photographs and the accompanying architectural strategies in red

METHODS AND LIMITATIONS

Methods involved analysis of context and the Stadium as has already been recorded. From site analysis, theory and technical investigations, speculative design responses were carried out for the Stadium in models, posters and collages. Precedent studies are used to inform several of the design decisions.

Given the size of the study and limited time, the design strategy is developed to different degrees at various scales, as a narrowing of scale corresponds with an increasing level of detail. Firstly, an attitude towards the Stadium's interaction with urban conditions is determined. The urban proposal is focused on the Stadium's perceived duty to the Common and the public realm. A set of programmatic and organisational strategies responds to the Stadium as a whole in diagrammatic form only. Following this, a region of the Stadium has been selected as a sample area in which to test an environmental and Metabolist architectural intervention.

URBAN PROPOSAL

As observed, the Common is characterised by isolated and cordoned off activities that contradict its mandate as a public service, and a desolate and deprived street and pedestrian life. The Stadium has participated in this by denying public access and presenting a harsh impenetrable edge to the street. Firstly, it is proposed that the Stadium nourish its public edges to include retail, dining and unenclosed activities such as a multisport court. On the Stadium's western edge, courtyards facilitate these new activities and break the edge's linearity with sheltered spaces.

The proposed campus at the Stadium aids in placing the building in public service. The campus is organised with spaces of public dialogue and showcase close to the public ground below and spaces of production above. Two new public stairways — on the west and south edges of the Stadium — grant the public permanent access to the podium and invite them into previously inaccessible internal areas (Figure 61 and Figure 62). While it is acknowledged that learning spaces even at a public institution privilege learners over the general public, a library on Level 5 and a 'high street' with food courts and leisure space on Level 6 are intended as public amenities through the building.

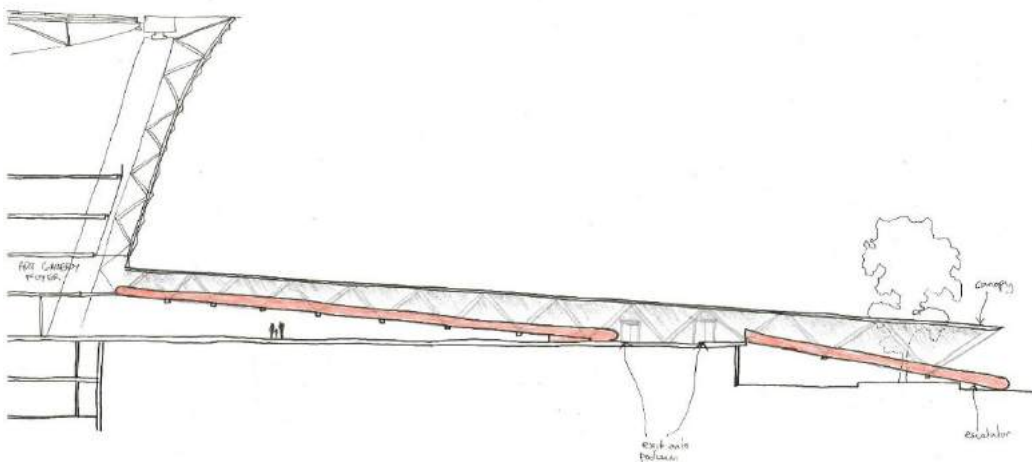


Figure 61 Section through new east public stairway that lands on the podium and new Art Gallery

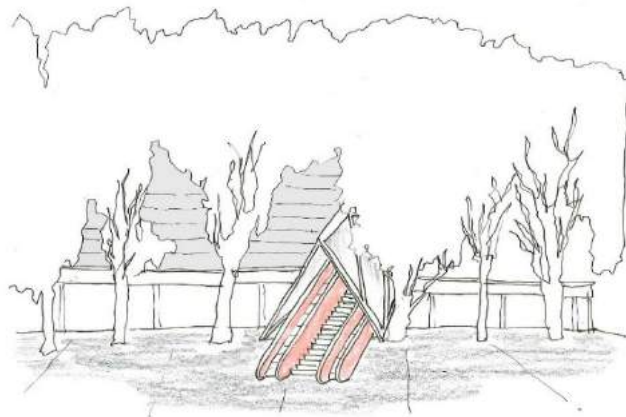


Figure 62 A new east stairway invites the public to the Stadium

The Stadium's perceived isolation is responded to in providing programmatic relationships with its surroundings: the predominance of sporting activity to the west of the Stadium corresponds with the centring of the sports education department towards it, while the arts department corresponds with the academic and cultural venues south-east of the Stadium. Student accommodation is located on the Stadium's north with vantage over the Atlantic Ocean. A culinary school is the confluence of catering to students above, stadium hospitality and art gallery that complete the major elements of the programme.



Figure 63 Programme organisation: student living and a culinary school establish contextual relationships to the north, a Sports Education department to the west and an Arts department to the east

Image by author with background map sourced: (Google Maps, 2017)

STADIUM OVERALL STRATEGIES

The design employs the Stadium's cohesive form in preserving a continuous circuit around the Stadium, from which events take place (Figure 64). The qualities of various floors are appropriated to complement new activities. The proposal includes many shared spaces, particularly among academic areas, that link activities of each floor so that, for example, administrative areas are all located on one floor, while learning spaces are similarly shared on another. To orient and coordinate each programme and strengthen contextual relationships, each has an atrium that links its activities vertically down to its own segment of Level 3's 'floating' platforms (shown on Figure 65).

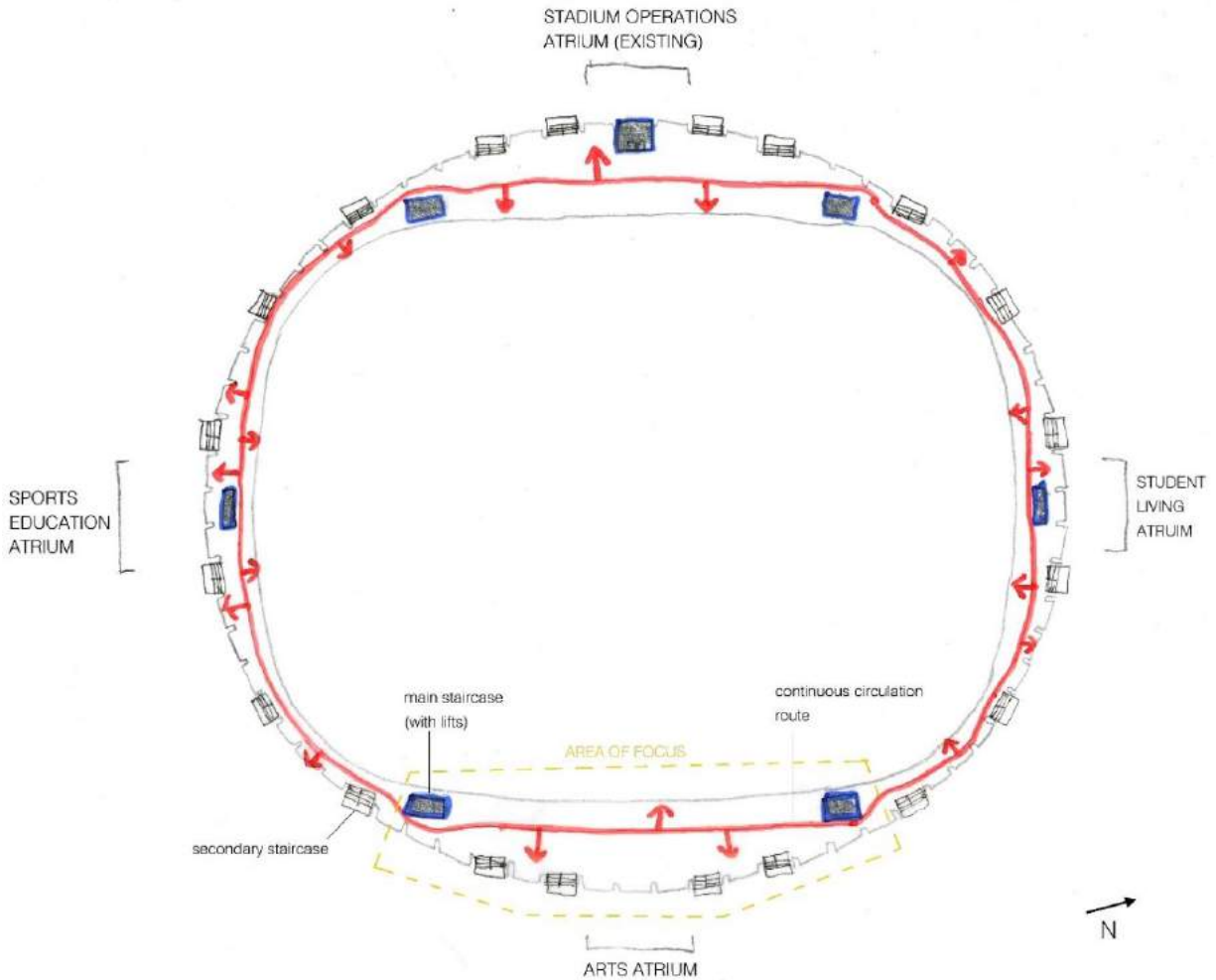


Figure 64 Concept plan showing how the Stadium's closed form is interpreted as a continuous route off which activity takes place

The activities of Level 3 continue and overlap on Level 4: the character of Levels 3 and 4 in the proposal are of public display — interfaces for knowledge showcase and sharing between the public and the campus. For instance, a route directly from the new public staircases brings the public to a Sports Museum and a new Art Gallery, where on the same admission a visitor might begin at one and proceed to engage and exit the other (Figure 66). Meanwhile, guests of the Stadium's events hospitality would as part of their invitation be shown the Sports Museum. The culinary school wing of the Stadium would likewise interact with the others on Level 4 in catering for them and vertically, for resident students. Such is the nature of the overlaps and interrelationships the proposal encourages.

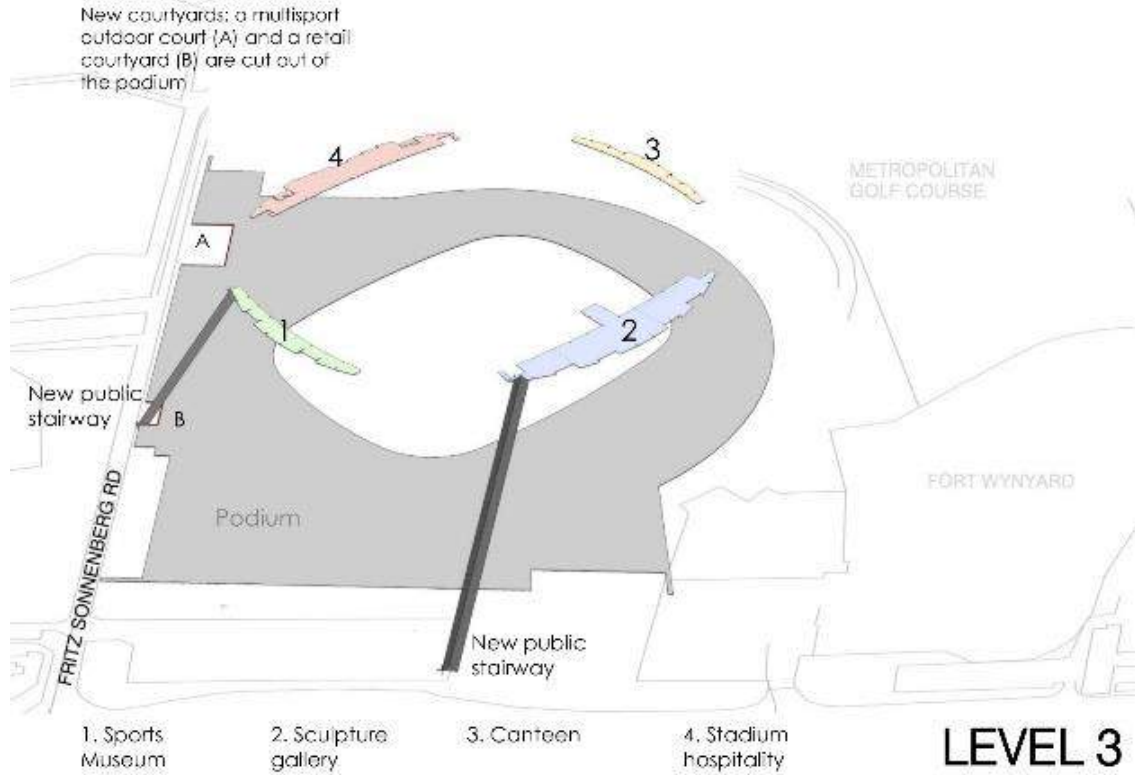


Figure 65 Level 3 layout

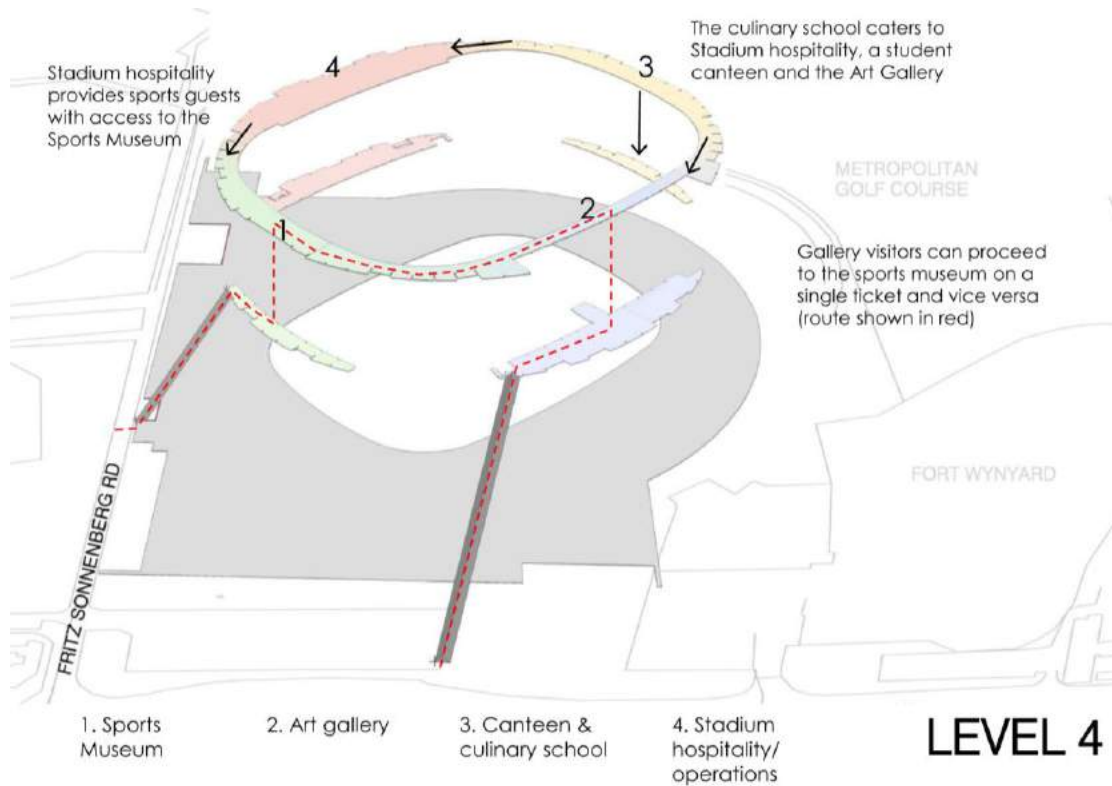


Figure 66 Level 4 layout

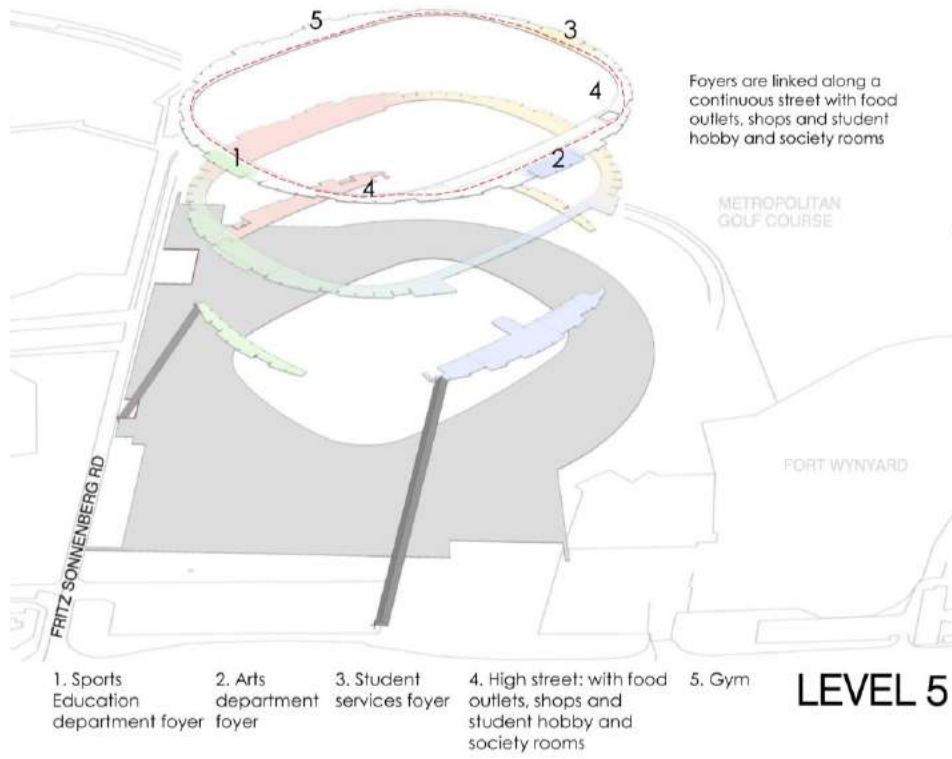


Figure 67 Level 5 layout

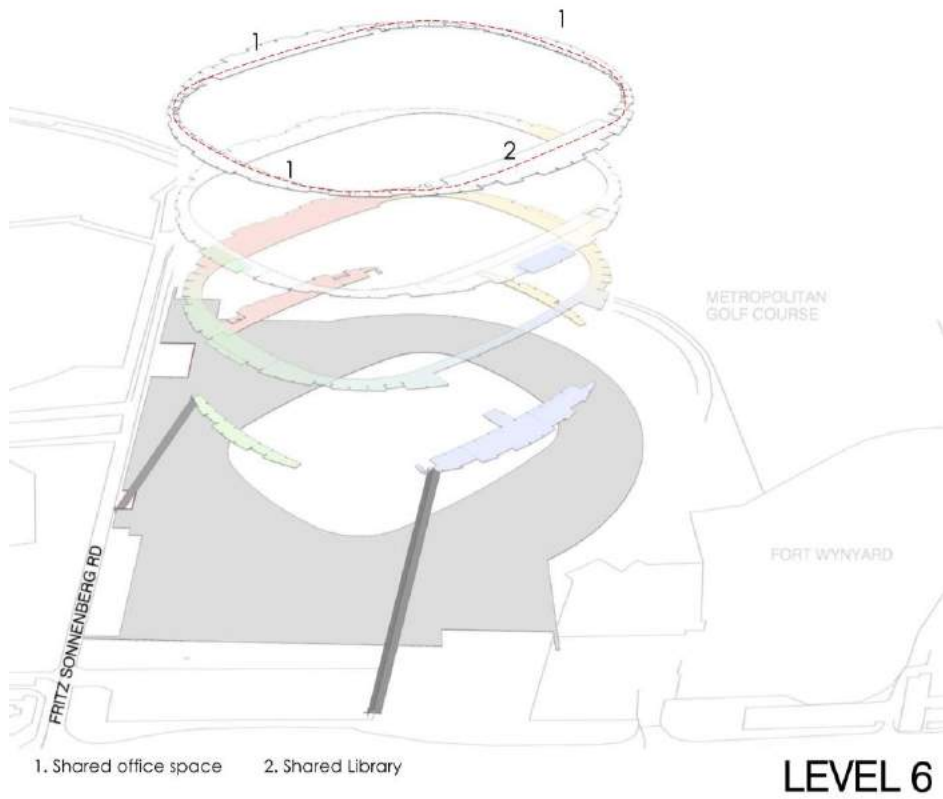


Figure 68 Level 6 layout

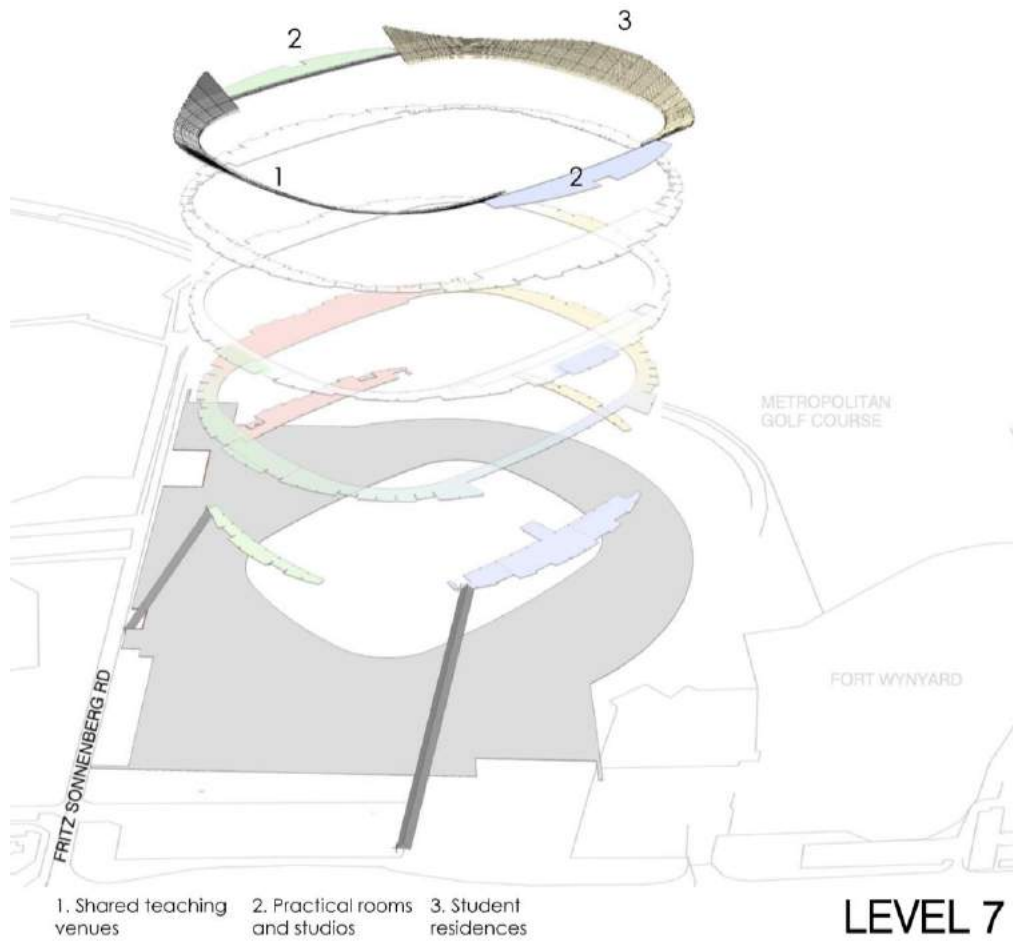


Figure 69 Level 7 layout

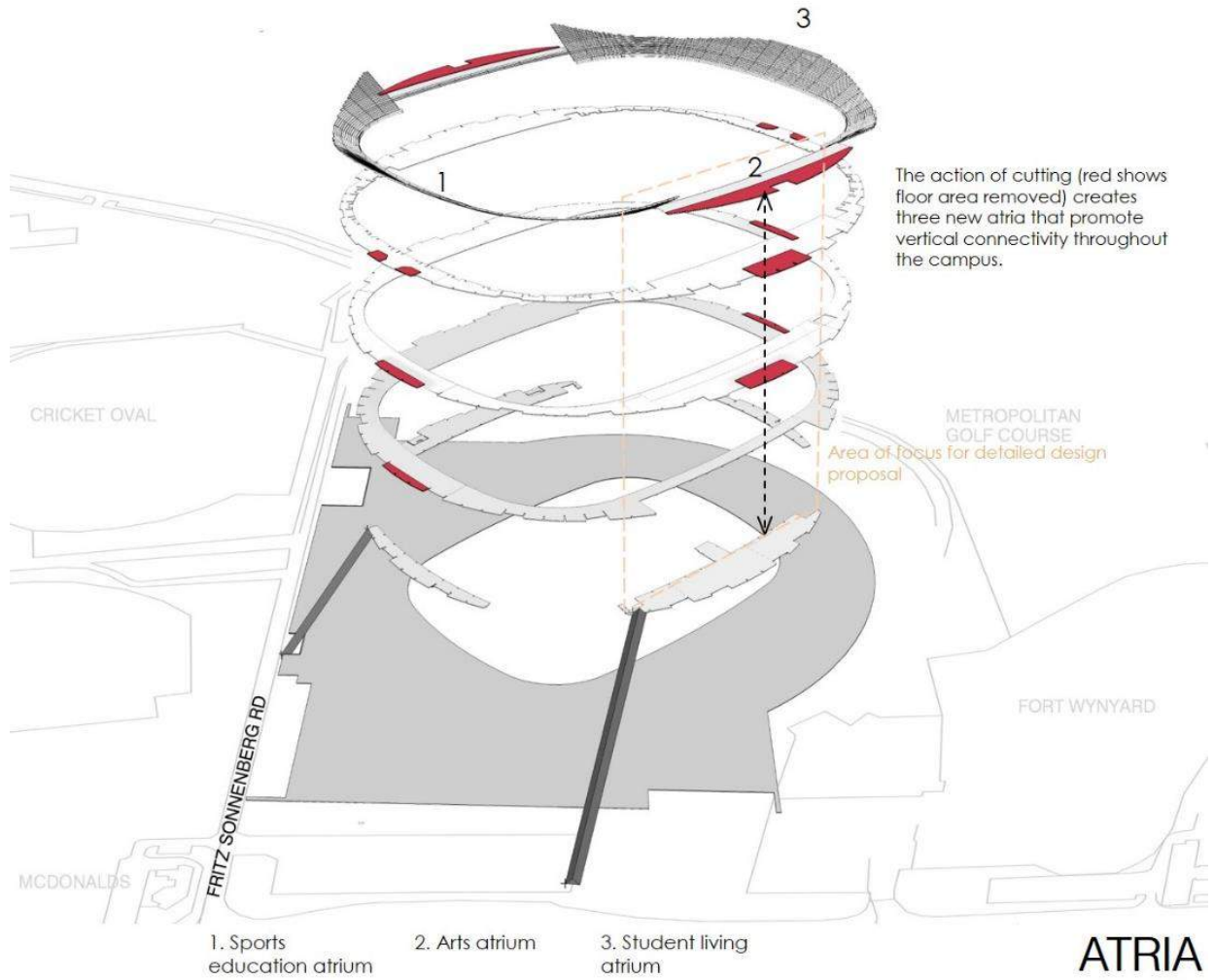


Figure 70 New atria introduced

DETAILED INTERVENTION

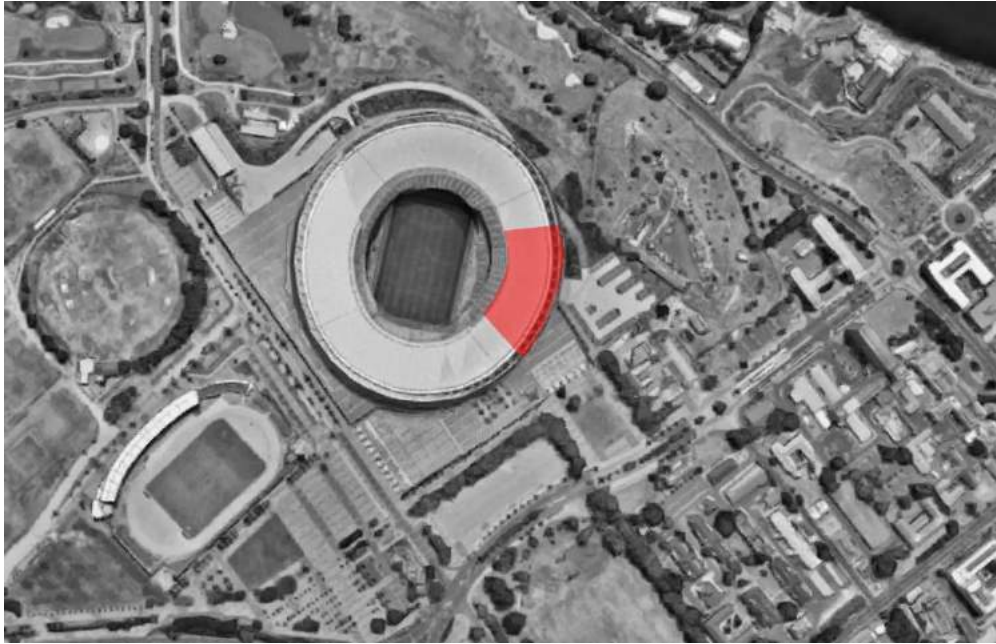


Figure 71 Area of focus (highlighted)

Adapted from: (Google Maps, 2017)

Further enquiry in this dissertation limits its scope to the Arts atrium, which is used as a sample area in which to investigate an environmental and Metabolist approach to adaptive reuse in the stadium megastructure. The selected region is of interest for several reasons:

- Of the spaces above the podium, this region has deep floor plates that are difficult to naturally light and ventilate
- This area has an interesting set of volumes and segregated spatial relationships that can be strengthened
- It is a point of contact for the public from the ground floor through the internal space of the Stadium
- The area is exemplary of the qualities of the Stadium that are appreciated, including its dramatic concrete forms that can be related to the proposed Arts programme.

Other observations of this area are that a character emerges in relationships of seeing and being seen and that the region gains east light to its outer side and west light to its inner, with exposure to the summer south-easterly wind.

Programmatically, a sculpture gallery on level 3 receives the public from the new grand stairway that begins at ground level, continuing to mounted artworks on level 4. Level 5 is a food court and relief space while level 6 serves primarily as an administrative level. Level 7 accommodates teaching and production space that in this region are arts studios and practical rooms.



Figure 72 Sectional model exploring organisation and adaptive reuse strategies in a section adjacent to the area of focus

The strategies used in this proposal are described as follows.

1. Cutting

The creation of an atrium by cutting provides interrelationships between volumes; allowing a greater volume for light and air to circulate with a corresponding reduction in the depth of floor plate that makes natural lighting and ventilation more viable. The atrium volume is left covered yet not fully enclosed, so that in conjunction with a corresponding cut of the Stadium's façade fabric, it connects people in the atrium to wind movement and the sound and views of surrounding activity (See comparison studies in Appendix A.2).

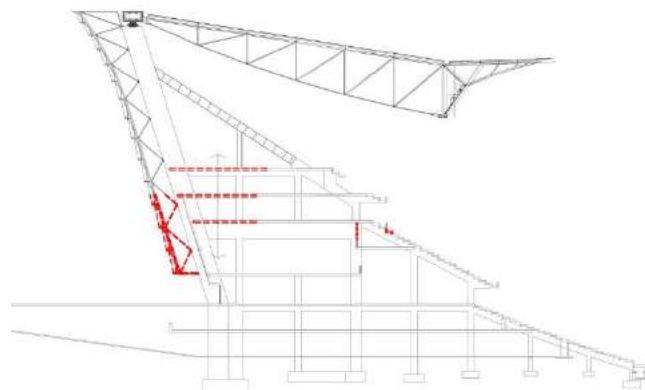


Figure 73 The action of cutting produces a new atrium that gives people greater awareness of the visual, acoustic, solar and wind environmental qualities and activity around them

Cutting the PTFE façade screen enhances the quality of seeing and being seen, connects internal and external contexts and announces the presence of the Arts department in a legible way to the exterior. Furthermore, the relationship of the occupant to the surrounding city and ocean (Figure 74) is improved with generosity and clarity.



Figure 74 Views that the atrium expands to occupants

Adapted from: (Google Earth V 7.3.0.3832, 2017)

2. Accessing

Redundant staircases are removed considering there are 10 staircases in the site. The removed staircases are instead consolidated as one decorative staircase that is placed centrally to encourage vertical circulation in the atrium. The main stair cores are extended to access Level 7 teaching spaces while a new discrete ground floor lobby provides alternative east pedestrian access.

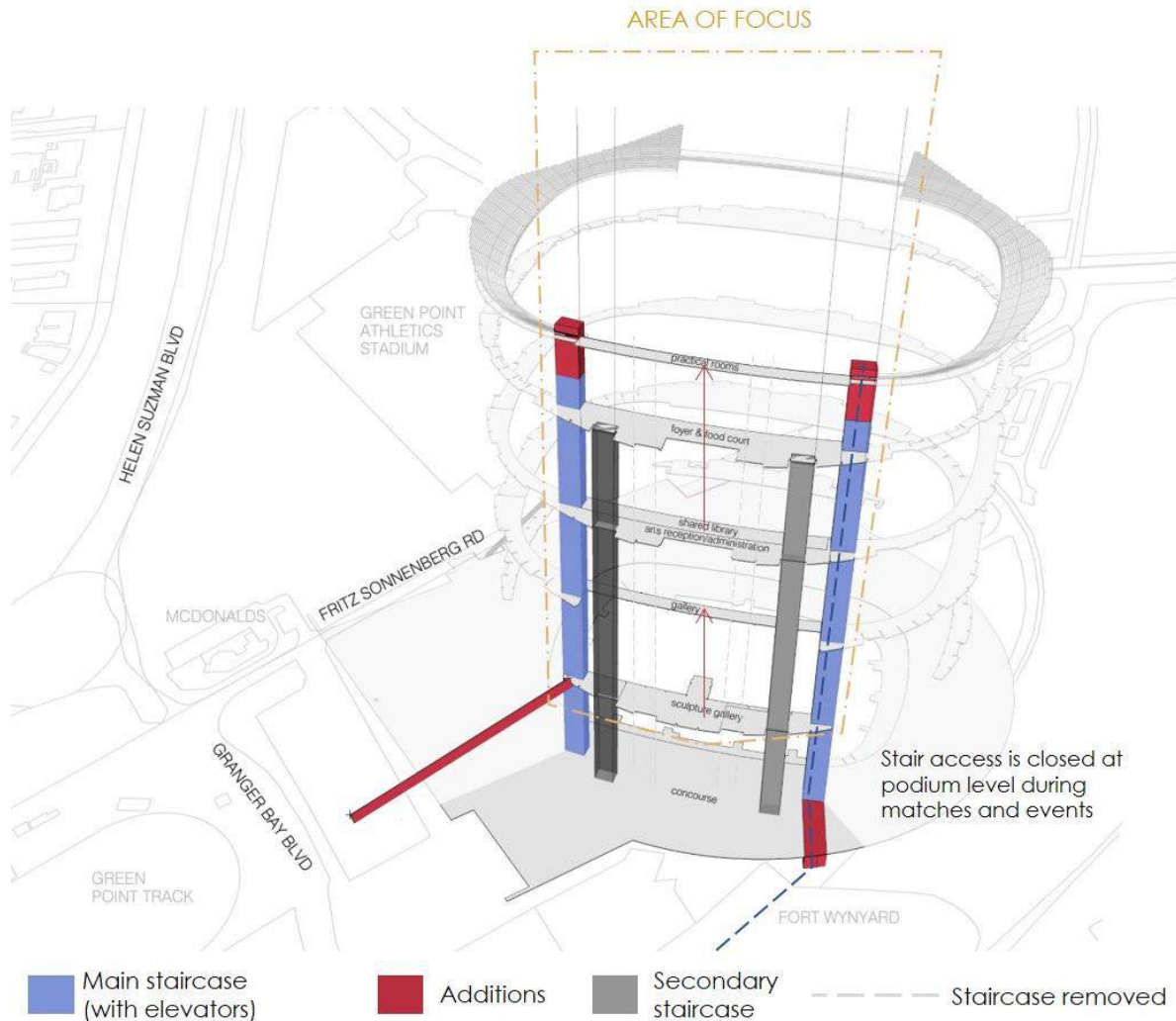


Figure 75 Circulation diagram showing removals and additions within the area of focus

3. Inside-outside relationships

The intention of making occupants aware of their environment is fulfilled in the range of inside-outside spaces, including the multi-volume atrium: where occupants sense the expanded view enabled by clear glazing and cutting the screen; the feel of the wind, activity around, scents from the cafes and eateries close by, sounds, nature and the pitch. In other instances, translucent panels and skylights make occupants aware of changes on daylight during the course of the day. Climatic requirements of specific activities in the atrium are enclosed in climatized units for work spaces.

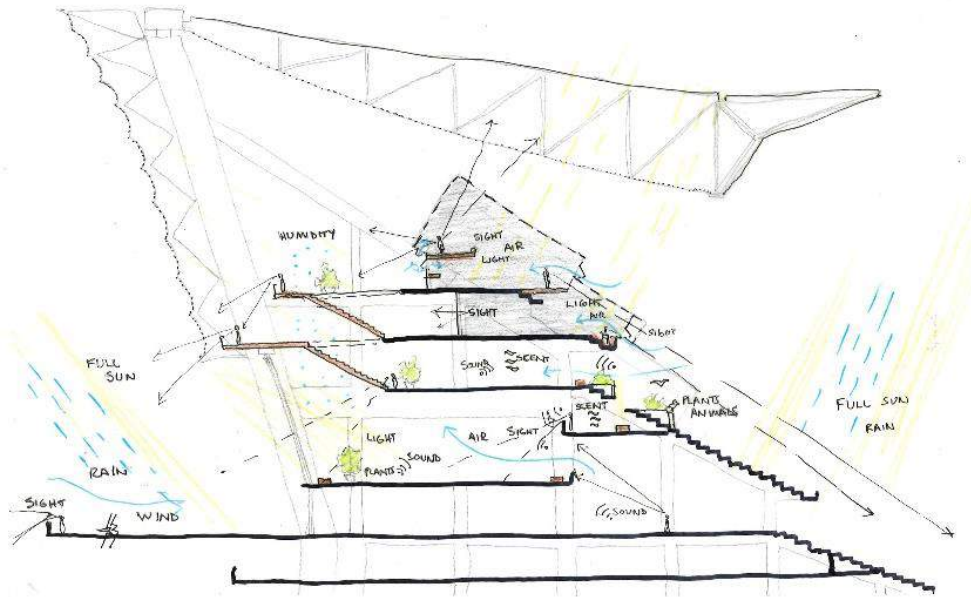


Figure 76 Sketch showing how sense and awareness of environment change with varying levels of enclosure

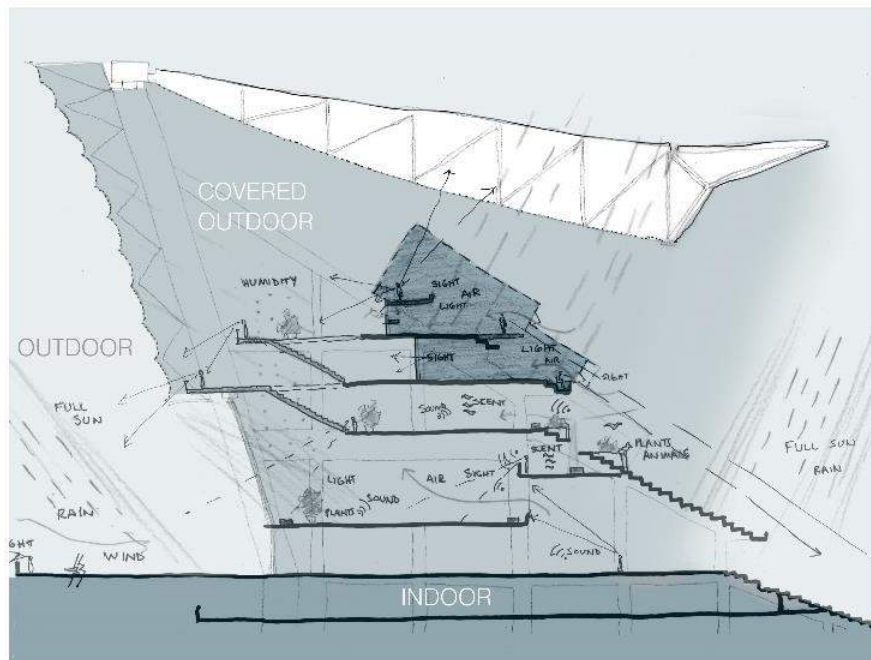


Figure 77 Indoor and outdoor relationships

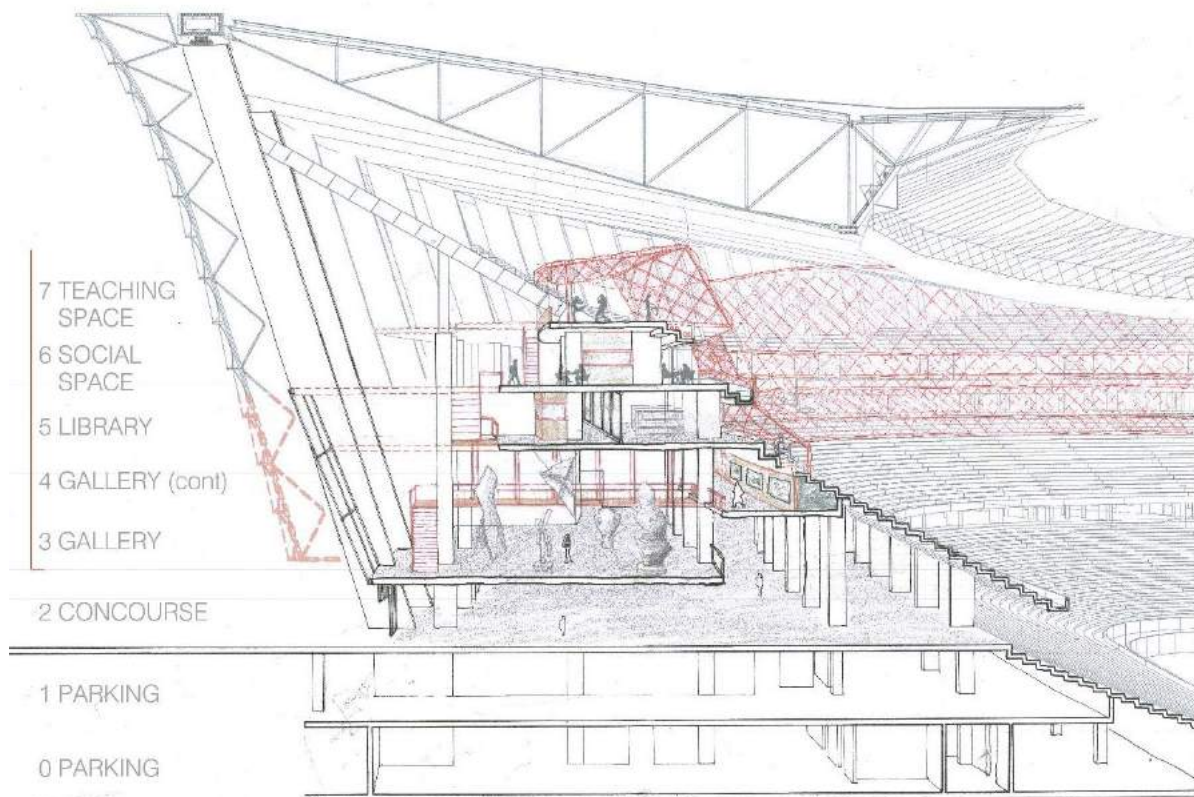


Figure 78 A sectional perspective study through Arts department foyer illustrates the cumulative effects of the adaptation strategies

The relationships of volumes complement the progression from conception to production and finally, showcase works across scales: imagining, for example, as a set designer conceptualising an artwork in the focused built-in desk space of the Studio, prototyping an element in the larger studio space- perhaps the theatre or performing arts students next door come in and try it out- exhibiting and having a discussion about it in the atrium and finally showcasing it at an event on the pitch.

5. Character and material

Metabolist megastructure is recalled at this point. The found Stadium is regarded as the robust structure onto which the intervention adds a second order of architecture that is less essential, more delicate and dependent on the permanent structure of the existing (elaborated in Figure 79). Given the large expanse of the pitch-side enclosure, and the Stadium's non-linear geometry, steel trusses at approximate 10-metre spacing negotiate the changes in geometry.

The intervention consists of prefabricated lightweight steel frames that admit polycarbonate and glass panels applied in response to environmental requirements of each space. This arrangement fulfils the aim of bringing light to the level 4 art gallery, filtering west light in the library, providing permeability on the level 5 street and finally, allowing studios to have ample lighting.

The new architecture continues to promote an awareness of environment by pulling you to the edge, opening up these edges with clear glazing and operable windows, and offering you everything you need to hold you there in built in elements as desk space, seating and deep handrails, all expressed in timber as a poetic representation of a heightened moment of closeness with the outside environment. Accompanying are staircases that push inhabitants out towards the edge before returning.

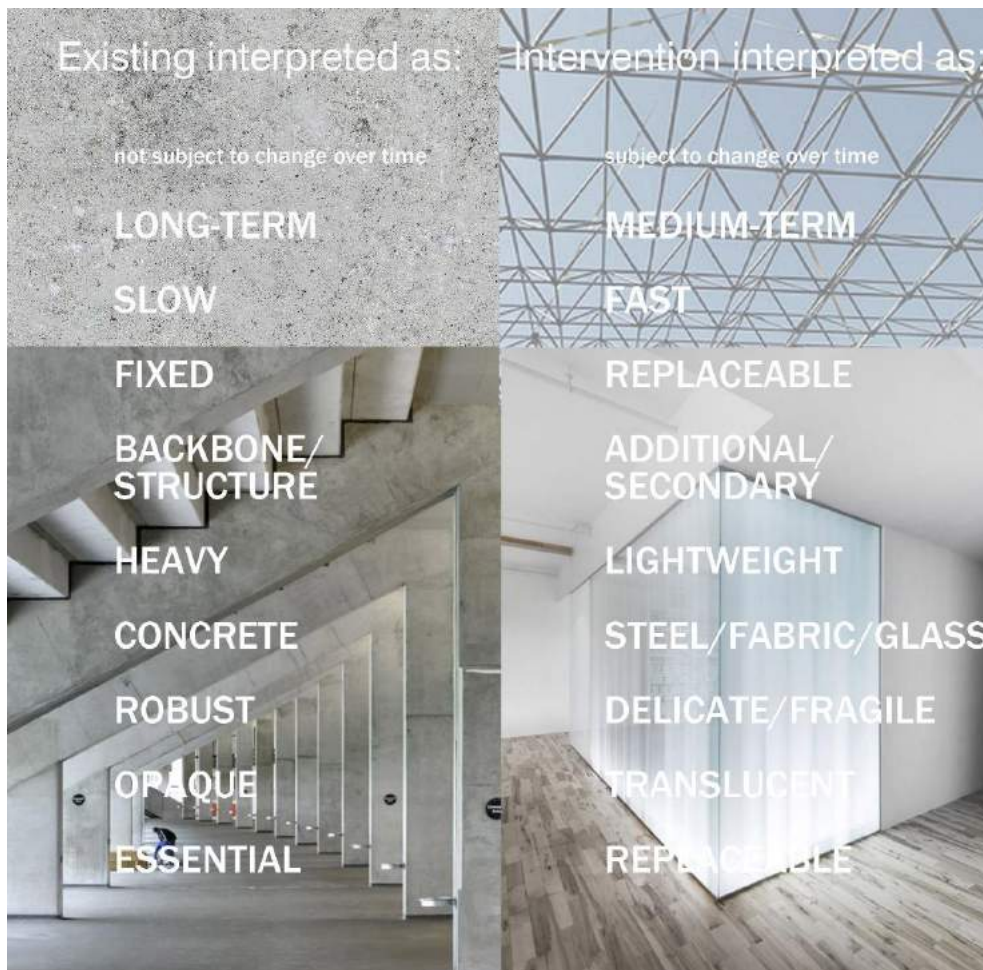


Figure 79 Metabolist megastructure theory interpreted as an adaptive reuse response

Poster by author with sourced imagery:
 (Textures.com, n.d.) (The Guardian, 2010)
 (Jain, 2016) (Liebal, 2017)

Conclusion

The design research explorations of this dissertation demonstrate that adaptive reuse can be utilised as an architectural strategy in the case of Cape Town Stadium. With an appreciation of precedent studies in a history of stadium adaptation, the dissertation provides support to the view that adaptive reuse can be regarded as an option worth exploring towards stadia that are underutilised following mega-events.

Understanding the existing Cape Town Stadium as a very large building that consequently faces particular characteristics and challenges to adaptation prompts a response that takes special consideration of this. An approach that values environmental engagement between occupants of very large buildings and their holistic environment is demonstrated as a useful means of analysing and intervening in Cape Town Stadium. Additionally, an adaptive reuse interpretation of Metabolist megastructure theory has proven an effective means to interpret and value the Stadium as megastructure and confidently inform the adaptive reuse response.

Within the context of the Green Point Common that alienates and denies the public access at many levels, the proposed appropriation of Cape Town Stadium as a campus realigns the Stadium to acknowledge its public role. The design proposal increases connectivity between the campus and its environment, while the campus provides the prospect of changing the legacy of the Stadium from one of underutilisation and public financial burden to one of nurturing self-sustaining talent and to public service, recreation, engagement and education.

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Appendices

APPENDIX A: DESIGN PROPOSAL

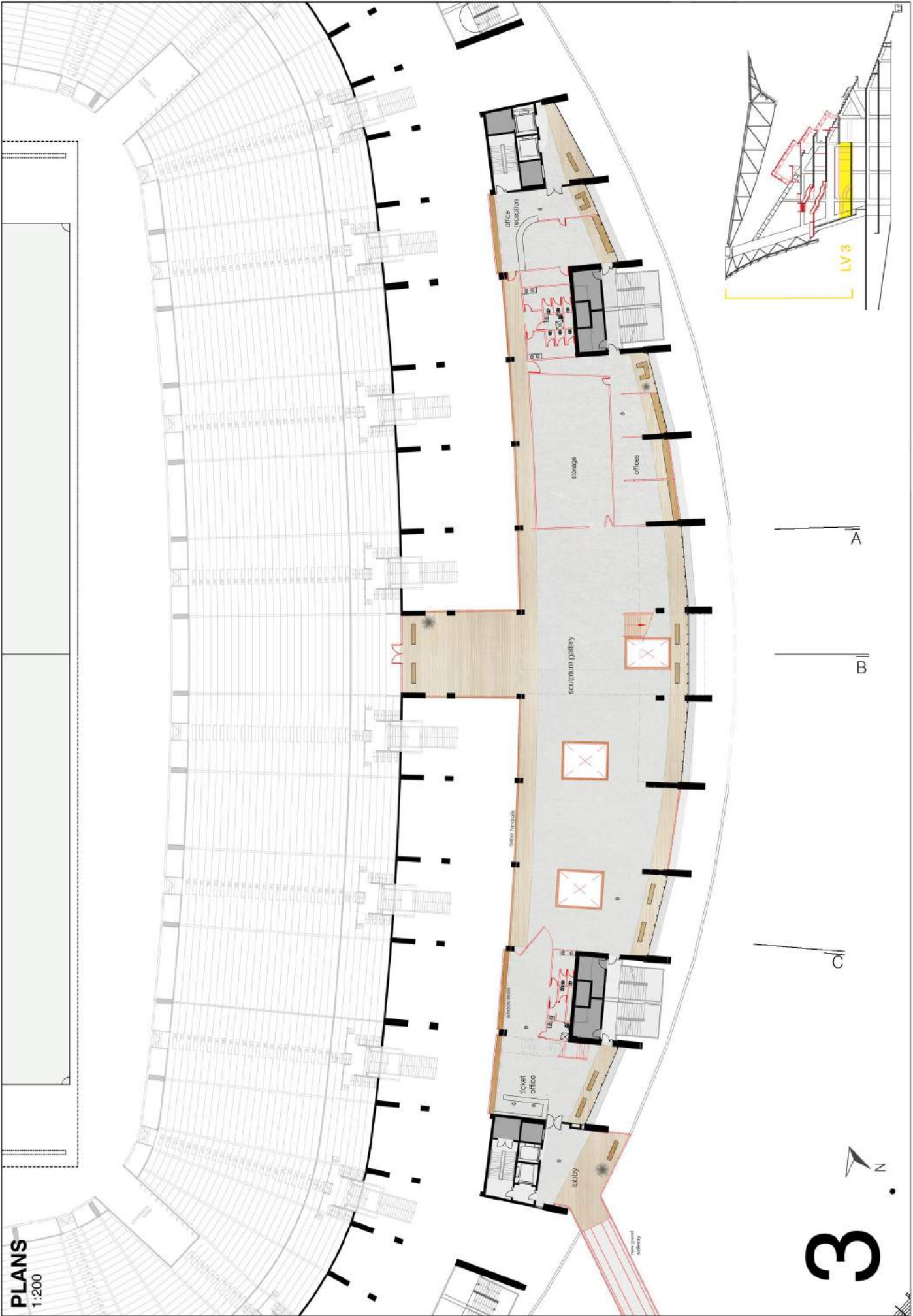
APPENDIX B: EXISTING BUILDING DOCUMENTATION

Appendix A: Design Proposal

1. FINAL DRAWINGS

2. SELECTED DESIGN STUDIES

PLANS
1:200



3

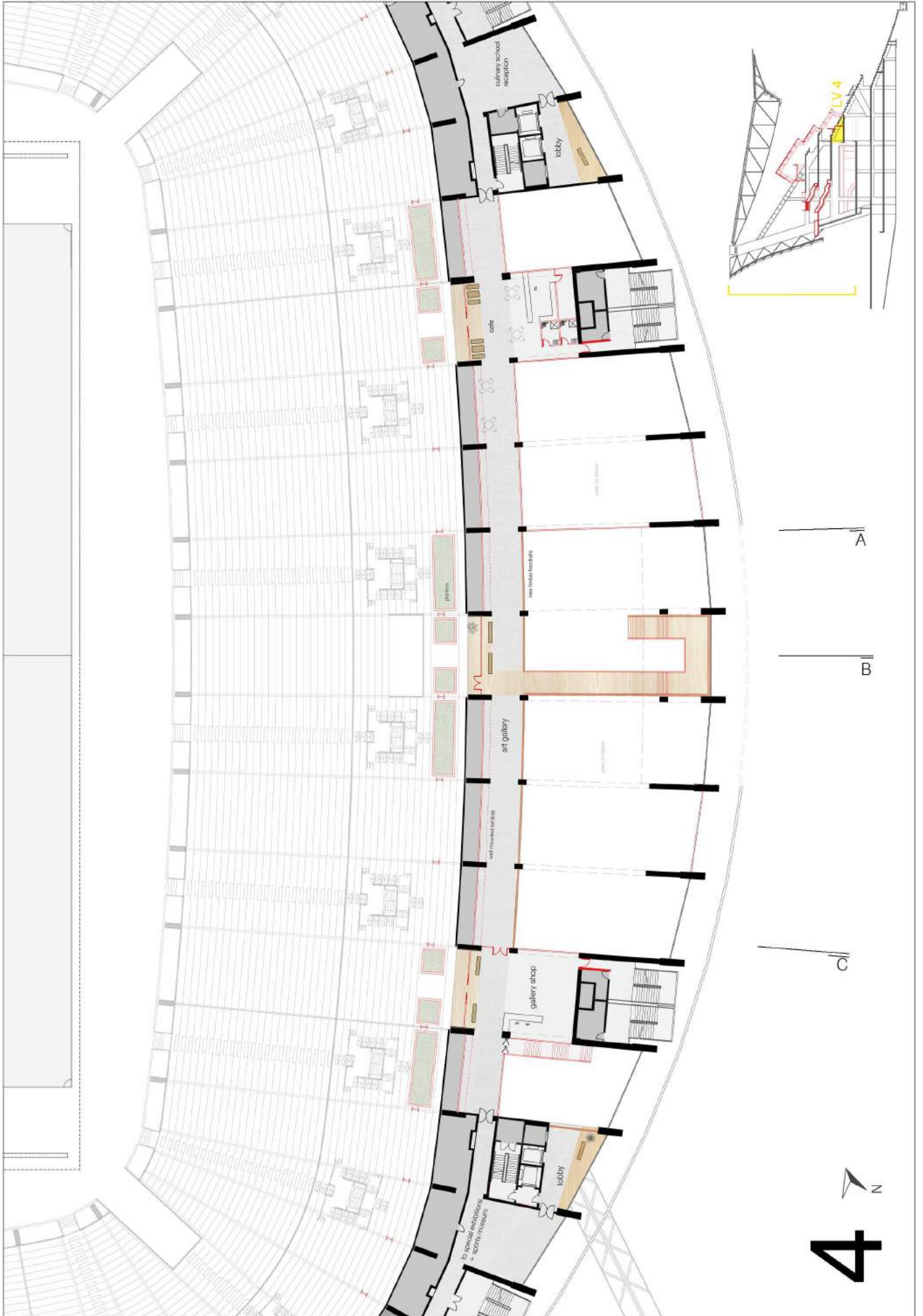


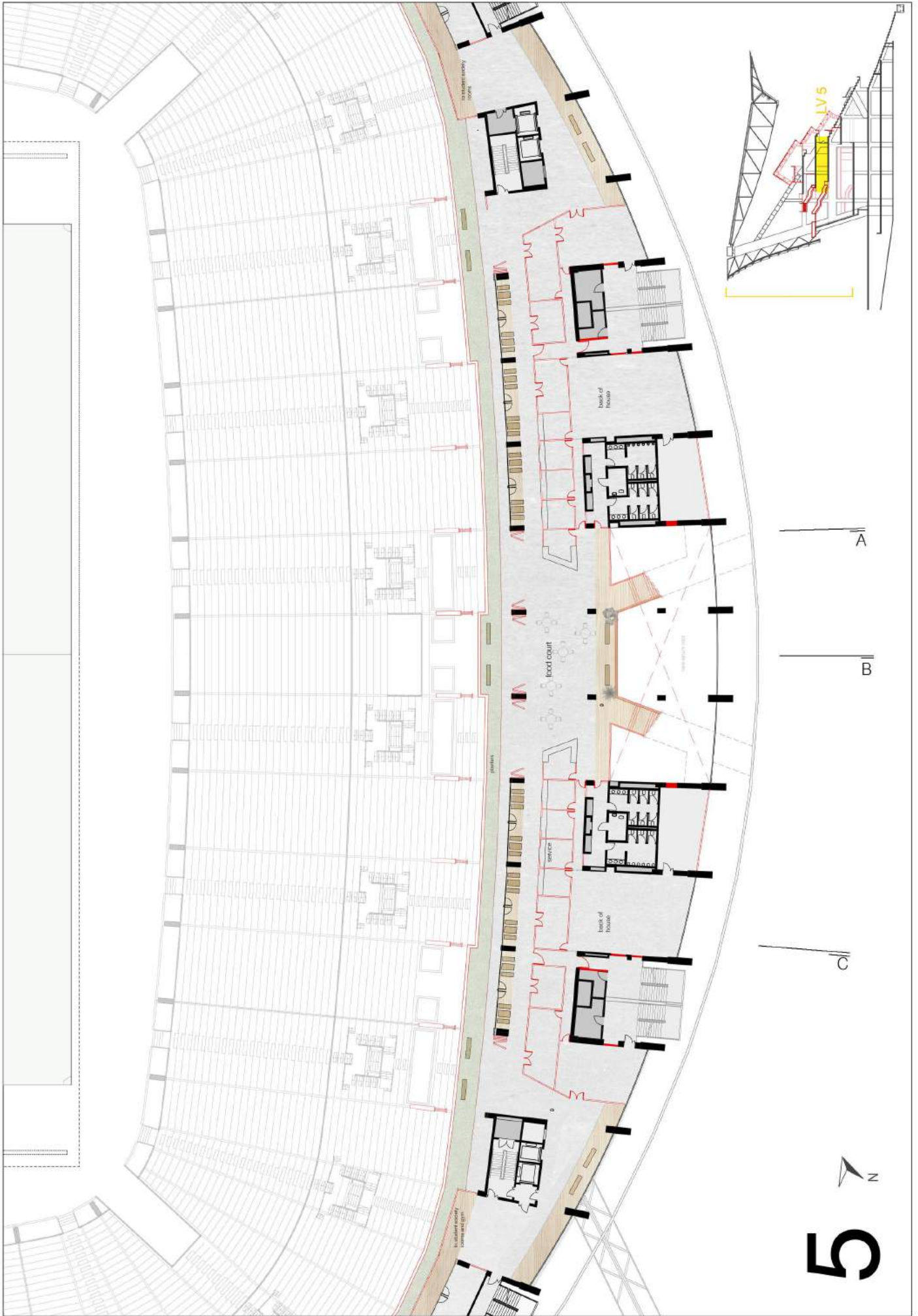
A

B

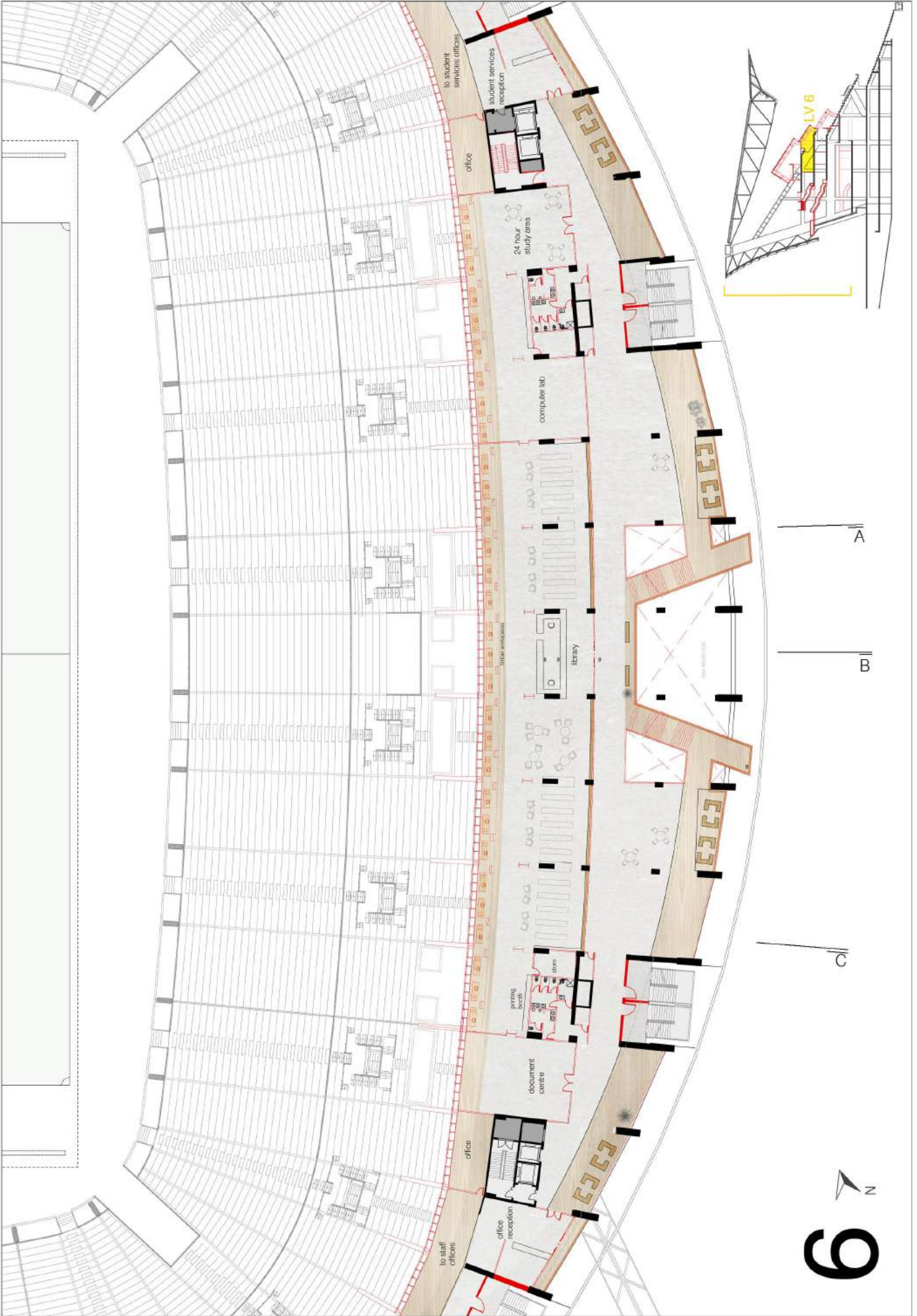
C

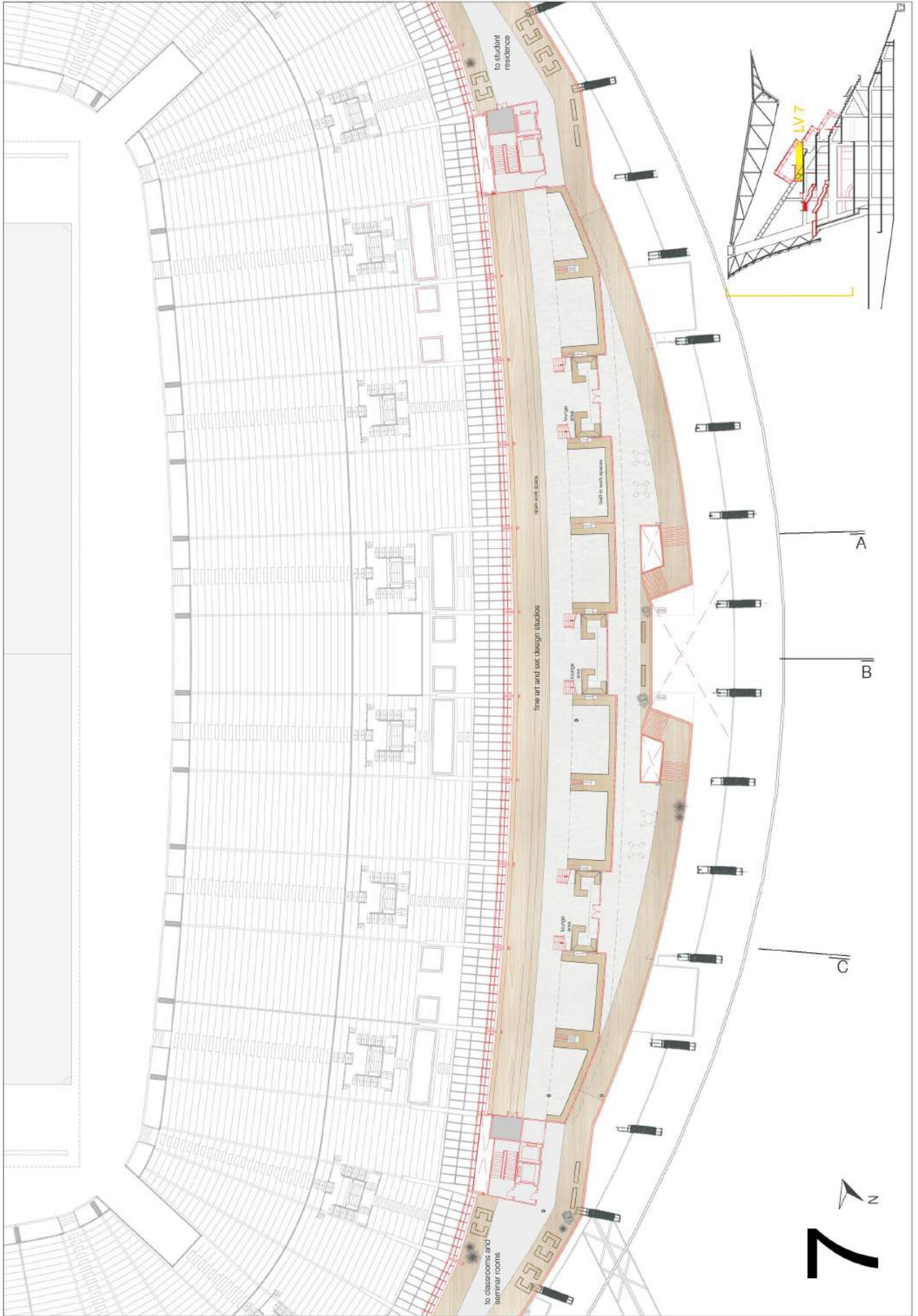
LV 3





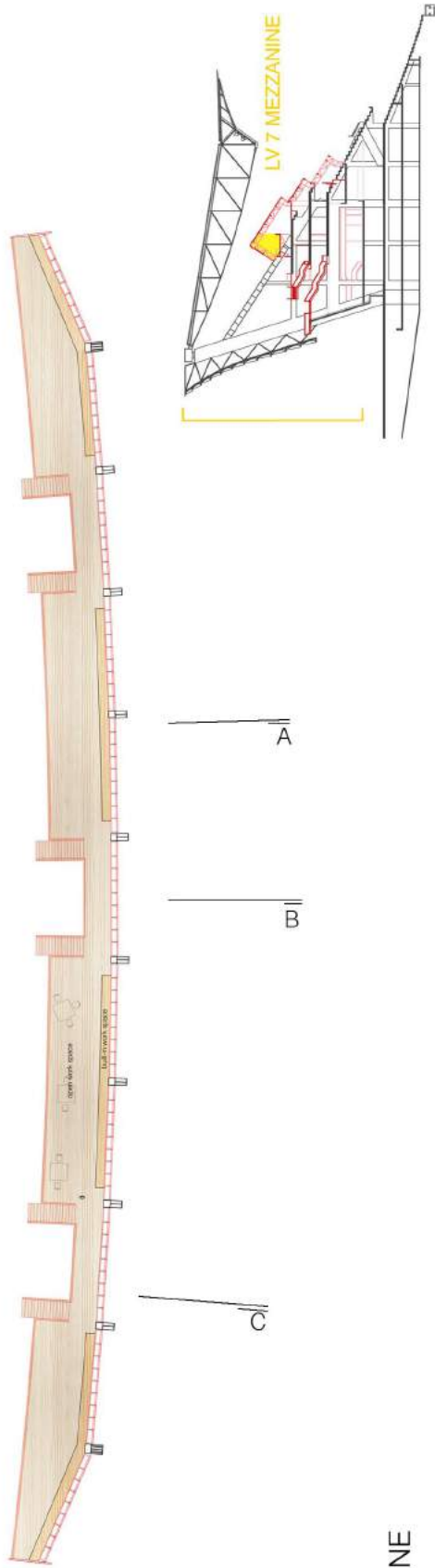
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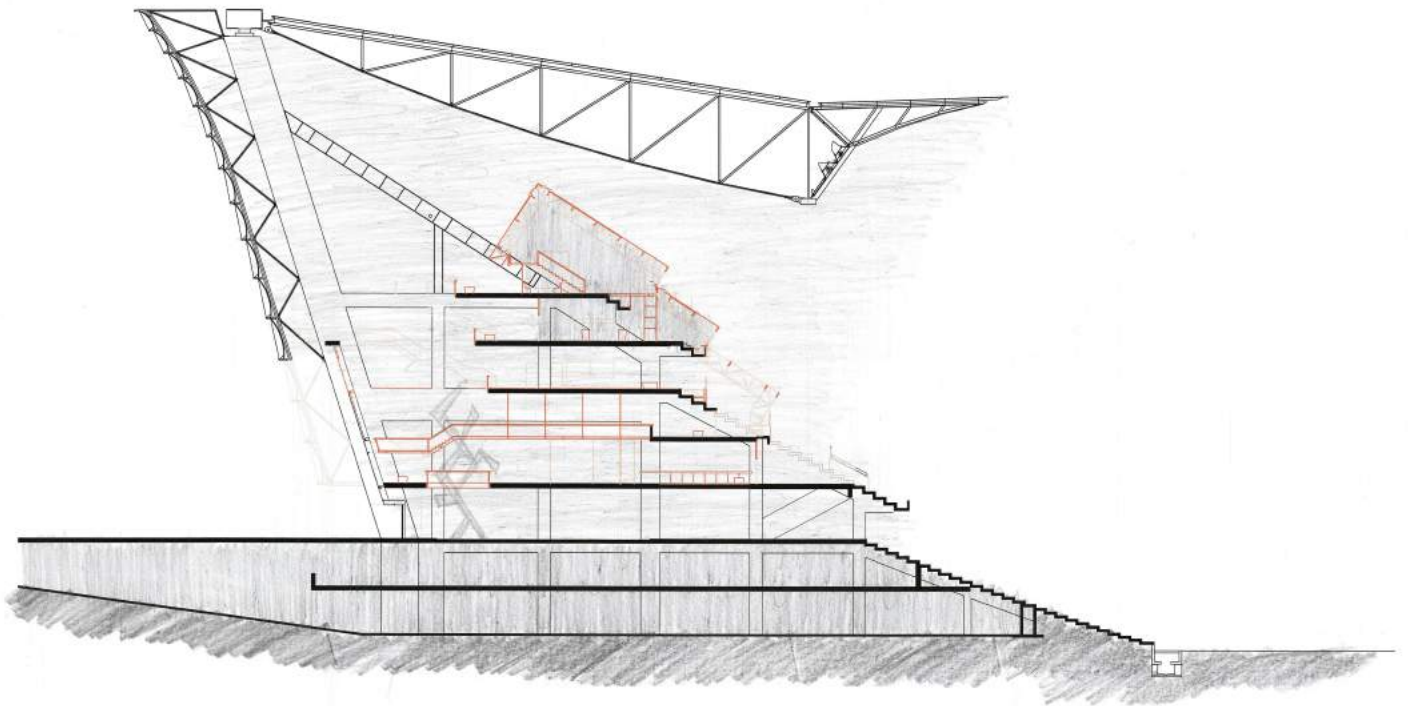
7

MEZZANINE

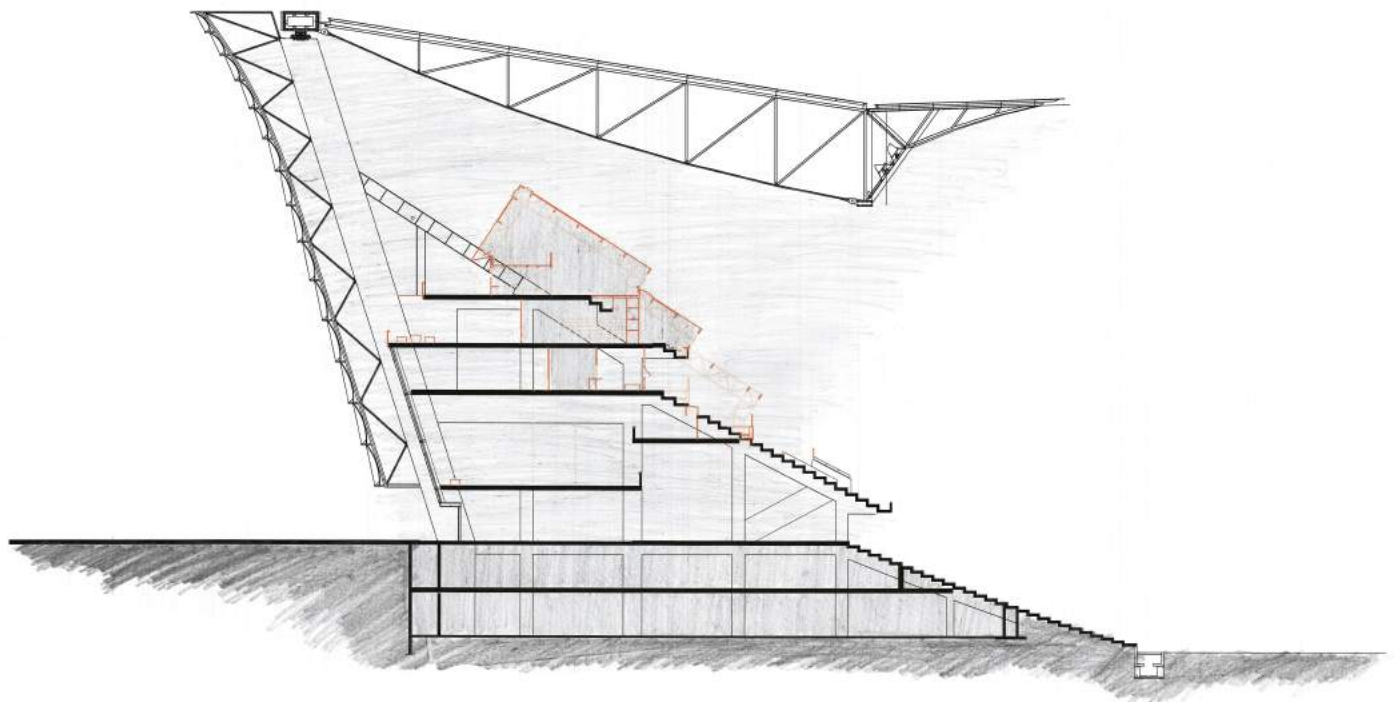


SECTIONS

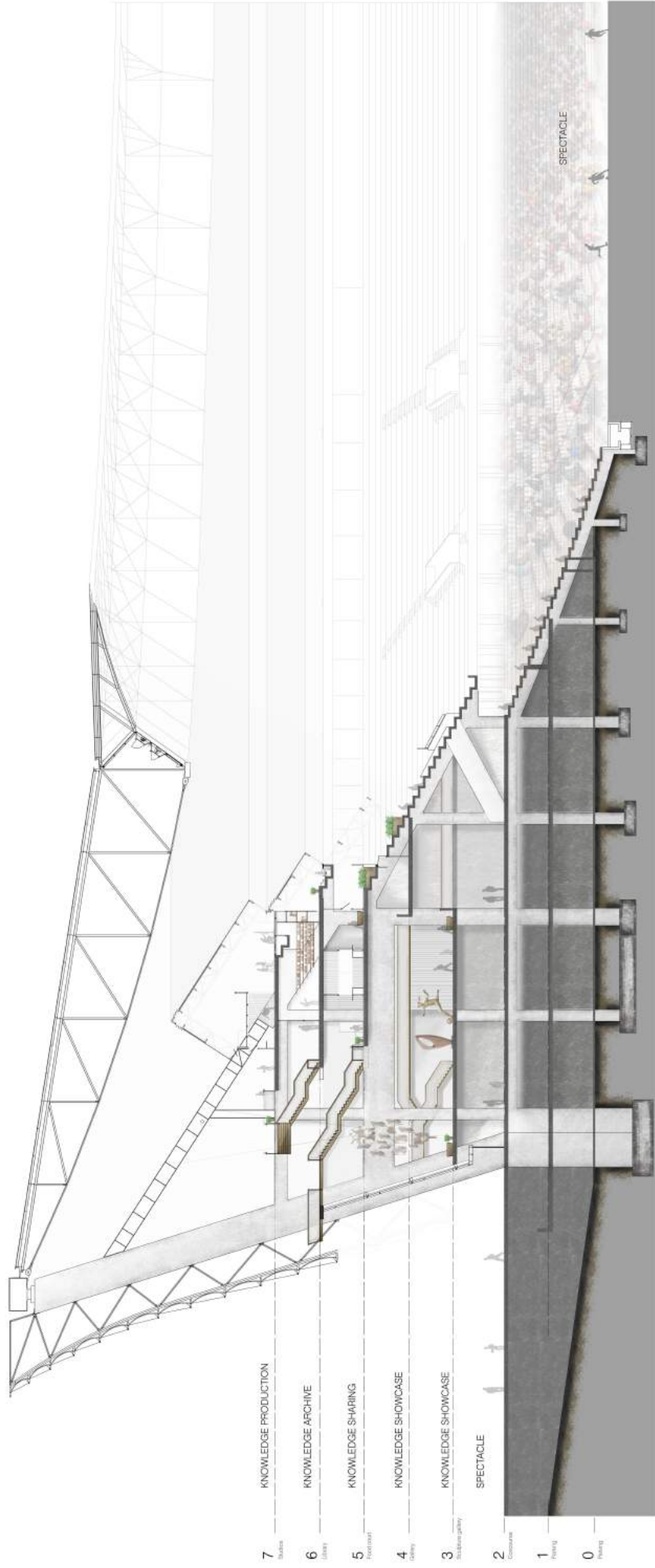
SECTION B

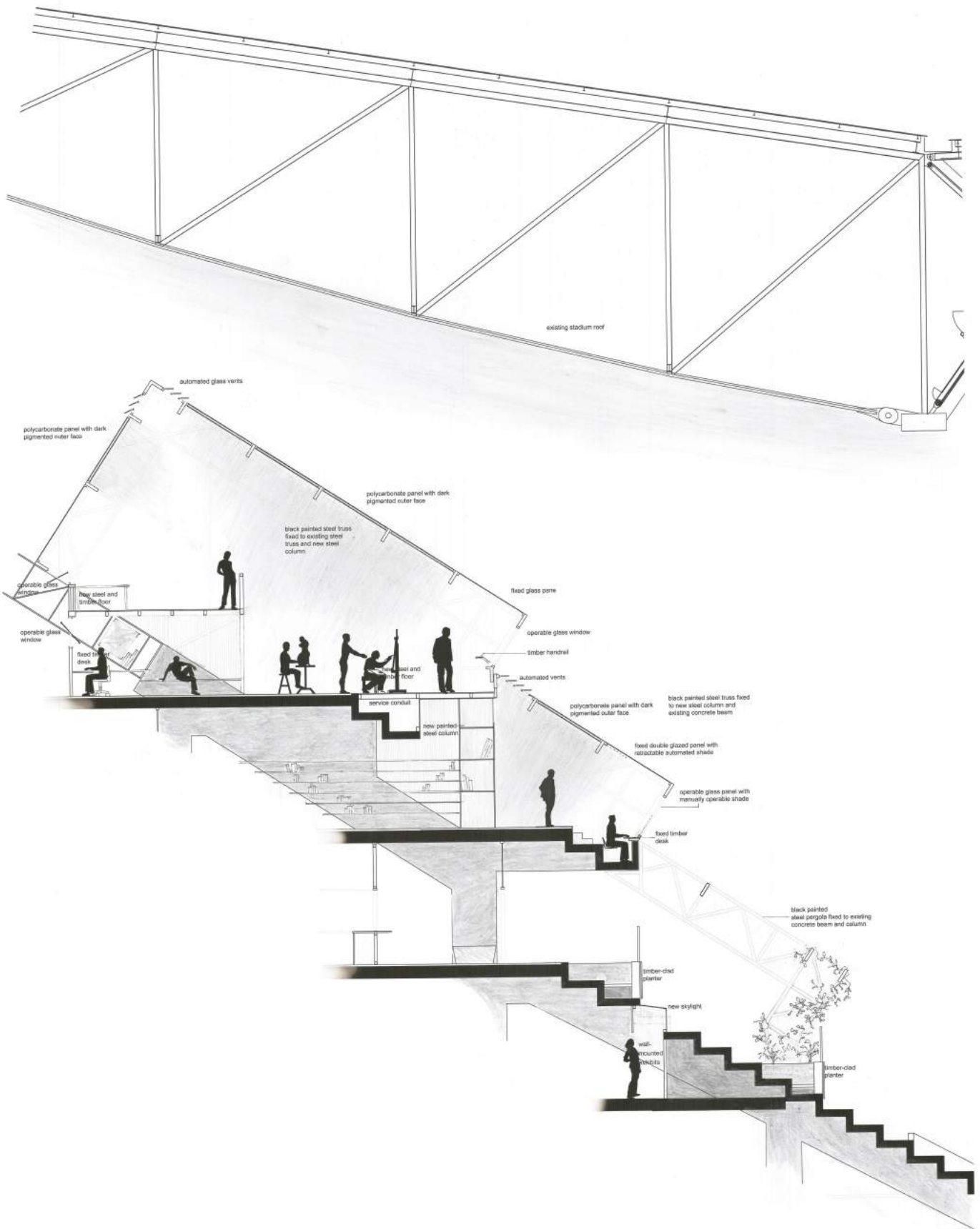


SECTION C



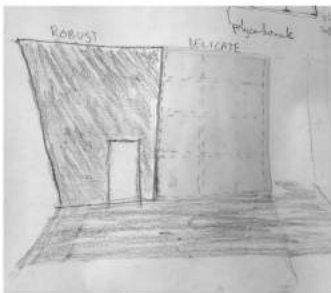
SECTION A



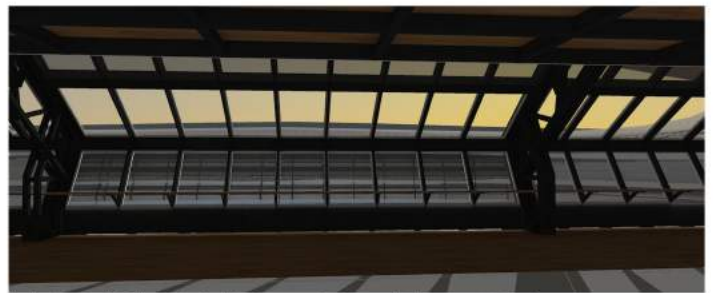


MATERIALITY AND CONTRAST

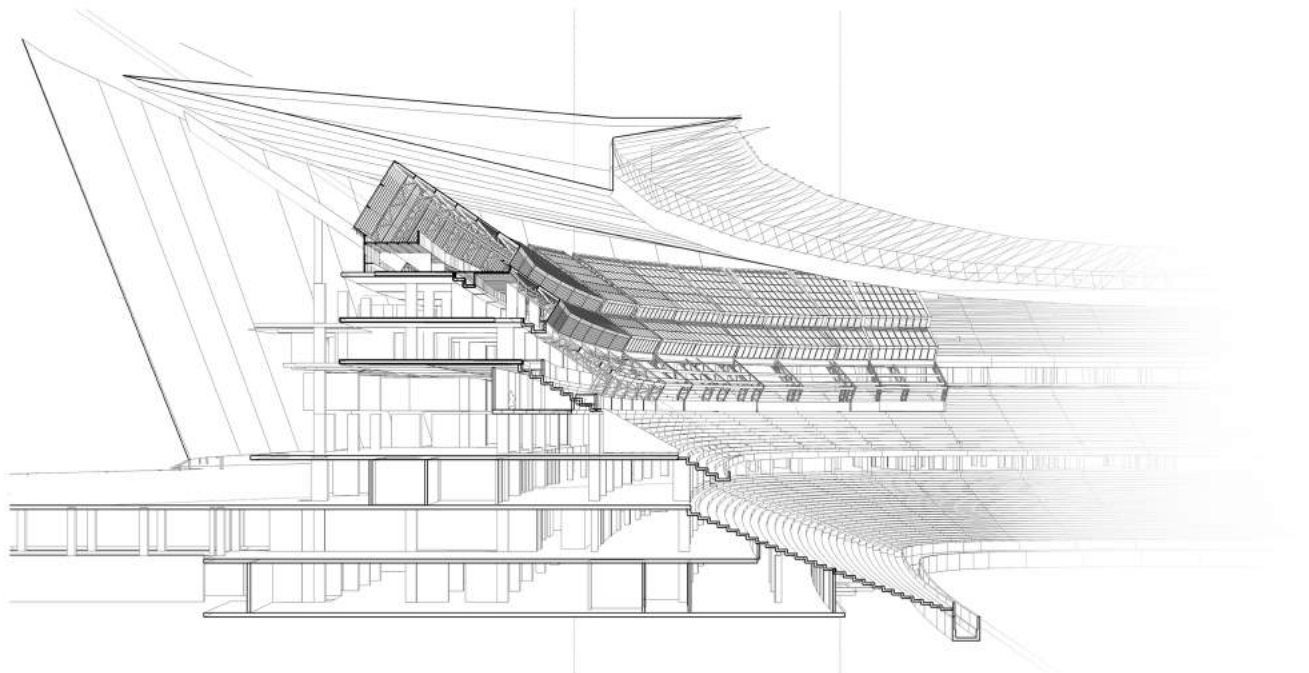
Existing interpreted as:	Intervention interpreted as:
not subject to change over time	subject to change over time
LONG-TERM	MEDIUM-TERM
SLOW	FAST
FIXED	REPLACEABLE
BACKBONE/ STRUCTURE	ADDITIONAL/ SECONDARY
HEAVY	LIGHTWEIGHT
CONCRETE	STEEL/FABRIC/GLASS
ROBUST	DELICATE/FRAGILE
OPAQUE	TRANSLUCENT
ESSENTIAL	REPLACABLE



Contrast between existing concrete and new polycarbonate



Rendered view from the Studios showing how timber elements and glazing are used to draw occupants to the edges, where they gain a heightened awareness of their environment.

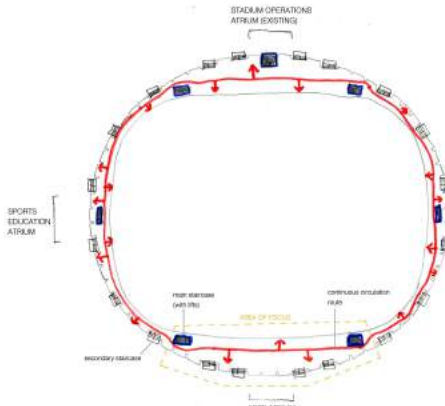


PROPOSED PROGRAMME

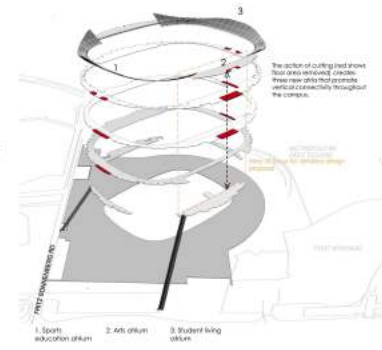
CONTEXTUAL RELATIONSHIPS



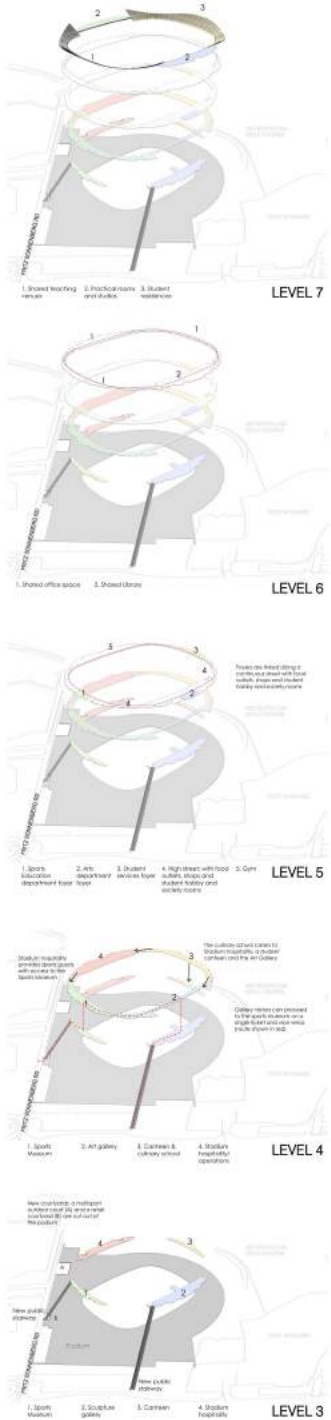
CONTINUITY & COHESION



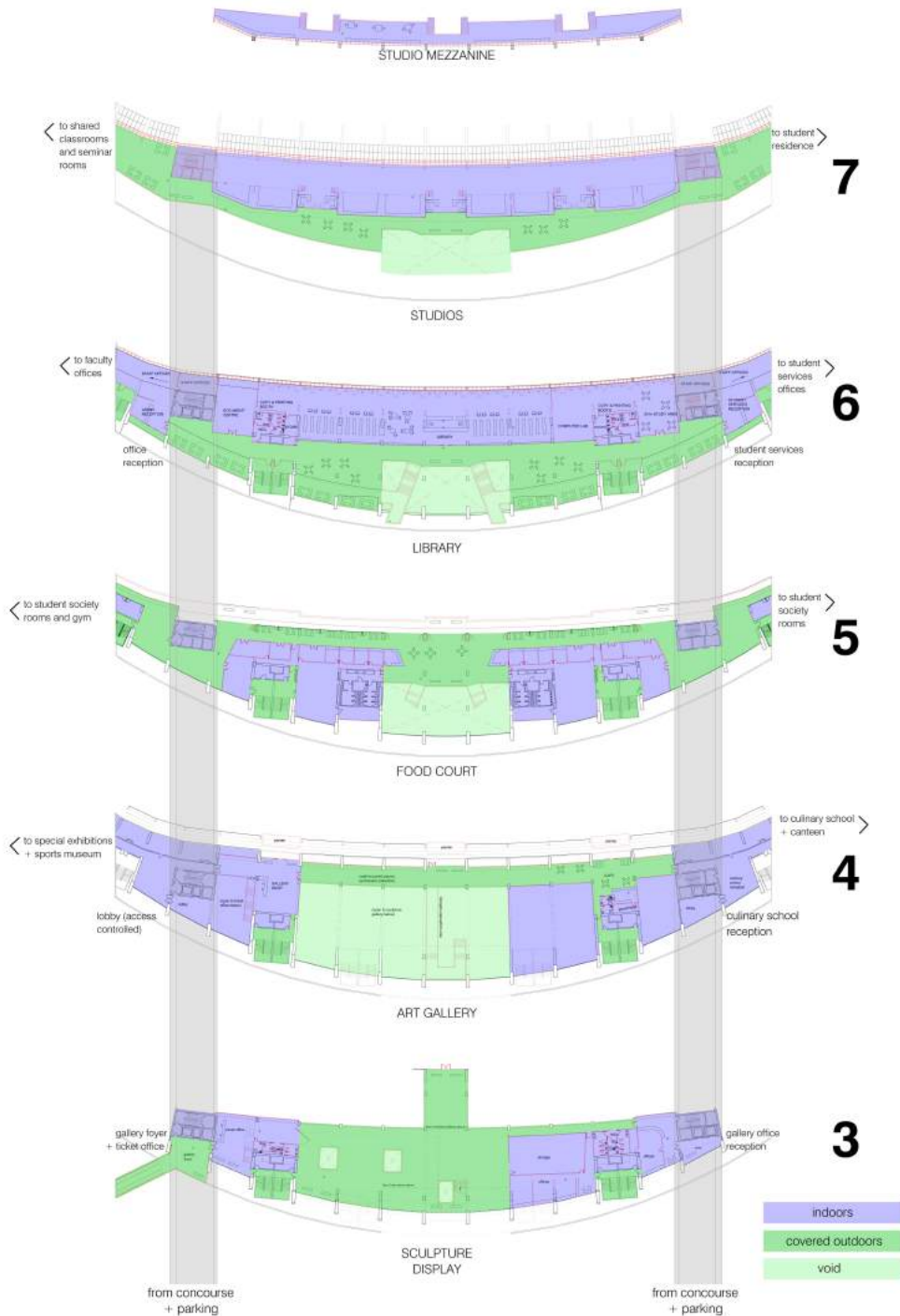
NEW ATRIA



PROPOSED OVERALL ORGANISATION



INSIDE AND OUTSIDE: AREA OF FOCUS

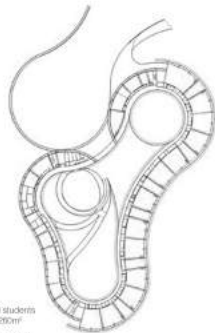


PRECEDENTS

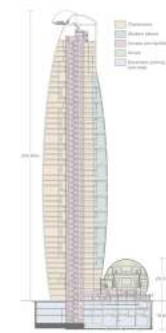
PROGRAMME



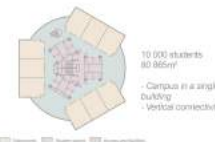
University of La Laguna, Faculty of Fine Arts, Tenerife



700 students
32,200m²
- Mitsui
- Classrooms of an open organic scale
- Drama of architecture



Mode Gaiusai Tower, Tokyo
Tange Associates



10,000 students
80,000m²
- Campus in a single building
- Vertical connectivity

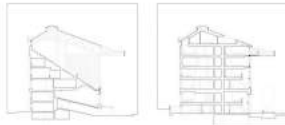


Universiti Teknologi Petronas, Malaysia
Foster + Partners

STADIUM ADAPTIVE REUSE



Clava Publico conceptual proposal
J. Weik / Project



Highbury Square Apartments, London
Alex / Mowlem



Wiss Science Centre, Jöhrenenburg
Seeger + Döll Architects



Arles amphitheatre, France

LANGUAGE



Glasgow School of Art
David Chipperfield



Objects: Folding, Transparency, Framing, Connections



Garvit Hall
John Augustus



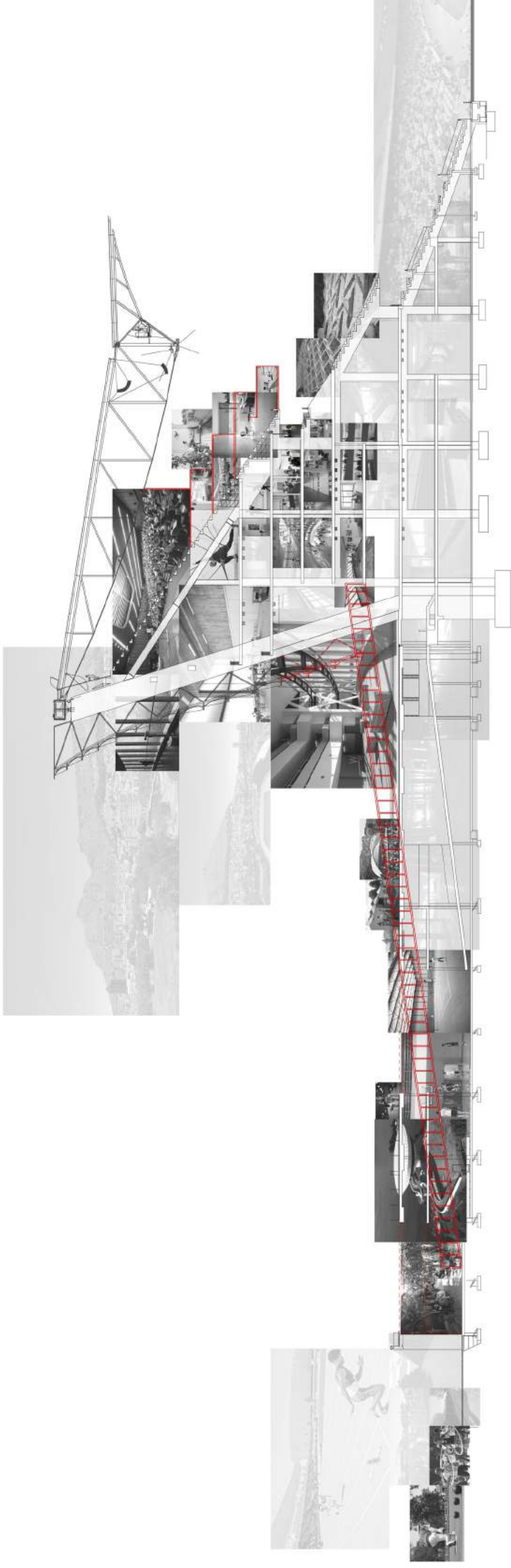
FFEW Office, Italy
Pierluigi Nicolin



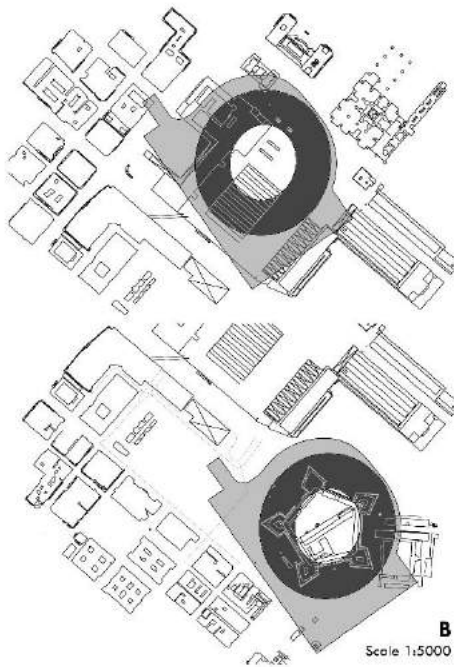
Chicago Federal Center, USA
Moshe Safdie



LCT Sports Center
Koolhaas/Hooyman

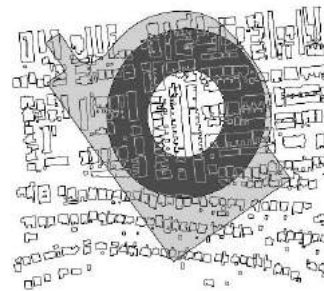
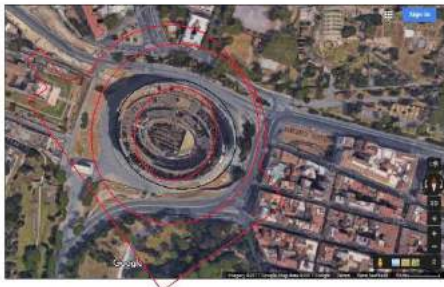
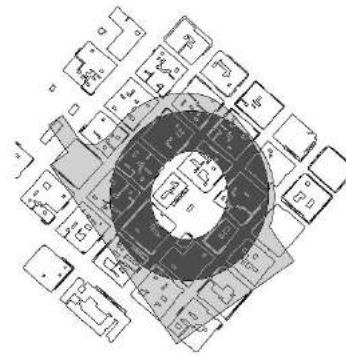
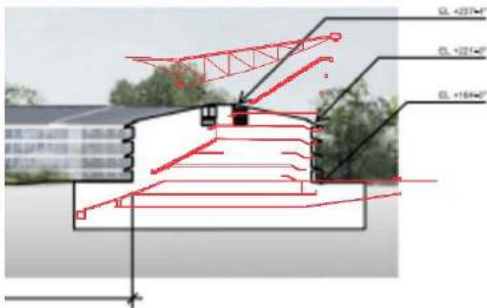


2. SELECTED DESIGN STUDIES



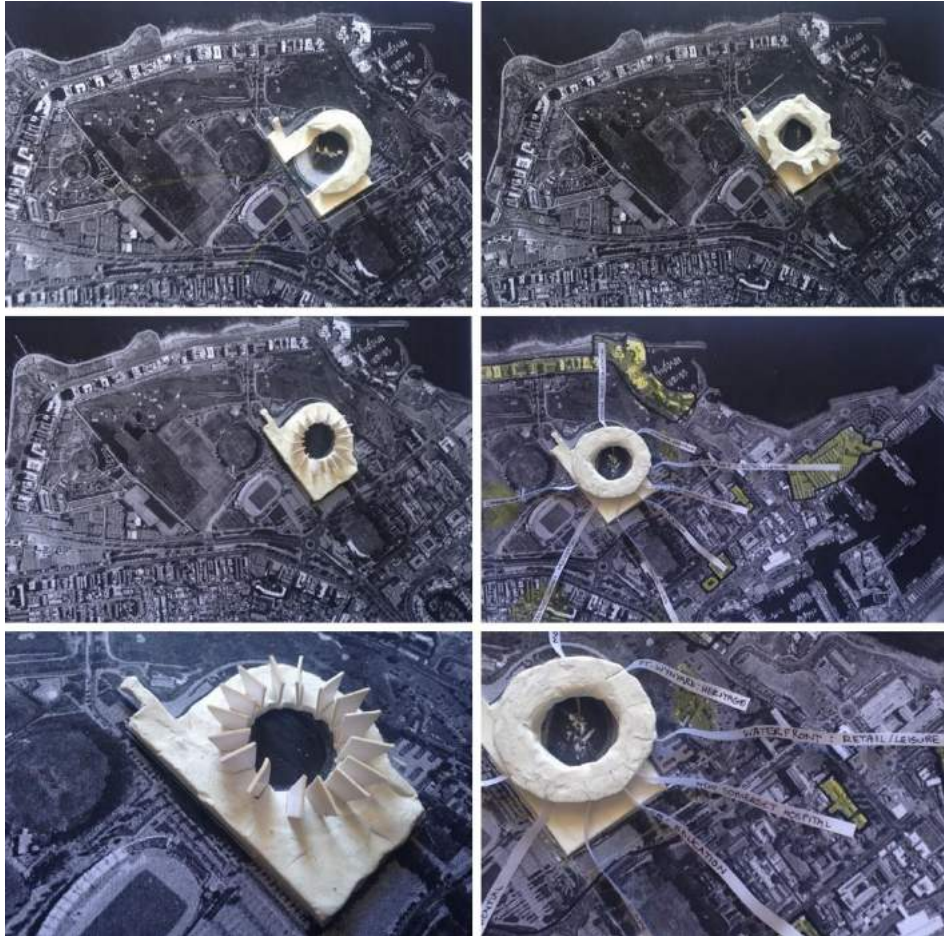
Scale studies compared the Stadium to Cape Town Station and the Castle of Good Hope (left), and the Apple Headquarters in Cupertino, USA (right)

Images on right adapted by author from: (Google Maps, 2017)

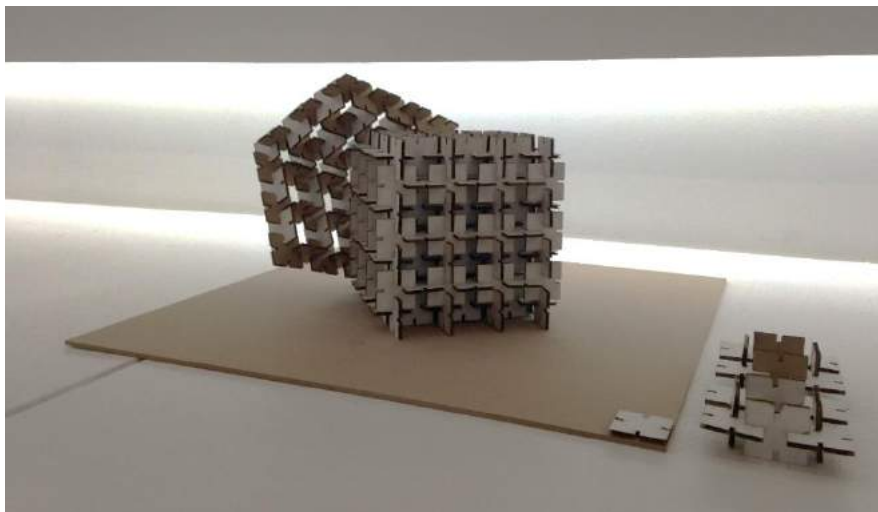


Scale studies compared the Stadium to the Apple Headquarters in Cupertino, USA and the Roman Colosseum (left); Greenmarket Square and Green Point (right)

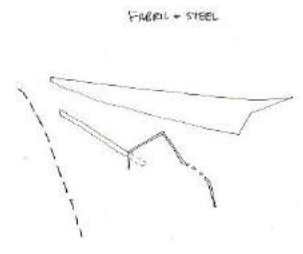
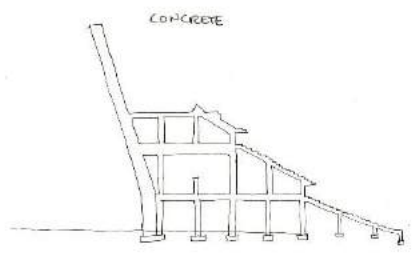
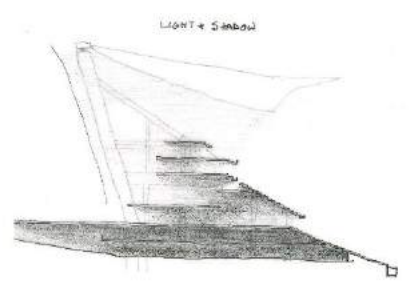
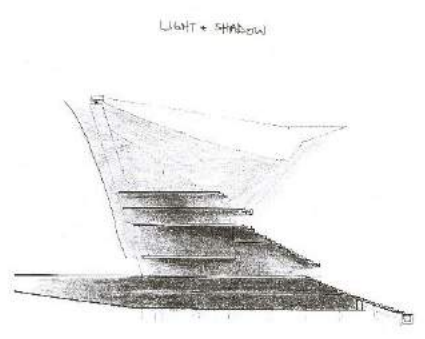
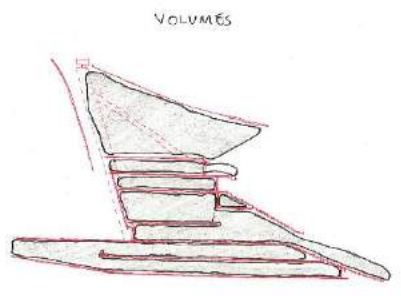
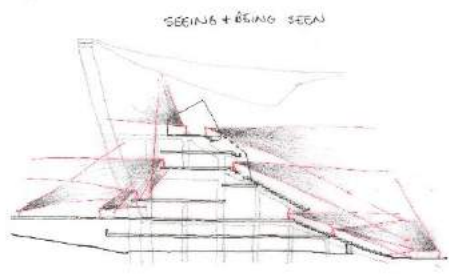
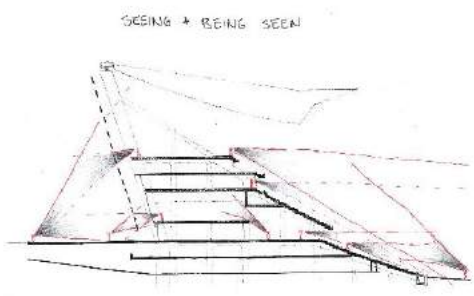
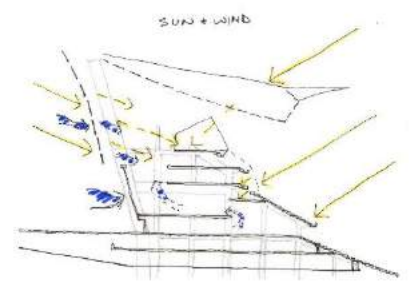
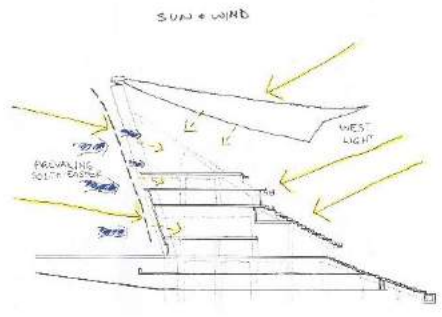
Images on left adapted by author from: (Google Maps, 2017) (Foster + Partners, 2011)



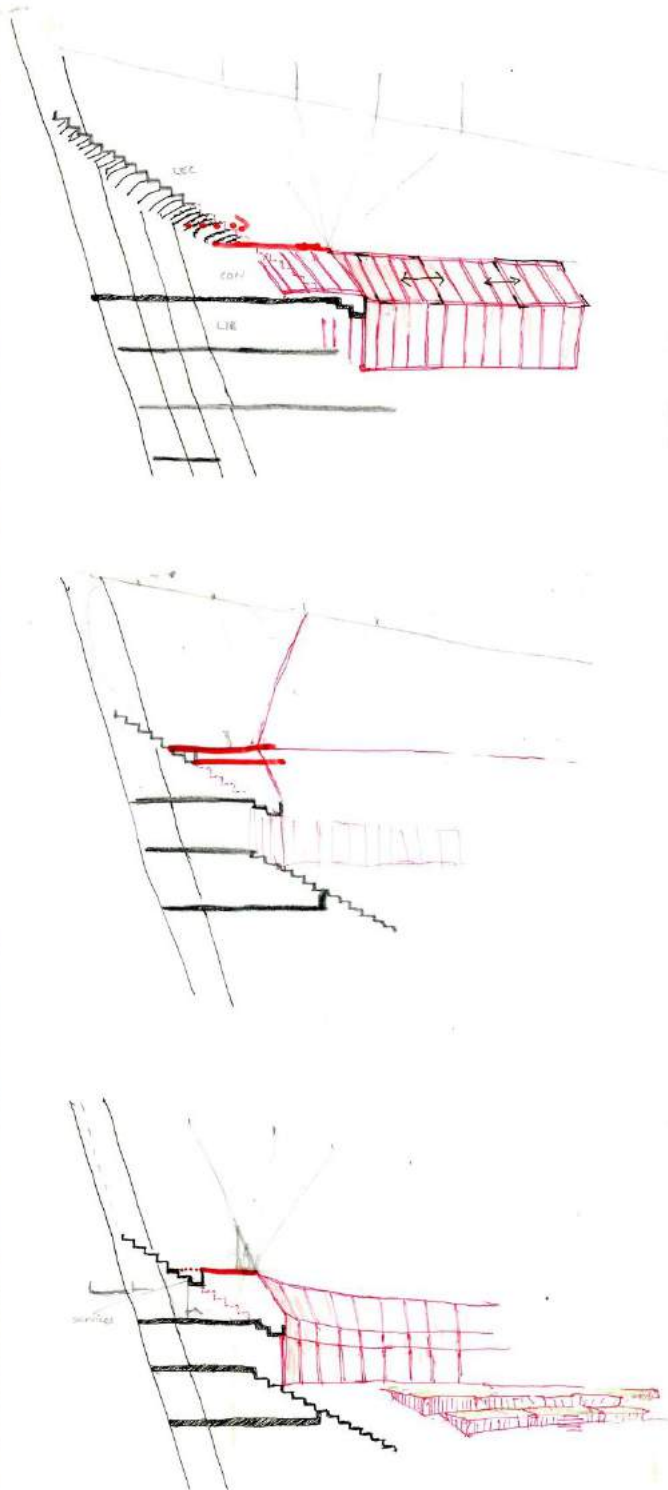
Models explored ideas of promoting connections between Stadium and context by: cutting and opening the Stadium to the Common; extending towards nearby context; exposing the structure and forming programmatic links



A model produced for the Adapt! studio exhibition in September explored how a repeating building system creates distance between interior and exterior as scale is increased (shown as the cube)

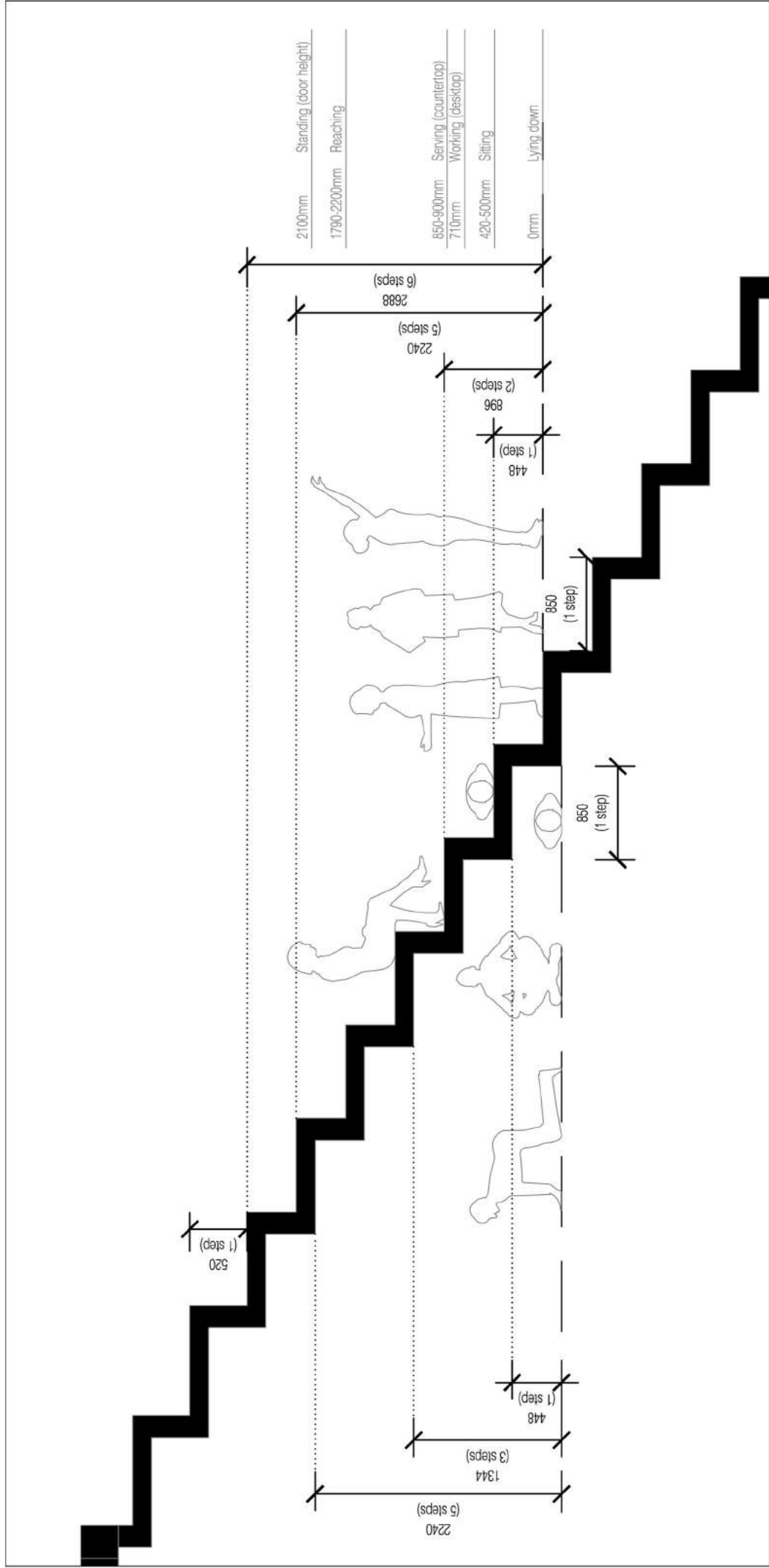


Sectional studies comparing the effect of the adaptive reuse strategies (right) to the existing building (left)



Precedents and studies for the pitch-side enclosure

Photo acknowledgements
(ArchDaily, 2017) (Baker, 2017) (Airsulpt Ltd, 2015) (Seele, 2017)



Appendix B: Existing Building Documentation

- 1. VIEWS FROM CAPE TOWN STADIUM**
- 2. MATERIAL EMBODIED ENERGY CALCULATION**
- 3. SOLAR ANALYSIS**
- 4. SPATIAL AND ENVIRONMENTAL QUALITIES**
- 5. AREA OF FOCUS AS EXISTING**
- 6. EXISTING DRAWINGS**



Metropolitan Golf Course

South Atlantic Ocean

View A from Stadium



Metropolitan Golf Course

Mouillie Point

South Atlantic Ocean

View B from Stadium



Green Point Common

Mouillie Point

Metropolitan Golf Course

South Atlantic Ocean

View C from Stadium



Green Point Common

Mouillie Point

Hamilton Rugby Club

South Atlantic Ocean

View D from Stadium



View E from Stadium



View F from Stadium



View G from Stadium



View H from Stadium



View I from Stadium



View K from Stadium

Views A-K adapted from: (Google Earth V 7.3.0.3832, 2017)

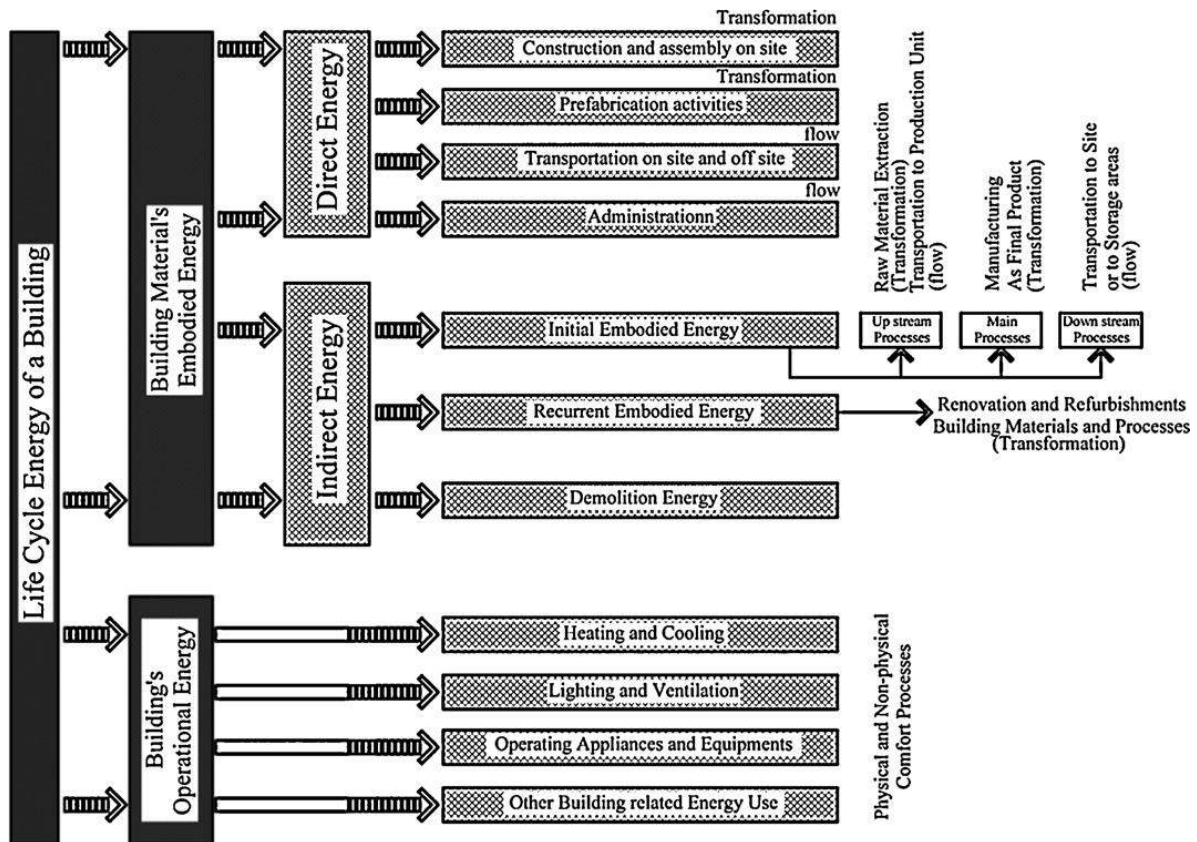


View to the pitch taken from the North side of Level 7

2. MATERIAL EMBODIED ENERGY CALCULATION

In construction, energy is “expended in the processes of building material production (mining and manufacture), on-site delivery, construction and assembly on-site, renovation and final demolition” (Dixit, et al., 2010). Embodied energy can be defined as “the total energy required in the creation of a building, including the direct energy used in the construction and assembly process, and the indirect energy, that is required to manufacture the materials and components of the buildings” (Crowther, 1999).

The figure that follows show the parameters measured in embodied energy calculation. It is acknowledged firstly that this study is limited to the determination of the embodied energy during production of materials and does not include the operational energy (after completion of construction) of the Stadium nor energy in renovation, refurbishments and demolition. The energy of transportation of building materials is also excluded from the calculations.



Parameters in building life cycle and embodied energy measurement

(Dixit, et al., 2010)

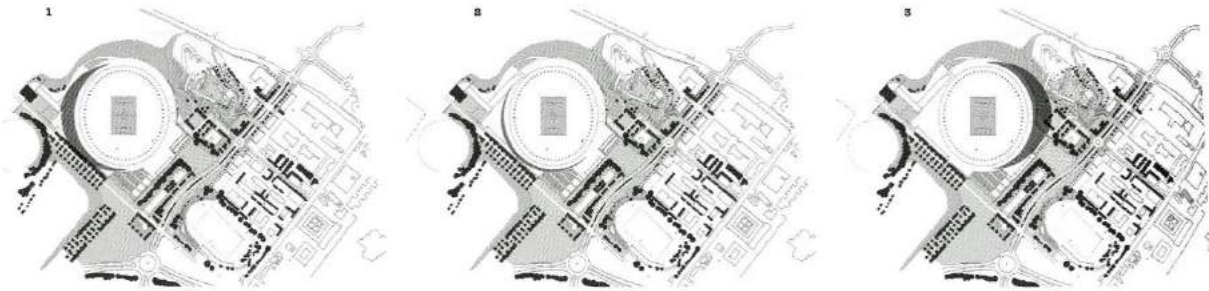
Because a precise calculation of embodied energy is complex and variable (Dixit, et al., 2010), the method for this study follows the recommendations of *A short guide to embodied carbon in building structures* (Institution of Structural Engineers: Great Britain, 2011) in sourcing standard embodied energy values for each material from the Inventory of Carbon and Energy (ICE) developed by the University of Bath. Metrics of Cape Town Stadium were primarily those reported in *Cape Town Stadium: Between the Lines* (Andrag, 2010) and measurements taken from the architects' drawings. The calculation is carried out for the major components of structure and enclosure — concrete structure, floor slabs and seating tiers, glass roof, brick walls, steel reinforcement and roof — and the results are shown below.

Embodied energy calculations for major elements of Cape Town Stadium

Construction Material and application	Quantity Used in Cape Town Stadium	Embodied Energy in Mega-Joules per 1 kilogram	Total embodied energy (MJ)
Concrete	109 000 m ³ / 261 600 tonnes	0.75	196 200 000
Reinforcing steel	12 000 tonnes	20.1	241 200 000
Brick	4.8 million / 11 040 tonnes	3.0	33 120 000
Roof steel	4 035 tonnes	20.1	81 103 500
Roof glazing (16mm laminated)	34 000 m ² / 1 271.6 tonnes	15.0	19 074 000
PTFE roof membrane	32 000m ² / 32 tonnes	295.0	9 440 000
PTFE membrane screen	27 500m ² / 27.5 tonnes	295.0	8 112 500
Sources: (Andrag, 2010) (Murray & Robberts, 2008) (Hammond & Jones, 2011) (Monticellia & Zanellia, 2016)			

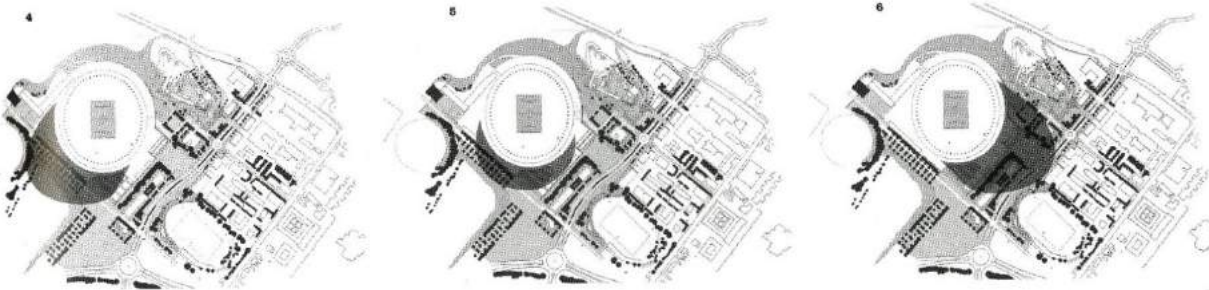
In order to put these values into perspective, the total embodied energy calculated for the Stadium is well over 500 times that of an average home, which has an embodied energy of 1000 GJ (Sattary & Thorpe, 2012). In other terms, the Stadium's embodied energy would meet the energy requirements of 600 homes for 15 years.

3. SOLAR ANALYSIS



Cape Town Stadium shadow studies for 21 December: 10:00am; 12:00pm and 4:00pm respectively

(Andrag, 2010)

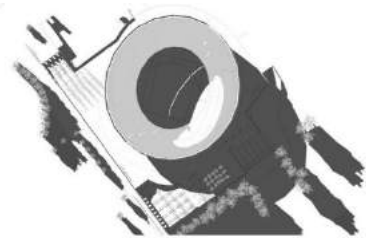
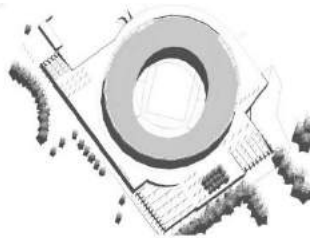


Cape Town Stadium shadow studies for 21 June: 10:00am; 12:00pm and 4:00pm respectively

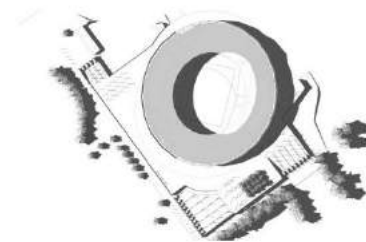
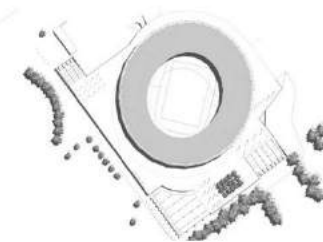
(Andrag, 2010)



21 June: 9AM / 12PM / 4PM



21 December: 9AM / 12PM / 4PM



Solar analysis revealing shadow cast by the Stadium roof

4. SPATIAL AND ENVIRONMENTAL QUALITIES

Level 0



Photograph showing the space of the northern parking area of Level 0

21 December

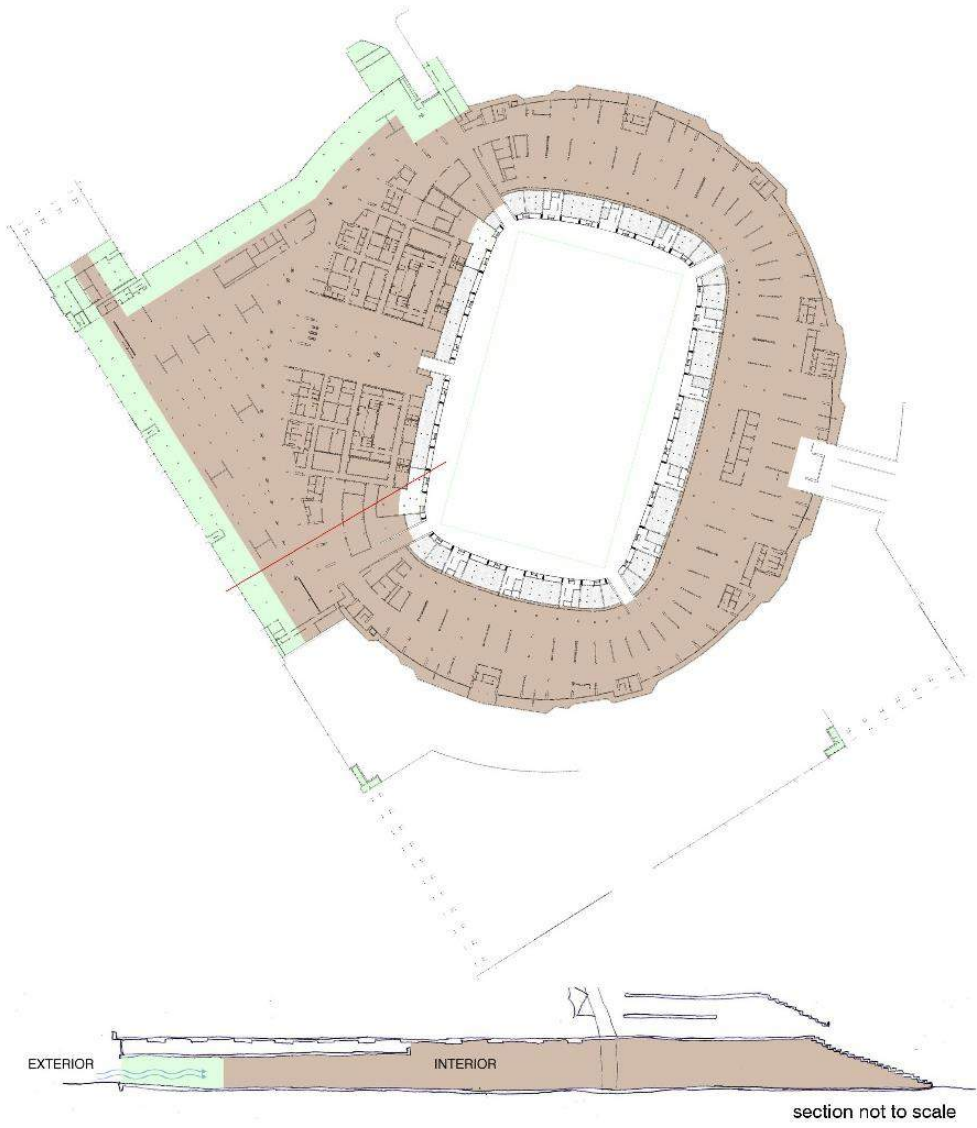
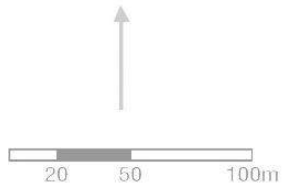


21 June



□ Floor area in direct sunlight (white) ■ Floor area in shadow ↑ N

Shadow studies for Level 0



- Single-sided
ventilation
- Cross-ventilation
- Mechanical ventilation
required

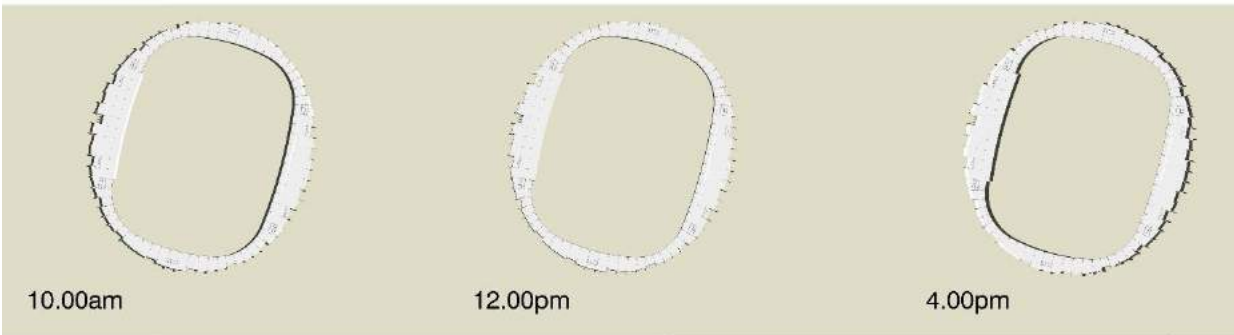
Ventilation study of Level 0- showing extensive mechanical ventilation requirement

Level 4



Photograph showing an empty office space on Level 4

21 December

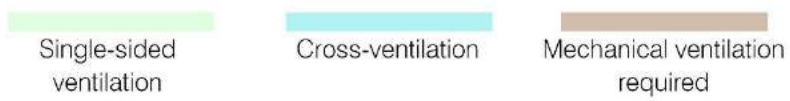
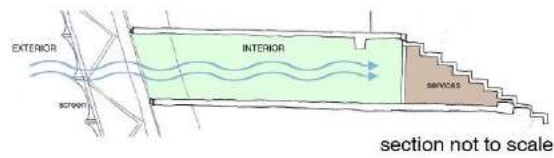
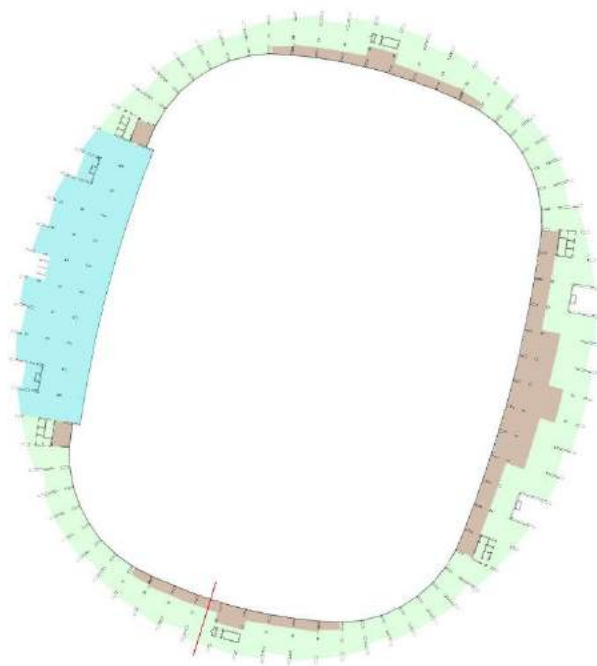
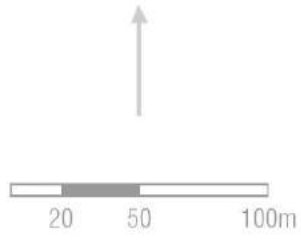


21 June



Legend: Floor area in direct sunlight (white) Floor area in shadow N

Shadow studies for Level 4



Ventilation study of Level 4- showing large areas are suitable for single-sided ventilation

Level 5



Photograph showing the lounges on Level 5

(City of Cape Town, 2017)

21 December

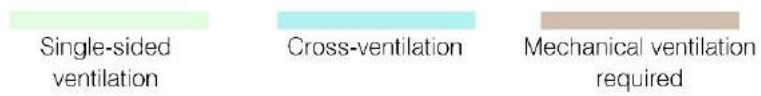
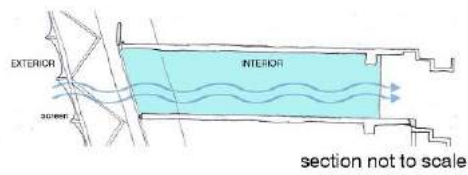
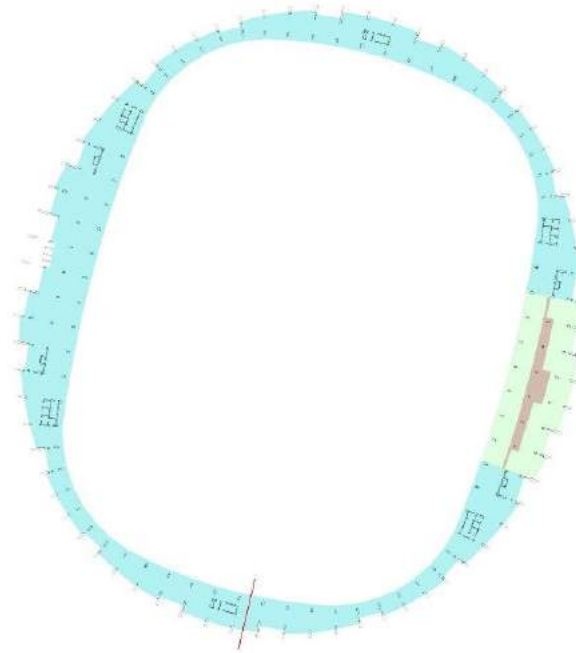
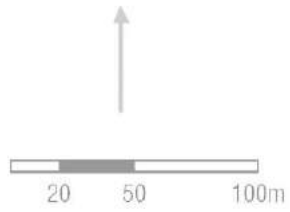


21 June



— Floor area in direct sunlight (white) — Floor area in shadow ↑_N

Shadow studies for Level 5 with notable direct light to the southern region of the floor



Ventilation study of Level 5- showing large areas are suitable for cross-ventilation

LEVEL 3: Spatial qualities (existing)



Deep and dark



Large, double
volumes



Open to concourse below



LEVEL 4: Spatial qualities (existing)



Large, deep, lined
hospitality rooms



Internalised passages with
services to one side



Series of alcove-like
spaces along a
passage, open to one
side

LEVEL 5: Spatial qualities (existing)



Timber floor lining



Three rows of private seating



Full opening glazing
on the internal pitch-
side

LEVELS 6 & 7: Spatial qualities (existing)



Views to the pitch and
mountain



Exposed concrete and
steel structure



Large views through
the fabric façade

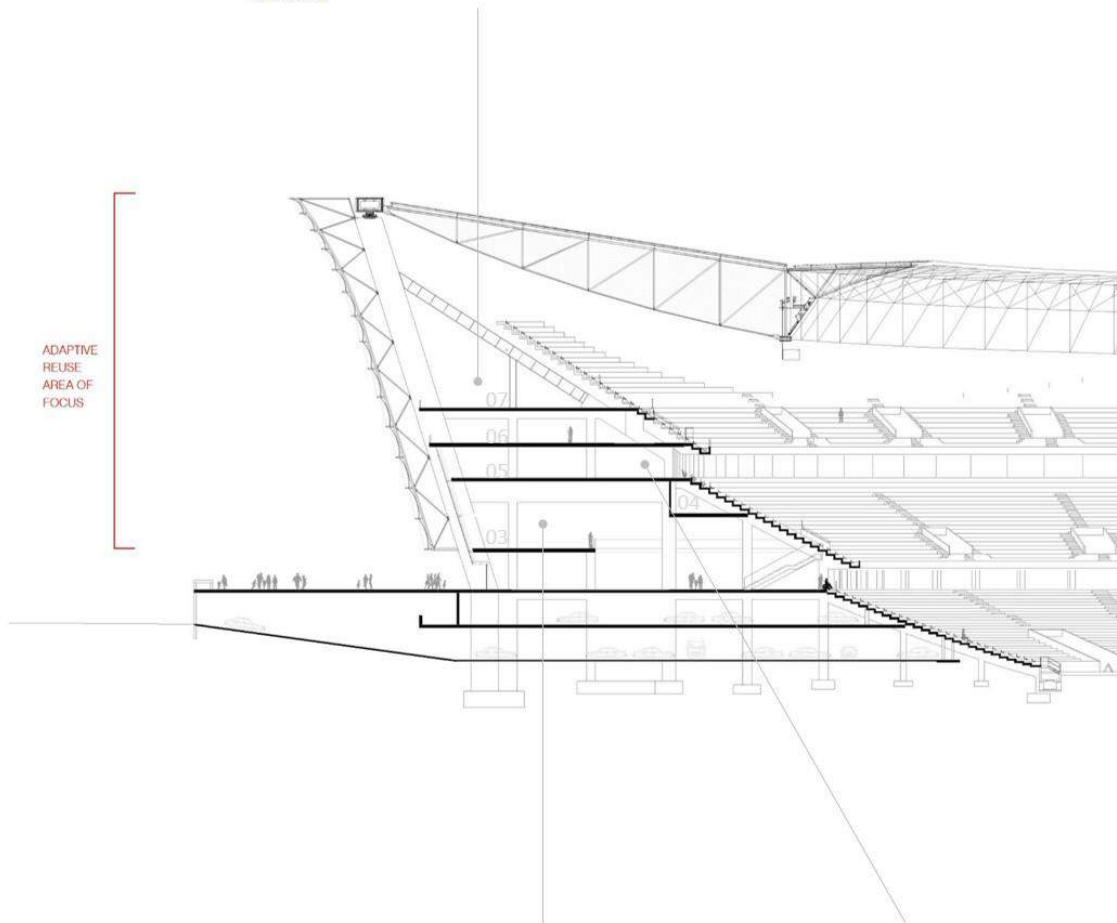
5. AREA OF FOCUS AS EXISTING



Area of focus, viewed from within the Stadium (highlighted)



Levels 6 & 7: Steel supports remain on level 7 where temporary seating was removed



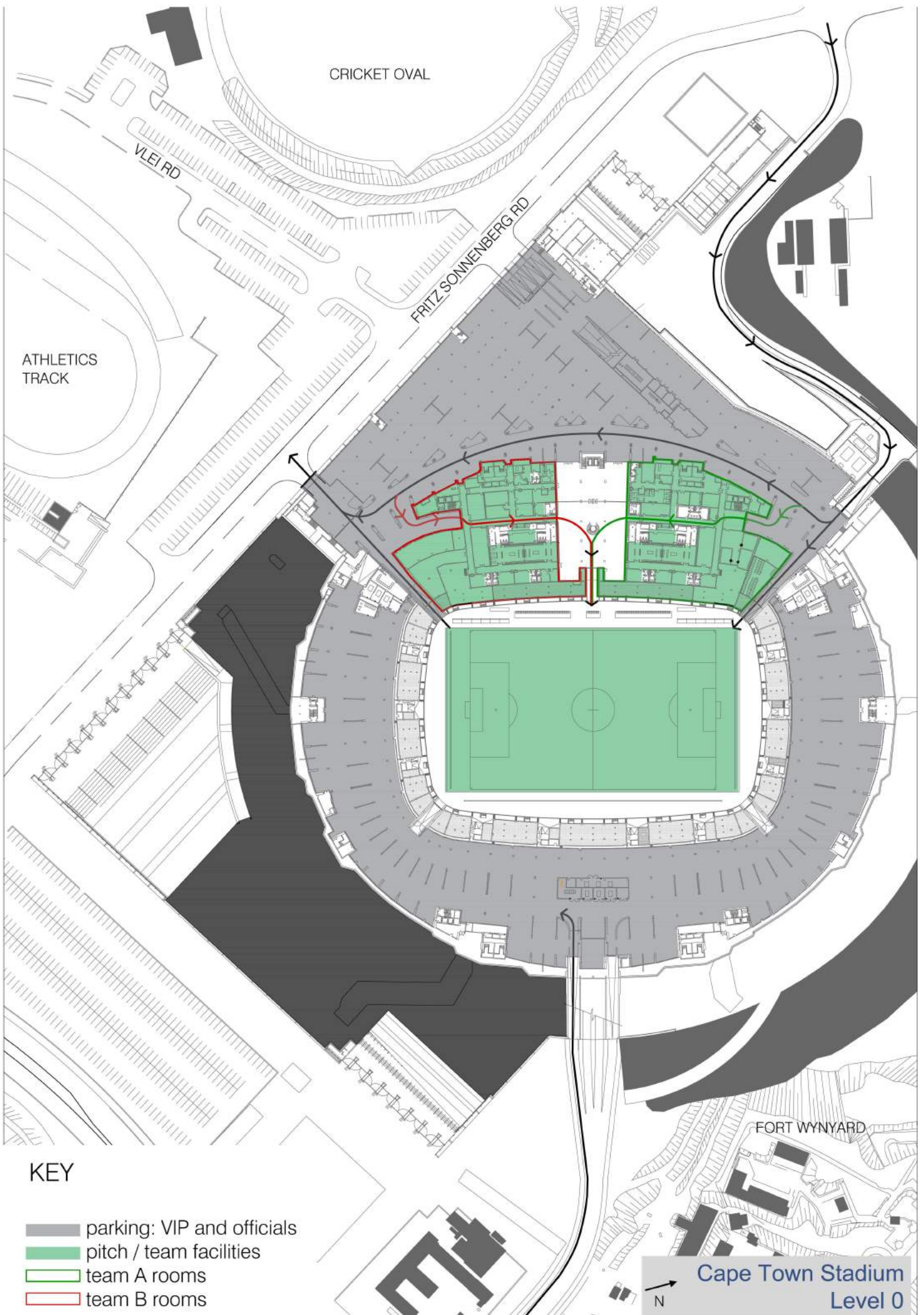
Level 3 has a generous double volume and overlooks the concourse below. Level 4 is obscured from it by a brick wall

VIP suites similar to the one shown in this photograph are located on Level 5

Section and photographs through area of focus

6. EXISTING DRAWINGS

Adapted from digital drawings supplied by Jakupa Architects and Urban Designers and physical copies supplied by Munnik Visser Architects.



CRICKET OVAL

VLEI RD

FRITZ SONNENBERG RD

ATHLETICS TRACK

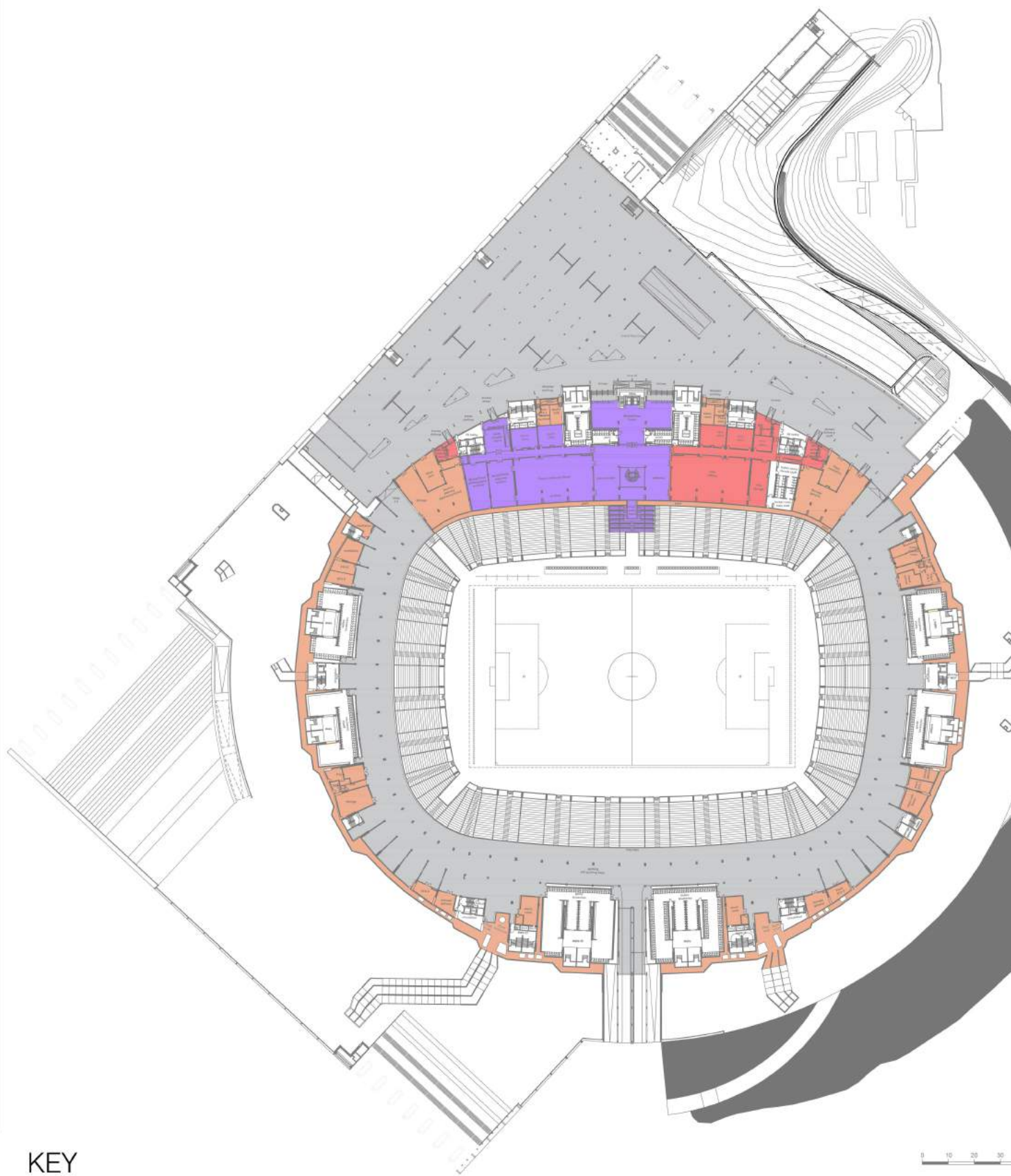
FORT WYNYARD

KEY

- parking: VIP and officials
- pitch / team facilities
- team A rooms
- team B rooms

Cape Town Stadium
Level 0



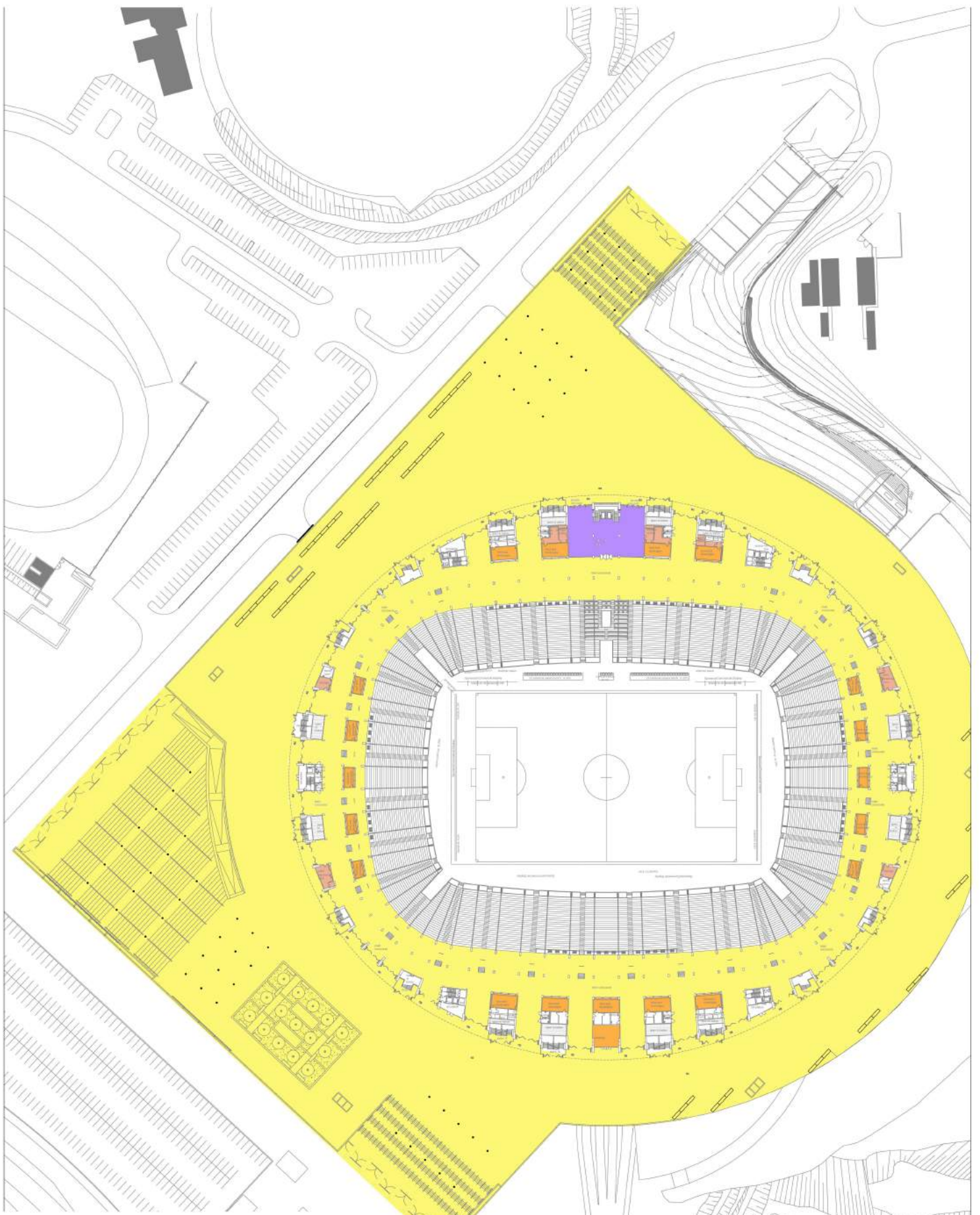


KEY

- parking: VIP and officials
- VIP/media facilities
- operations: admin and offices
- operations: services / storage / plant

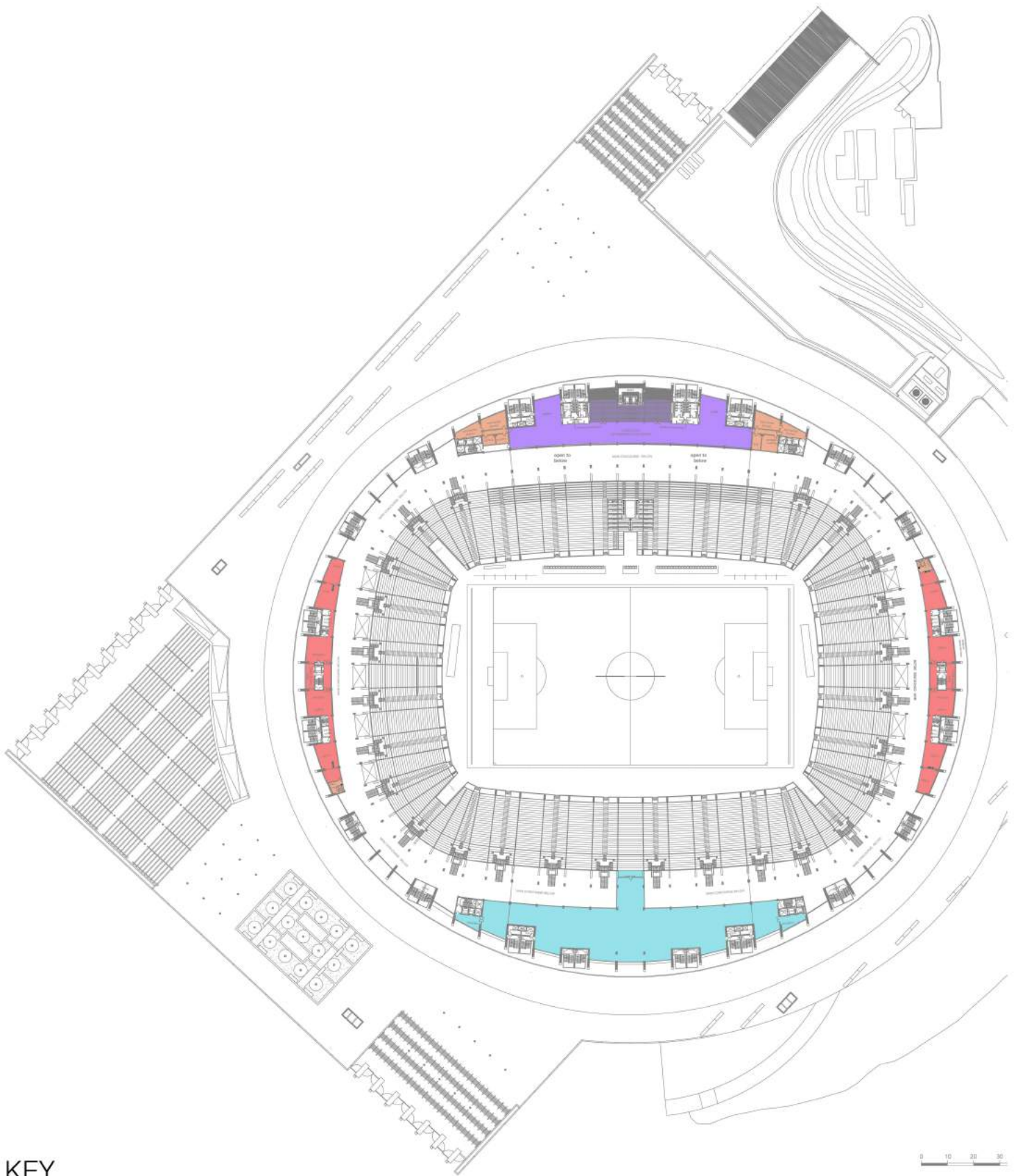


Cape Town Stadium
 Level 1



KEY

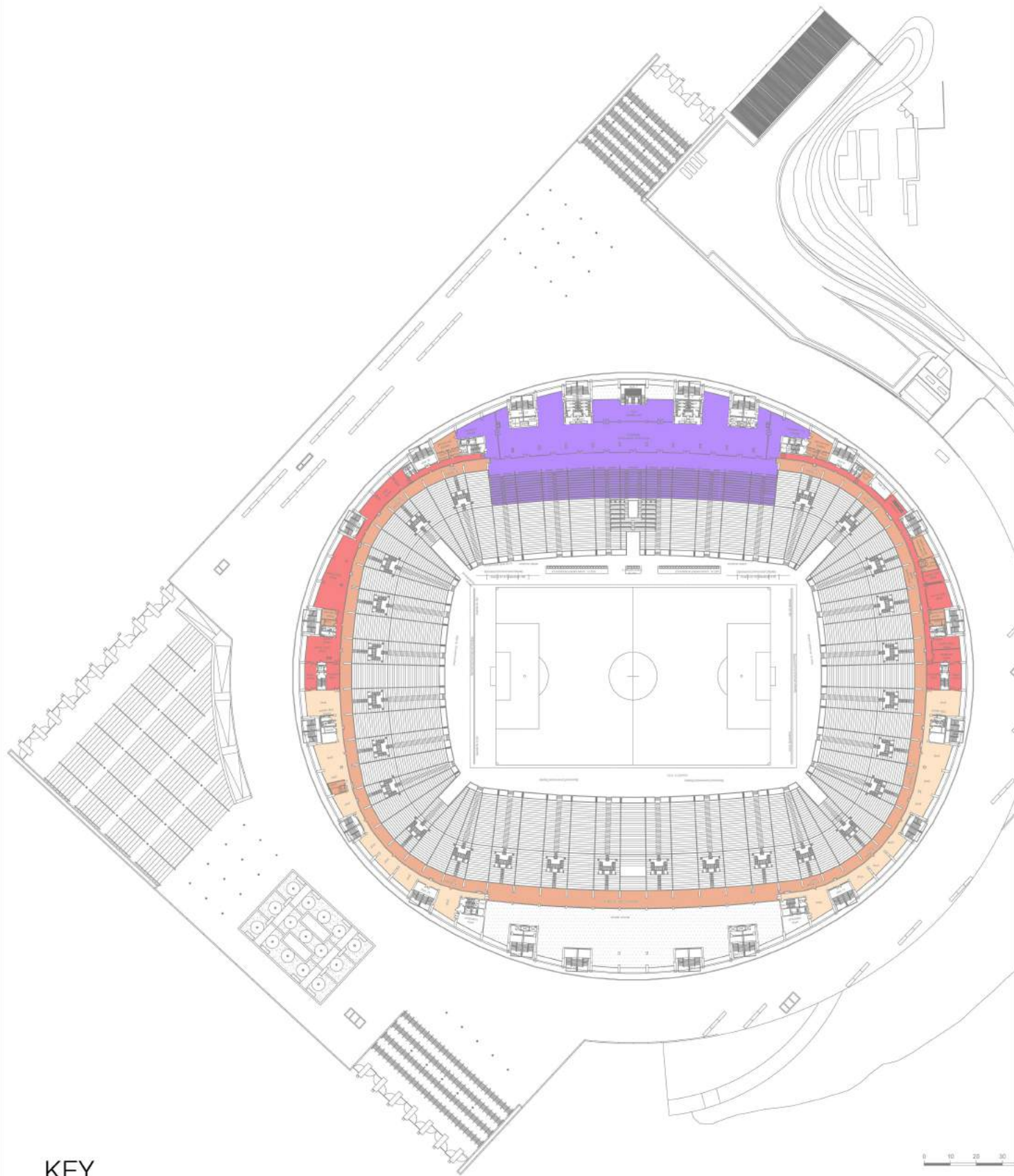
- concourse
- VIP/media facilities
- food and beverages
- operations: services / storage / plant



KEY

- media centre
- VIP/media facilities
- operations: admin / offices
- operations: services / storage / plant

Cape Town Stadium
Level 3

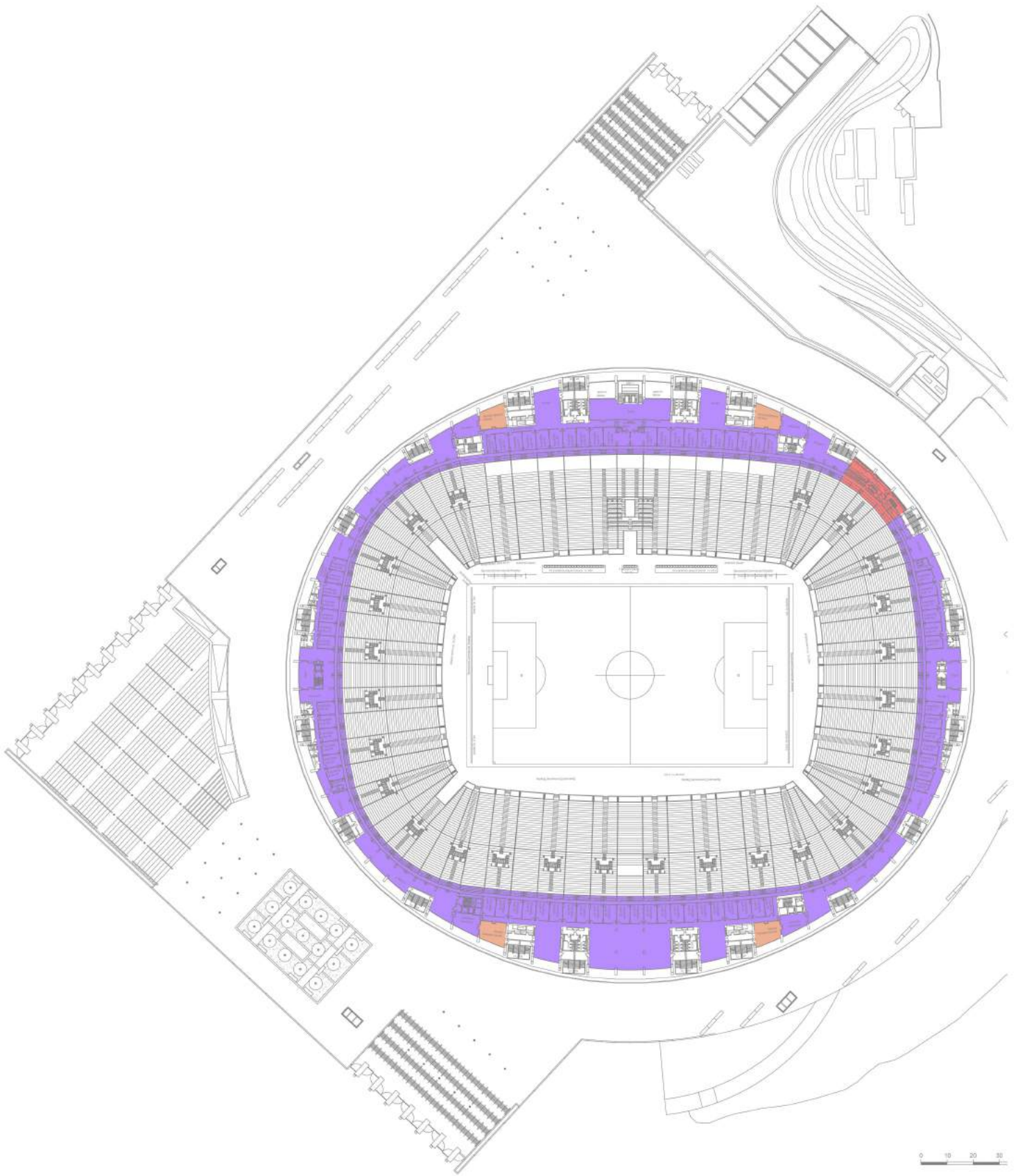


KEY

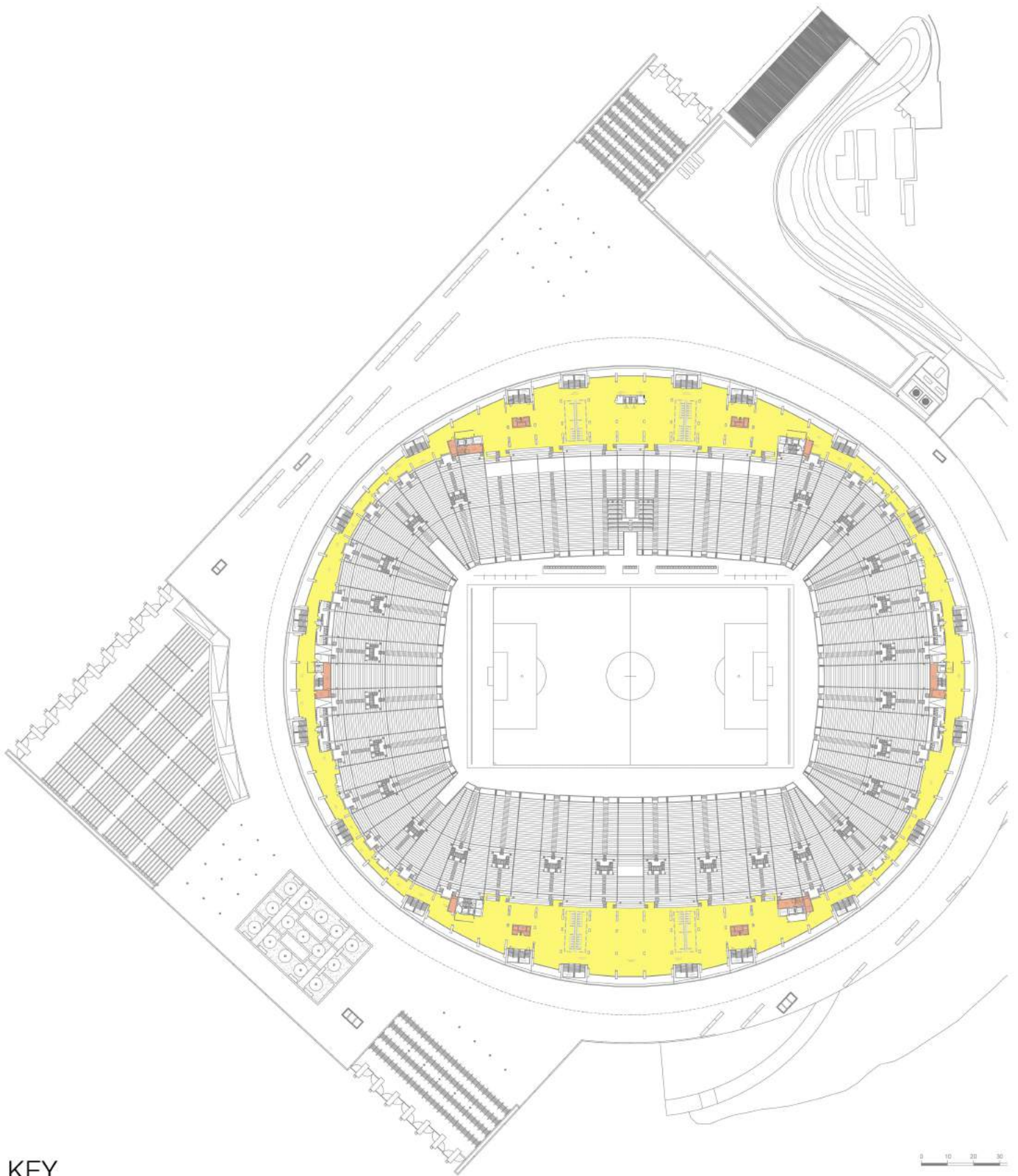
- undesignated areas (empty shell)
- VIP/media facilities
- operations: admin / offices
- operations: services / storage / plant

Cape Town Stadium
Level 4



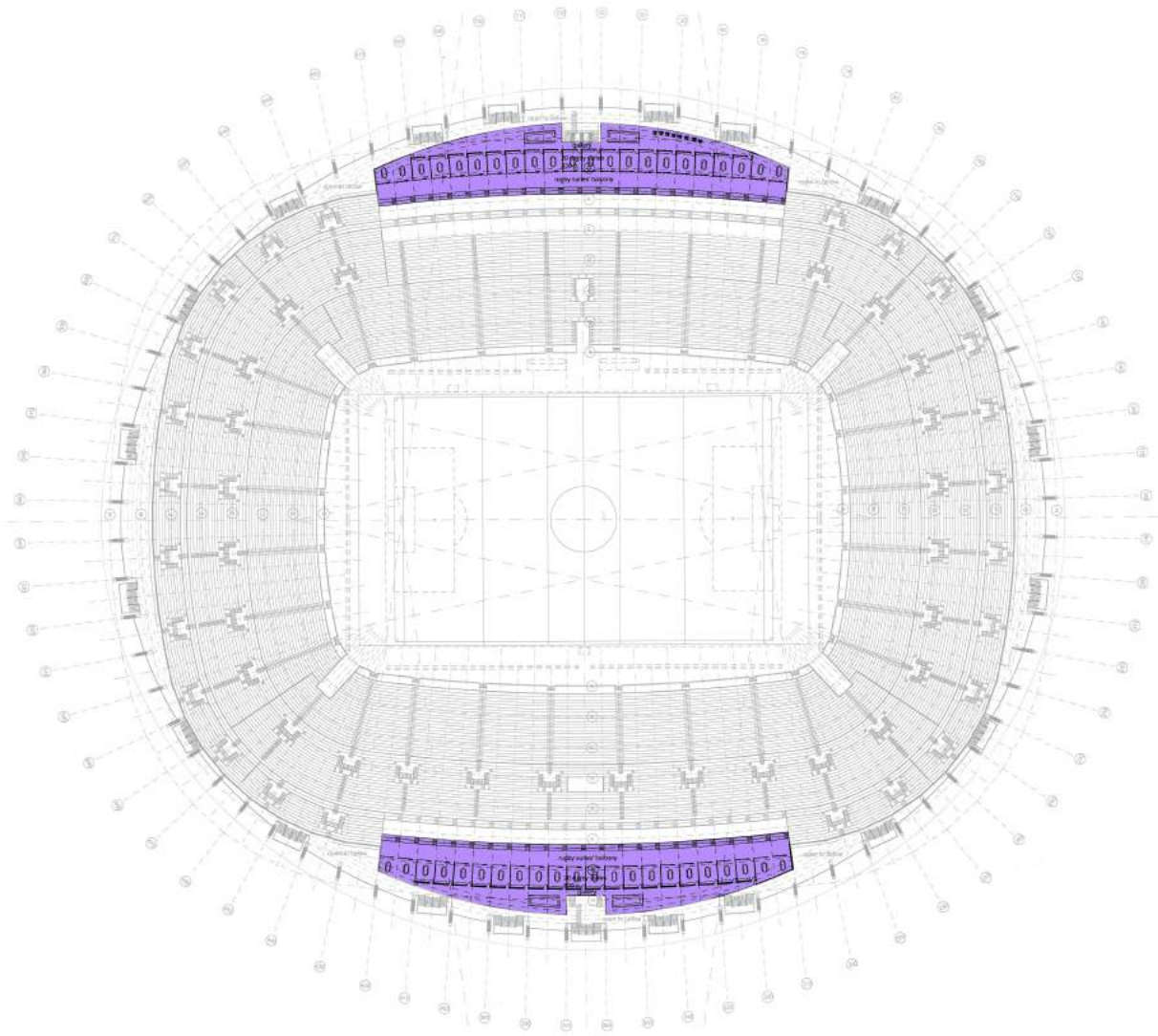


 Cape Town Stadium
Level 5



KEY

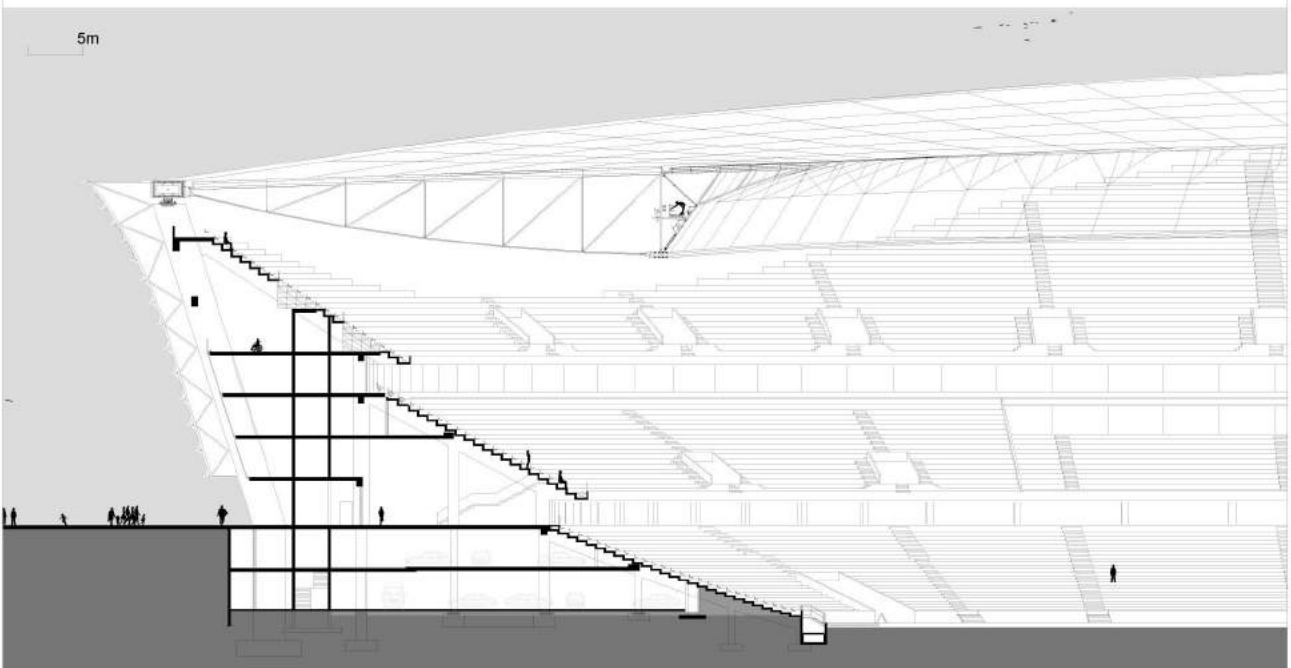
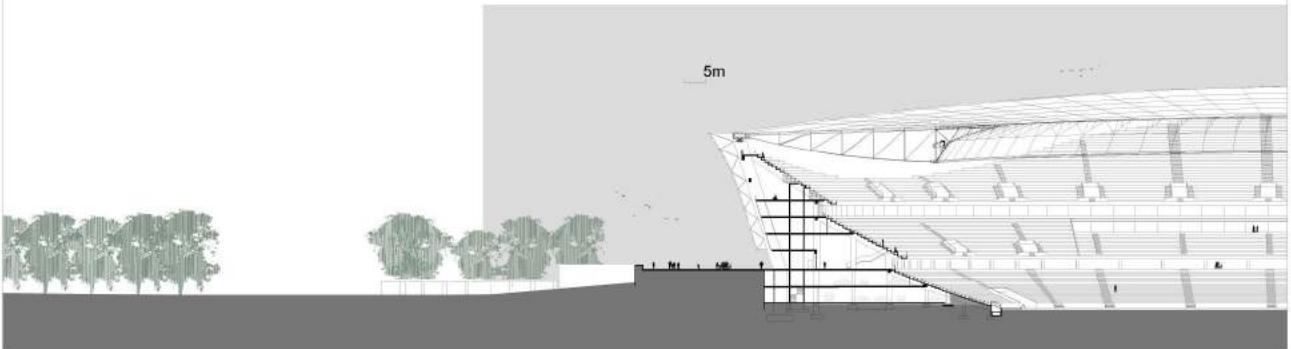
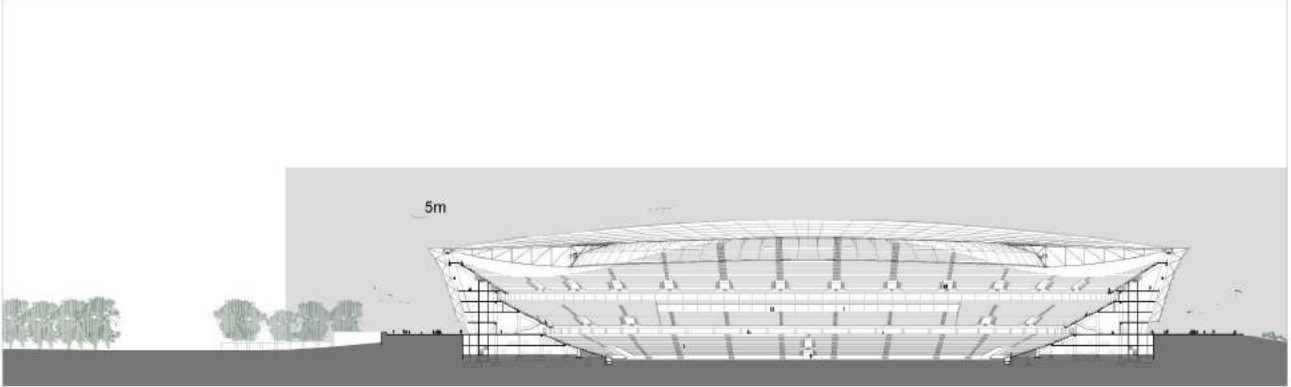
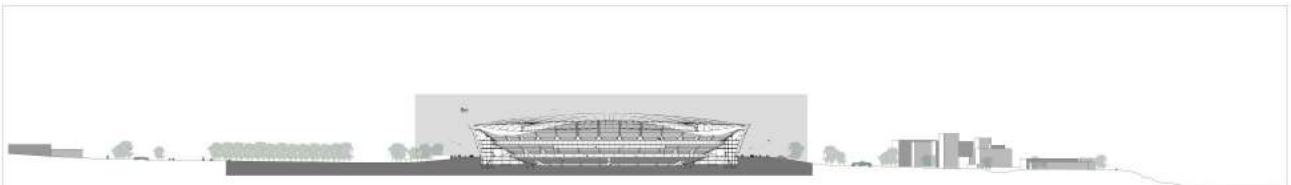
- concourse
- operations: services / storage / plant



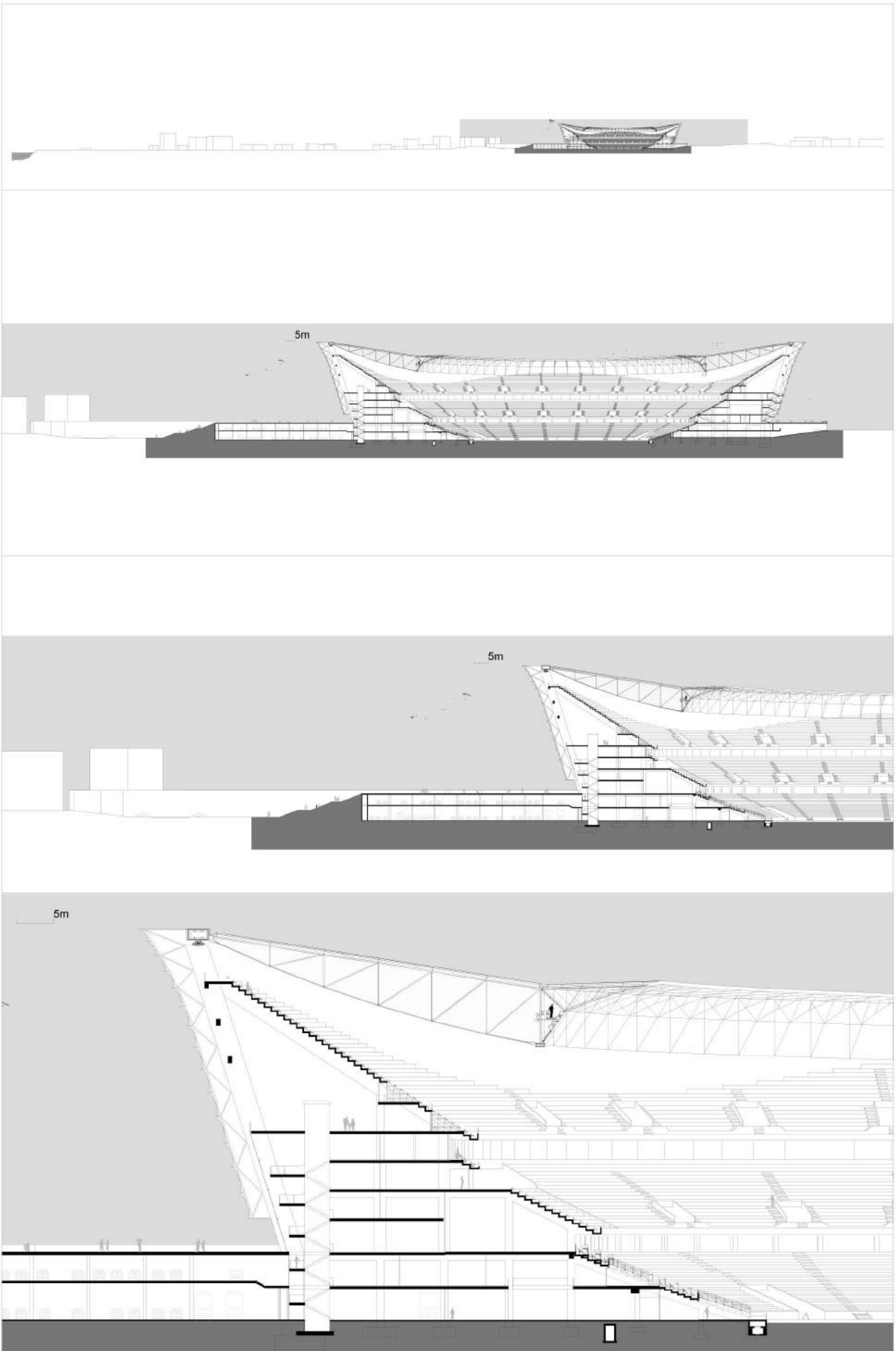
KEY

- concourse
- VIP/media facilities
- food and beverages
- operations: services / storage / plant

Cape Town Stadium
Level 7



North-South Section



East-West Section