Empathetic Kinaesthesia
Sport within Architecture

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Master Thesis Explanatory Document

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Abstract

“Where crowds gather, history is made.”

Spiro Kostof

Sport has been part of human life throughout recorded history, shaped by architecture since ancient times. How is this still relevant today as we strive towards future ‘sporting legacy’?

This project looks at the impact of a proposed global sporting event in Auckland in a masterplanning exploration, after which a particular stadium is chosen for further development in terms of legacy transformation and spatial/structural articulation.

The latter part of the project seeks to incorporate theories of kinaesthetic movement resulting in empathetic experiences for all users of the sporting venue which reacts to its function, site and legacy.

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Empathetic Kinaesthesia

Sport within Architecture
Architecture has formed the backdrop to large sporting events since ancient sporting games were held in Greece. This was more particularly the Panhellenic Games—comprising the Pythian Games, Nemean Games, Isthmian Games and, most famously, the Olympic Games taking place in Olympia as early as 776BC. Although architecture itself was minimal, as the “stadium” in Olympia was essentially a U-shaped running track at the bottom of an artificial valley with seating comprising of mud; but the games would have been a forgotten, or insignificant, event without an attending audience which is estimated to have been about 50,000 at the time. Interesting architectural contributions that are still present on the original site include a raised platform or “exedra” for the judges and a vaulted tunnel leading into the stadium.

After the birth of the first “multi-sport” events in Ancient Greece, the next noteworthy civilization that benefitted from architecture contributing to sport were the Ancient Romans who through the form of amphitheatres, e.g. the Arles Amphitheatre, Verona Arena and the Flavian Amphitheatre, or Colosseum, forced the spectator to have a central visual focus on the proceedings. The Romans proceeded to develop the ideologies offered by amphitheatres and produced the circus, in which equestrian races could take place on an oval-shaped track, enabling continuous laps.

Due to Christian rule in the middle ages and the Council of Arles held in 314, it was decided that equestrian and running events were pagan events, leading to the majority of amphitheatres being abandoned or demolished. Only in the Renaissance were sporting events popularised again, this time taking place in public squares such as Piazza del Campo in Siena and Piazza Santa Croce in Florence. Here, architecture once again made it possible for sporting events not only to take place, but also to be appreciated by an audience.

The rules of particular sports, as well as the formation of clubs, federations and national leagues, took place several centuries later, most noticeably in Great Britain, sparking the need for new sporting facilities. In 1894, the French baron Pierre de Coubertin proposed the revival of the ancient Olympic games, marking the new age of stadia. The first such event took place in Panathinaiko Stadium in Athens which could originally hold up to 80,000 spectators. It marked the first time architecture was intentionally used to facilitate multi-sport events since ancient times. With the industrial revolution taking off in Great Britain—the construction of modern stadia spread all over the globe, with innovations linked to the Olympic Games and the FIFA World Cups.

New Zealand hosted the IRB Rugby World Cup in 2011 for the first time since 1987. The number and quality of stadia around the country made hosting the event, from a facility point of view, a very achievable prospect. The issue though was public transport, which arose on the night of the opening game as trains broke down in Newmarket, resulting in approximately 2,000 fans missing out. The IRB Rugby World Cup is the 3rd largest international sporting tournament in terms of attendance, only surpassed by the FIFA World Cup and the Olympic Games. The question is, apart from some transport issues, if New Zealand is
capable of hosting the 3rd largest international sporting event, is it able to host the 2nd largest; the Olympic Games?

Auckland would be an obvious choice as a host city within New Zealand. It has previously hosted two Commonwealth Games, the Asia Pacific Games, the World Masters Games, the 2012 Triathlon World Championships as well as both of the semi-finals, the bronze final and final of the 2011 IRB Rugby World Cup. Auckland recently looked at putting in a bid to host the 2018 Commonwealth Games and former mayor, John Banks even hinted at possibly bidding to host the 2020 Olympic Games³. The other aspect this Olympic stadium could provide for Auckland is an iconic architectural landmark as well as stepping beyond simply being a building, but also integrating itself into the surrounding context and community, creating job opportunities and being a much needed new high performance venue in Auckland.

Realistically Auckland would never be chosen as an Olympic Host City because of economic or infrastructural reasons, but has a chance as an interpretation of de Coubertin’s ideal Olympic City. In a constant search for a city’s own translation of Coubertin’s visions, Auckland could provide a raw natural setting in which the beautiful landscape forms the backdrop to the games. This “Aucklandness” is interpreted as incorporating prominent natural features found throughout Auckland such as bays, islands and volcanic cones. As Coubertin states himself: “the selected site will necessarily influence the architectural design. Lake Geneva or San Francisco Bay, the banks of the Thames or of the Danube, the Lombardy plain or the Pyszta vary greatly in line and colour.”

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⁴ Pierre De Coubertin, Olympism: Selected Writings (English Version translated by Norbert Muller), 257
The purpose of the project

The project is clearly divided into two parts; the first (chapters 1-2) dealing with the site and masterplanning of the Auckland Olympic Park, whilst the latter (chapters 3-5) deals with a particular chosen facility, the Auckland Olympic Stadium. This has been done to allow a series of theories to be tested at a vast range in scale.

Part 1_ Auckland Olympic Park

Apart from the obvious: Is Auckland able to provide architectural solutions that enable the city to host the Olympic Games?—this project seeks to find the underlying connection between sport, urbanism and architecture. At an urban scale the purpose of this project is to analyse the latest trends in stadia and sporting facilities which are constructed at a metropolitan scale. This includes architectural considerations such as being a defining part of a city’s skyline, being integral to transport networks and surrounding land uses as well as assisting and triggering urban regeneration all around them. This all rephrases the above question to: How can urban planning and design assist in Auckland plausibly hosting an Olympic Games?

Part 2_ Auckland Olympic Stadium

Integral strategies in sporting facilities in this day and age are structural, economic, cultural and ecological sustainability; how the new facilities will be used after the Games. Legacy is an ever expanding term associated with large scale sporting events, which we are only now beginning to grapple with. Host cities, such as London, masterplan for future uses of the Olympic Park before even bidding to host the Games. So, how are sports stadia able adapt themselves after their short Olympic lifecycles?

Transformation and adaptability will need to be explored.

The detailed analyses of how architecture influences sport will likely focus on the structure and circulation of a chosen facility. Subjects such as movement and empathy will have an active role in shaping how users of a stadium experience their environment. How does architecture influence, or discourage, sport taking place and how can it cater to over 50,000 clients that use and experience it? How are these issues addressed after the Games?
Despite New Zealand as a whole benefitting largely from the IRB Rugby World Cup economically, the smaller businesses have been suffering as consumers have been distracted by the sport with sections of downtown described as “like Bosnia with its Portaloos and temporary fencing”. The purpose will not simply be to design an Olympic Stadium and an Olympic Village for Auckland, but also to analyse how hosting an Olympic Games would change the urban fabric with sport types hosted all over the city needing new or redeveloped sports venues which in turn could provide SME’s with consumer impetus.


I believe the future focus in the field of sport architecture will be in the “recyclable”, “transformable” and “relocation able” stadia, as planned for the 2022 FIFA World Cup in Qatar.

Part 1 – Auckland Olympic Park
Site Establishment
Dr Timothy S. Chapin of the Department of Urban and Regional Planning of Florida State University states: “as I hope to have made abundantly clear, little is known concerning the location of sports stadia in metropolitan areas in North America or elsewhere.” In his article “Some Ideas on Stadium Location” he references some small studies done by American urban planners which mainly focus on baseball stadia and their economic effects on the surrounding neighbourhood. He adapts an article by Swallow, Opaluch and Weaver in which they outline an approach to siting large, noxious facilities as follows:

1. Choosing a long list of sites based upon certain minimum technical standards. For stadia this would include a minimum parcel size, existing public transportation, parking infrastructure and compatibility of neighbouring uses.

2. The second stage narrows the original site list by some social standards. These social standards might include a desire to revitalize downtown (i.e. Baltimore, Cleveland) or a goal of integrating the existing stadium with the convention infrastructure (i.e. Atlanta, St. Louis). This process should narrow down the list of sites significantly.

3. The third, and final, stage has been labelled by the authors as Compensation/Community Acceptance. Swallow et al clearly recognize the implications of locating a noxious facility. The existing community within which this facility is to be inserted is likely to be opposed to the decision. Invariably some form of negotiation will be required to determine an adequate compensation for the community. For examples, in Atlanta the siting of the new Olympic Stadium in the same neighbourhood as the existing Fulton County Stadium required special concessions from the Olympic Committee and the Atlanta Braves regarding parking revenues and local hiring.

Following through with Swallow, Opaluch and Weaver’s process resulted in the following when applied to Auckland:

1. Long list of sites based upon minimum technical standards (refer to Figure 1 for letter significations in brackets after location names)
   - North Harbour Stadium (S)(R)(E)(B)-M-
   - Trusts Stadium (S)(E)-M-
   - Rosebank Park Domain (S)(E)(F)(B)-M-
   - Western Springs (S)(E)(B)-T--M-
   - Avondale Horseracing (S)(E)-T-
   - Waterfront/Marsden Wharf (U)(F)(B)-T-
   - Carlaw Park (U)(E)(B)-T--M-
   - Victoria Park (U)-M-
   - Point England (S)(B)-T-
   - Mt Smart Stadium (S)(E)-T--M-
   - Mangere Inlet (S)(R)(F)(B)-T--M-
   - Telstra Clear Pacific Events Centre (S)(E)-M-

2. Narrow the original site list by some social standards
   The two sites with the most potential are North Harbour Stadium and the Mangere Inlet. Other sites with plenty of features are Rosebank Park Domain, Western Springs and Carlaw Park. They were all considered as sites for the proposed new stadium for Auckland to host the 2011 IRB Rugby World Cup. 

An Auckland-wide search
have suited that purpose, but would not have sufficient space for a larger Olympic development. The IOC requires Olympic Parks to be as compact as possible and the three above mentioned sites would be more suitable for a scheme which clusters venues in separate sites around Auckland. This would be disadvantageous as will be explained later.

The focus now shifts to the two candidate sites; North Harbour Stadium (NHS) and the Mangere Inlet (MI), in order to assess their advantages and disadvantages.

Figure 1 _ Possible locations for Auckland Olympic Park

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7 IOC Manual for Cities Bidding for the Olympic Games, (Lausanne, Switzerland: The IOC, 1992)
Possible Site A: North Harbour Stadium

**Location:** 19km north of Auckland CBD

**Infrastructure:** Motorways 1 + 16, Northern Express Bus Lane, Whenuapai Airport

**Context:** Suburban-Rural fringe. Borders Westfield Albany Shopping Centre, Albany Village, Oteha Valley Reserve, Albany Domain, Suburban Oteha + Pinehill, Kell Park

**Sporting context:** ASB Tennis Centre, Millennium Institute (aquatics), Crown Auckland Hockey Centre, North Shore Golf Course, North Shore Events Centre (basketball, gymnastics, table tennis, etc.), Lukas Creek (slalom kayaking), Hauraki Gulf (sailing), Waitemata Harbour (rowing)

Located in Albany, situated on the North Shore of Auckland, this site combines the advantages of an existing 25,000 capacity stadium, few resource issues and good infrastructure. The existing NHS is home to North Harbour Rugby and is also renowned for hosting international test matches of various sporting codes such as football, rugby union and rugby league. The south-eastern side of the ground is dominated by an existing roofed grandstand and the other sides only feature unroofed grandstands or grass embankments, which mean that expanding the regulation rugby pitch to an athletic sized one will not be much of an issue. The greatest advantage of the NHS site is that there are almost no resource consent issues as the entire site is designated as a sporting complex. The infrastructure of State Highways 1 and 16 will deliver cars from western and southern Auckland and the Northern Express Bus Lane will provide a public transport corridor to and from the CBD. The potential to build a light rail line alongside the bus lane is also extremely plausible. In terms of being a ‘beautiful’ site, the site is surrounded by the Albany Heights embankment of native bush on the northern edge, making the site appear to sit in a cauldron. A few small rivers also border the site which could provide an attractive wetland. In order to obtain sea views, an observation tower/Olympic cauldron similar to London’s ‘Orbit’ could be planned into the proposal.
Figure 2. Location of North Harbour Stadium (red) relevant to Auckland’s CBD (blue).

Figure 3. Site plan of North Harbour Stadium.
An optimal location, beautiful backdrop and excellent infrastructure all combine to make this site an ideal ‘Auckland Olympic Park’. Located 15min from Auckland International Airport and 20min from Auckland CBD, this site effectively bridges the central and southern districts of the city. Intertidal bays and views towards volcanic cones as well as the Manukau Harbour entrance make the setting a great representation of the beautiful natural aspects of Auckland. The existing infrastructure includes State Highway 20 which comes directly from the airport and crosses the inlet via the Mangere Bridge, State Highway 1 which passes of the eastern fringe on the site and rail lines linking the CBD and southern Auckland with multiple train stations in close vicinity to the site. The proximity of Mt. Smart Stadium and Waikaraka Park offer the potential of sporting axes.

3. Compensation/community acceptance

The decision on the site for the Auckland Olympic Park can be helped by placing the sites in a table and assessing the sites against each other in various categories:

<table>
<thead>
<tr>
<th>Less resource consent issues</th>
<th>NHS</th>
<th>MI</th>
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<tr>
<td>Better proximity to airport</td>
<td></td>
<td></td>
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<tr>
<td>Better existing infrastructure</td>
<td></td>
<td></td>
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<tr>
<td>Closer to the CBD</td>
<td></td>
<td></td>
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<tr>
<td>More public transport potential</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More ‘beautiful’ location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More historical relevance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iconically ‘Auckland’</td>
<td></td>
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As is very obvious from the simple comparison above, the Mangere Inlet site clearly has far more potential as a site for the Auckland Olympic Park. Further advantages of choosing the MI as the final site will be made clear in the following section.
Figure 4 _ Location of Mangere Inlet (red) relevant to Auckland's CBD (blue)

Figure 5 _ Site plan of Mangere Inlet
Greater Auckland

Figure 6 shows the Mangere Inlet (red square) placed conveniently between the Auckland CBD (blue circle) and Auckland International Airport (green airplane). As Pete Bossley and Barry Copeland stated during their proposal for a new IRB Rugby World Cup stadium, this site is clearly an excellent choice for a sporting complex to be integrated into Auckland’s fabric (see appendix column for article quote).

One of the most important factors in planning large international sporting competitions is infrastructure as Bossley and Copeland identified. The major factor here is motor vehicle infrastructure and, when observing greater Auckland on Figure 7, motorways (pink) run past the eastern and western fringes of the site. State Highway 20, which defines the eastern edge of the Mangere Inlet as the Manukau Bridge, provides a 15min link to Auckland International Airport and, once the connection to State Highway 16 is established, this will also network western Auckland with the site. State Highway 1, which runs parallel to the train lines on the western end of the site, will allow motor vehicle traffic from southern and northern Auckland.

The last important feature that the MI site possesses at this scale is that according to Barry Copeland, it is geographically centred in Auckland8. This is evidently so when major roads are highlighted in yellow on Figure 8 which shows the highest concentration of major roads centring themselves around the MI. This could point towards greater congestion around the site, but this also provides a large range of access/egress roads and together with numerous public transportation options truly make the central location of the MI accessible to all Aucklanders as well as visitors.

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8 Interview with Barry Copeland 13.02.2012
The new stadium should be easily accessible by car, train, and foot, without contributing even more to localized congestion. It should also be accessible to the thousands of supporters coming from south of Auckland and also be handy to the airport. Extremely importantly, also, it should be in a location which would not offend existing residents and businesses. It should be acceptable to the surrounding population during the disruptive period of construction, and also during operations over the next 100 years. It should be a valued part of the urban fabric, rather than an imposition. It should be in scale with the surroundings, rather than overshadow them. It should be something which people would be proud to look at, rather than something which blocked their view or connection with light and air. These were our criteria. Consideration of the maps of Greater Auckland, and an awareness of the areas of future population expansion, carried out in conjunction with town planning and environmental engineering advice, led us to what we consider to be the only appropriate location: at the head of the Harbour.

Manukau Harbour

In terms of vicinity, the distance to the CBD from the Mangere Bridge is 12.6km with a driving time around 20min and to Auckland International Airport the distance 10.3km with an estimated drive time of 11min. To once again compare to North Harbour Stadium, the distances from there to the CBD and Auckland International Airport are 18.9km and 39km respectively.

When Figure 11 is overlaid with existing infrastructure, the connections to the CBD and the Auckland International Airport become a lot more apparent. As discussed earlier, the motorways (pink), will be vital for delivering vehicles to the site and, once the Waterview Connection is complete in 2017, State Highway 20 will connect to State Highway 16 allowing shorter commuting times with western Auckland. Once this is done, Auckland’s motorway network will look as displayed in Figure 13.

Rail will play an increasingly important role in aiding Auckland’s congestion problems and would also be vital in connecting an Olympic Park situated on the Mangere Inlet to the rest of Auckland. Figure 11 shows the Auckland rail network (blue) defining the eastern edge of the MI. The Westfield, Te Papapa and Penrose Stations in walking distance of the MI and Mt Smart Stadium will be receiving the majority of people commuting via train.

Figure 9 shows that these stations are connected on three of Auckland’s four rail lines, namely the Eastern, Southern and Onehunga lines, meaning a greater distribution of people across more lines. More detailed analyses of rail potential will be discussed later in the masterplanning section.

Worth observing from this scale is the distribution of regional parks around the Manukau Harbour as depicted in Figure 12 in light green. The highest concentration occurs at the mouth of the Mangere Inlet with Avondale South Domain, Manukau Domain, Wattle Reserve and Ambury Farm Park situated on the southern entrance to the Mangere Inlet. The only public park with access to the Mangere Inlet itself is Norana Park which comprises little more than three softball pitches. There is obviously a need for quality regional parks providing public access to the Mangere Inlet. An Olympic Park could well provide that.

Figure 9 - Auckland Rail Network and suitable stations for pedestrian access to the Auckland Olympic Park
Mangere Inlet

- History

Located in the north-eastern corner of the Manukau Harbour, this inlet has been highly modified by land reclamation and industrial use. It used to be the outlet of three historic streams and provide tidal inundation to the Hopua volcanic crater forming Onehunga Basin. Anne’s Creek remains in the north-east corner, although it has been encroached by land reclamation on the eastern shore to form the Westfield rail yards. The northern shore has been almost straightened by Pike’s Point airport and now mostly consists of an assortment of abandoned factories and landfills.

The southern edge has remained mostly intact with Harania and Tararata Creeks opening into the Manukau Harbour here, although their upper reaches are dissected by high volume roads and are heavily forested with mangroves. The only actual island in the inlet is Ngarango Otainui from which a shelly shoal extends westwards which has been present since being mapped in 1853 (Figure 15).

Due to the fertile volcanic soils, abundant marine life and the narrow corridor of land that separates the Tasman Sea to the Pacific Ocean, the Mangere Inlet has had a long history of human use and development. “Portage Road” has enabled Maori and early Europeans to transport canoes and boats between the east and west coasts via the Otahuhu Creek and the Waiuku Portage has provided a critical link with the Waikato River. Seafood has been actively acquired by Maori, due to the tides exposing extensive mudflats. The Maori also altered the landscape by clearing forests to promote the growth of fern bracken as well as for horticulture.

When Europeans first settled along the shores of the inlet in the mid-1800s it was used mainly as Auckland’s agricultural centre. In the 1870’s numerous small industries established themselves around the inlet including meat works, tanneries and brickworks. The present-day Westfield rail yards were constructed on the eastern foreshore by 1875 and further industrial growth centred around this area led to wastewater being directly discharged into

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9 Auckland Regional Council, Environmental Condition and Values of Mangere Inlet, Whau Estuary and Tamaki Estuary (Auckland: The Council, 2008), 44.
Urban and industrial development which expanded during the 1900’s led to ongoing discharges leading into the inlet which include the following sources (located in Figure 16):

1. Roskill Septic Tank
2. Onehunga Septic Tank
3. Tannery
4-6. Wool Scours
7. Fertiliser Works
8. Glue Works
9. Battery Factory
10. Board Mills
11. Animal By-products
12-13. Freezing Works
14. Meat Company
15. Soap & Candle Works
16. Fertiliser Works
17. Freezing Works
18. Municipal Abattoir
19. Otahuhu Septic Tank
20. Railway Workshops
21. Middlemore Hospital.

Figure 16. Schematic map of the Mangere Inlet

the inlet. Figure 17 shows the soil condition of the Westfield rail yards site. Interestingly over 60cm of soil has been gained through land reclamation.

Figure 17. Soil records of land reclamation in the Mangere Inlet

Decomposition of organic wastes stranded on the mud flats led sulphate reduction under anaerobic conditions resulting in complaints about the smell of hydrogen sulphide and blackening of lead paint on houses in adjacent neighbourhoods. In 1962, the Mangere Sewage Purification Works opened to handle these discharges which greatly improved the environmental conditions within the harbour. The last decades of the twentieth century involved further land reclamations and straightening of northern shore of the inlet. The Mangere Wastewater Treatment Plant was upgraded in 2001 and the former oxidation ponds were returned to the harbour.

The Mangere Inlet is meso-tidal, meaning it has a tidal range (neap/spring tides) of 2-4m, with the average being 2-3.4m at the Onehunga Wharf. Peak velocities at the entrance to the MI reach 1.0ms\(^{-1}\) during spring tides and 0.50ms\(^{-1}\) during neap tides.\(^{12}\)

Although tidal-driven circulation is prominent in most areas of the Manukau Harbour, the upper reaches and inlets such as the Mangere Inlet are characterised by wind-driven circulation through downwind flows over intertidal sand banks with pressure-driven return flows in the deeper main channels.\(^{13}\)

The prevailing surface-wind directions are from the south-west (26%), north to north-east (24%) and west (10%). The dominant wind speeds occur in the range of 2-4ms\(^{-1}\) (42%) while speeds in excess of 9ms\(^{-1}\) occur 15% of the time.\(^{14}\)

During the dominant south-westerlies, a coherent north to north-east wind-induced flow is established at higher tide levels along the north-eastern perimeter through Mangere Inlet. This mechanism partly explains the large influx of suspended sediment often found on the southern side of the Mangere Inlet during the late stages of a flood tide, after a persistent south-west breeze of 6-8ms\(^{-1}\) together with locally sourced sediment stirred from the adjacent near shore surf zone (see Figure 19).\(^{15}\)

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\(^{13}\) Bell, "Hydrodynamics of Manukau Harbour," 81.

\(^{14}\) Ibid. 83.

\(^{15}\) Ibid. 95.
• Topography

The focus now shifts towards microsites within the Mangere Inlet in order to define the site boundaries. Figure 20 shows the terrain around the MI, with the contours (red) highlighting some volcanic cones in the vicinity, most notably Mangere Domain, Mt Richmond, Hamlin’s Hill and Mt Smart. The volcanic overflow of these volcanoes still define the form of the Mangere Inlet to some extent but the northern shore is an exception as it has been vastly altered due to “port activities, roading and coastal reclamation” since the 1950’s\textsuperscript{16}. A focal point from anywhere within the Inlet is Mount Mangere which defines the horizon at the mouth of the Mangere Inlet and will be an icon to draw sightlines towards.

Figure 20 clearly shows that the land surrounding the inlet

\textsuperscript{16} ARC, Environmental Conditions, 43
is fairly flat, meaning major earthworks to remove large hilled landscapes will not be necessary to accommodate the Auckland Olympic Park, although sometimes artificial landscapes are sculpted to produce dynamic landscaping within the Olympic Park, as was done for the 1972 Munich Olympics.

- Built Environment

As depicted above in Figure 23 the Mangere Inlet is almost exclusively surrounded by commercial and industrial buildings (pink), especially along motorway and rail corridors. Residential housing (yellow) seems to be pushed inland and away from the inlet. There therefore exists an opportunity for an Olympic Village located on the shore of the Mangere Inlet to connect with an existing residential community.
Figure 26: Panorama from northern shore of the Mangere Inlet towards Mount Mangere
From research conducted on the Mangere Inlet, a site for the Olympic Park can be defined along the northern shoreline. The site occupied by the Olympic Park and the Olympic Village is described by the Auckland Council as “industrial / business land with little landscape value”, currently consisting of dilapidated warehouses, industrial buildings and landfills.

In the Auckland Plan, Onehunga has been identified as an area in need of development with ambitious density plans:

This site(s) represents one of Auckland’s best opportunities to provide a significant number of new residential dwellings, in a building form and density that is perhaps not available elsewhere. With the need for at least 300,000 new dwellings in Auckland over the next 30 to 50 years, unless there are some areas where large numbers of dwellings are provided, this figure will not be possible through small amounts of incremental infill development.

As shown in Figure 27 the Olympic Park site is bounded in the north by Nielson St., in the east by the Southern line of the Auckland Rail Network, in the south by the Mangere Inlet itself and in the west by Waikaraka Park. The Olympic Village plugs into the Olympic Park in the north-west and extends in that direction towards residential Onehunga.

In order to grasp the scale of an Olympic park and the infrastructure required, site visits to Olympic Parks in London, Berlin, Munich and Barcelona were undertaken with the London Olympic Park (LOP) analysed in depth along with the Olympic Delivery Authority document Design and Access Statement – Olympic, Paralympic and Legacy Transformation Planning Applications.

The first associated task was to produce a list of required stadia and other facilities with their functions (and abbreviation in brackets):

- Olympic Stadium (O) – athletics, opening and closing ceremonies
- Olympic Cauldron (OC) – Olympic Torch
- Aquatic Centre (A) – swimming, water polo, diving
- Basketball Arena (B) – basketball, volleyball, badminton, table tennis
- Handball Arena (H) – handball, weightlifting, combat sports
- Velodrome (V) – track cycling
- Primary + Secondary Hockey venues (FH) – field hockey
- BMX Venue (BMX) – BMX cycling
- Fencing Venue (F) – fencing, combat sports
- Gymnastics Arena (G) – gymnastics, combat sports, weightlifting
- Rowing Venue (R) – rowing, kayaking, canoeing
- Sailing Venue (SL) – sailing
Key redevelopment goals of the Auckland Plan include:
- Land between Waikaraka Park/Cemetery and SH20 rezoned and masterplanned to provide for a new residential community, supporting the existing town centre (as opposed to creating new town centre)
- Create clear and legible route through development to existing rail station and town centre
- Create high quality waterfront route – walking, cycling, slow speed vehicles
- Provide associated amenities – such as additional (primary) school, town park, small retail units, additional leisure and community facilities
- Clear and legible public transport link route provided to circle through new development and link people into Onehunga town and nearby key facilities
- Range of residential buildings, including 2-3 storey terraced housing and apartment buildings, ranging from 3-10 storeys
- Perimeter block model to be commonly used buildings close to the street edge with inner areas used for private amenity space. Car parking accommodated in (semi) basements and on-street, but avoiding excessive surface parking areas.
- Highest density in north west corner (close to existing rail station), with density decreasing away from this point
- Areas immediately along Neilson Street could provide opportunity for commercial or mixed use buildings.

From the list, relationship diagrams could be established. They serve as a comparative tool in order to indicate certain relationships venues/facilities might have with each other (see Figures 31 + 32).

The key lay in separating the 5 major venues (Olympic Stadium, Aquatic Centre, Basketball Arena, Handball Arena and Velodrome), whilst still providing straightforward concourse connections. The relationship diagrams helped in creating certain hierarchies or groupings. These groupings will lead to the creation of precincts which in legacy mode (after the Games) form concentrated clusters. One such example is the grouping of the Handball Arena and the Fencing Venue which share similar functions (hall sports) and utilise the same back-of-house service area.

The Central Transport Hub (orange surface in Figure 30) serves as the main connection point for most visitors to the Park. It comprises a bus drop-off/pick-up area and the “Olympic Hub” train station (green volume next to it in Figure 30). The “Olympic Hub” train station is connected to the Southern and Eastern Line of the Auckland Rail Network and will bring visitors into the Park via its own shuttle train connected with Westfield and Te Papapa stations. These short stretches will also allow visitors the best way of experiencing the Park with views unfolding along the way to all the major venues.

The two most important circulation routes within the park are the public concourse and the service roads. The concourse (yellow in Figure 30) serves to connect pedestrians with the front-of-house (FOH) areas of the major sporting venues situated in the Olympic Park as directly as possible. At its widest point it measures approximately 100m across as this section connects directly to the Central Transport Hub, whilst the narrowest points, measuring 25m across, are located at extremities or the least trafficked areas. As some venues are distanced far apart along the concourse, the Velodrome and the Aquatic Centre being the most extreme case at approximately 950m, there is an opportunity for a shuttle service along the edge to assist the elderly or disabled. The concourse is to be laid with sections of permanent paving as well as temporary, the latter being removed after the Games.

The service roads (blue in Figure 30) provide access to the back-of-house (BOH) areas of the sporting venues. They will be mainly utilised by delivery vehicles, as well as vehicles dropping off competing athletes and their families to the venues around the Park. The service roads all have outlets to Nielson Street which is set to be widened into a major road also linking State Highways 1 and 20 which bound the site at the eastern and western edges.

As the concourse and the service road are, respectively, public and private, they are separated as much as possible. At nodes where these circulation routes cross each other, such as west of

Figure 29. Relationship table
the Velodrome, the concourse always runs over the service road in the form of a bridge, creating a horizontal barrier. When the circulation routes run parallel to each other, such as between the Olympic Stadium and the Velodrome, trees between them will form a screen, a vertical barrier in this instance.

The other sporting venues outside of the Park are to be distributed around Auckland whilst keeping in mind that they should be well connected with existing state highways and rail. An example would be hosting gymnastics at the TelstraClear Pacific Events Centre, which is easily reachable from Auckland International Airport or the Olympic Park site.
Figure 33: Auckland Olympic Park masterplan
Olympic Stadium
Aquatic Centre
Basketball Arena
Velodrome
Handball Arena
Hockey Venues
Fencing Venue
BMX Venue
Mt. Smart Stadium
Athletic Training
Aquatic Training
Gymnastics Training
Olympic Village
Central Transport Hub
Energy Centre
International Broadcast Centre
Main Press Centre
Sporting Legacy

Legacy has only been a term associated with the Olympic Games in recent years. The constant redevelopment of the Olympic Park after the games is essential in order to avoid state of the art ghost towns and white elephants. The unique approach of the London 2012 Games is that a legacy plan was put into action before bidding to host the Games.

In order for the Auckland Olympic Park to fully adopt a sporting legacy, 3 objectives need to be addressed:\textsuperscript{17}:

1. To unveil the concentration of the stadia in the Olympic Park and the impact on planning of the post-Olympic Park
2. To explore the way of integrating sports and other functions and creating the mixed-use urban precinct with concentrated legacy functions
3. To examine how a mixed-use Olympic Park can be integrated into the broader city context and surrounding neighbourhoods.

1. Concentration of stadia:

During the bidding phase of the 2000 Games, emphasis from the IOC (International Olympic Committee) was placed on concentrating venues for practical and ideological reasons. Previously this technique had only been adopted in Munich, Montreal and Seoul. The 2000 bidding manual stated:

"The geographical area occupied by the sports installations required for the Olympic programme should be as compact as possible. This can be a vital element for awarding of the Games [...] Generally speaking, the IFs (International Federations) wish to have their competition sites as near as possible to the Olympic village and the centre of the Olympic area in general [...] The geographical situation may also be important for post-Olympic use." \textsuperscript{18}

Figure 34 shows diagrams of the six clustering approaches adopted by previous Olympic Parks. When the number of venues are analysed in terms of how many are situated on the Olympic Park a clear trend towards a very compact approach is evident as shown in Figure 35.

In addition to this, the idea of creating “a grandiose and dignified ensemble” which “should be enough to indicate its purpose from a distance” was integral to Pierre de Coubertin’s visions of a modern Olympic Games. He believed that the sites should not be too spread out and should fit into the surrounding countryside site, stating:

"Modern Olympia will inevitably contain many buildings, as will be seen from the examination which we are about to make of its possible organisation.

\textsuperscript{17} Hiromasa Shirai, \textit{From Global Field to Local Neighbourhood: Sustainable Transformation of the Olympic Park for the City} (London: The London School of Economics and Political Science, 2008).

\textsuperscript{18} IOC, \textit{Manual for Cities Bidding for the Olympic Games}, 216.
These buildings, by virtue of their purpose, will often go together. There will be a real inconvenience in separating them too widely. Apart from this practical drawback, beauty would be bound to suffer also from impossibility of taking in the city visually as a whole[…] It is certain that modern Olympia ought not to consist of buildings scattered about a casino park.19

In response to this the Auckland Olympic Park features nine venues within it to cater for the majority of Olympic sports.

2. Integrating sports into a mixed-use urban precinct with concentrated legacy functions:

With Mt. Smart Stadium (northern border of AOP), Waikaraka Park (western border of AOP) and Simson Reserve (eastern boarder of AOP) providing an existing sporting infrastructure to the district (as shown in Figure 36), an Olympic Park on the northern shore of the Mangere Inlet would only further the establishment of a central sporting attraction in Auckland.

Mt. Smart Stadium is home to the New Zealand Warriors, as well as being a ground frequently used for international football games, on a 22-hectare site with more than 1,500 car parks20, so it seems profitable to link it with the Auckland Olympic park. The new “Olympic Hub” rail station within the Park, linked to the Auckland Rail Network will also serve Mt. Smart Stadium in the legacy phase due to close proximity.

Waikaraka Park is a multipurpose park which features six full size and two mini soccer pitches during the winter months whilst adapting into seven cricket pitches in summer.

Simson Reserve, one of 550 sport parks within Auckland, is also multipurpose in terms of providing two softball pitches during summer and one football pitch during winter.21

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When analysing the London 2012 Olympic Park legacy transformation, the emphasis was placed on retaining the main venues in two secluded “Planning Delivery Zones”, in the north and south of the park (see Figures 38 +39). These would later integrate themselves into local neighbourhoods in order to form concentrated clusters within the Park itself.

This approach is also to be implemented in the Auckland Olympic Park, with all the venues retained in legacy situated in a precinct on the eastern end of the park apart from the Aquatic Centre which will form a separate sporting cluster with Waikaraka Park. A great deal of emphasis was placed on the main legacy sporting centre forming axes via public concourses with the existing Mt. Smart Stadium and Simson Reserve in order to form a comprehensive sporting legacy transformation.

3. Integrating the Olympic Park into the broader city context and surrounding neighbourhoods:

The fact that the Olympic Park is surrounded by industry is not much of an issue as it is well integrated into existing transport grids. However, as shown in Figure 23, residential buildings are virtually non-existent along the shore of the Mangere Inlet, which is a main reason for including the Olympic Village, within the Olympic Park. Together with pedestrian access through boulevards and parks, a residential suburb could be connected to the Olympic Village which would grant public access to the shore of the Mangere Inlet after the Games.

When analysing the built environment, the closest residential area to the site of the Olympic Park is Onehunga. A realistic approach adopted in the AOP masterplan is to extend the Olympic Village towards Onehunga along the axis of Marys Road, which also bypasses Te Papapa rail station. This station could then also provide an access point for visitors to the Aquatic Centre via Captain Springs Road.

With sporting events becoming more global and temporary, the emphasis is turning towards “recyclable”, “transformable”

![Figure 36 _ Sporting infrastructure bounding the Olympic Park](image)

Figure 36 _ Sporting infrastructure bounding the Olympic Park

govt.nz/whatson/places/sportsparks/default.asp

![Figure 37 _ Auckland Olympic Park legacy mode](image)

Figure 37 _ Auckland Olympic Park legacy mode
A case study into London’s projected growth after 2012 Olympic Games by Michael Batty is worth mentioning. It discusses that the urban renewal and its knock-on effects will not be felt in east London, where the Olympic Park is situated, but in west London. This he says, is due to the new Crossrail rail line which connects the Olympic Park with western London; as businesses pop up along the line there is a greater demand for retail towards the west leading to population and economic growth. This might not mean much at the present time, but with further legacy planning and infrastructural development, the knock-on effects of the Auckland Olympic Park can reach out to areas of Auckland in need of regeneration.

and “relocation able” stadia. Chicago’s 2016 Olympic Games bid featured 11 temporary venues, including the Olympic Stadium itself, the first ever attempted in this fashion. The 2022 FIFA World Cup, set to be hosted in Qatar, is another event which features mainly temporary structures. As the local football league does not require 45,000 seat capacity stadia, most will be dismantled to approximately 5,000 seats, not unlike London’s 2012 Olympic Stadium. Some stadia, such as the Port of Doha Stadium, will be completely disassembled into five smaller parts and sold to developing Middle Eastern and Asian countries.

The following can be benefits of temporary sporting structures which will drive the future of sporting architecture:

- Lesser environmental footprint
- Avoidance of “white elephants”
- Less maintenance
- Lower operational costs
- Economically sensible

This solution will be integral to Auckland hosting an Olympic Games with the Olympic Stadium and the Basketball Arena along with other smaller venues to be removed and exported in the legacy mode. The remaining stadia will be highly valued and required in Auckland such as a world class Aquatic Centre. Another candidate is the Velodrome which Auckland desires after recently losing the rights to Cambridge for a national velodrome.

Olympic Village

An Olympic Village is an accommodation centre built for the Olympic Games, usually within an Olympic Park or elsewhere in a host city, housing most participating athletes, as well as officials and athletic trainers. After the Munich Massacre at the 1972 Olympics, the Villages have been strictly controlled by security legislations. Only athletes, trainers and officials are allowed to room at the Village, though family members and former Olympic athletes are allowed inside with proper checks whilst press and media are also barred. Purpose-built Olympic Villages are often adapted into town housing which need to integrate themselves in the existing context. In order to distinguish what sort of scale and density would be appropriate for Auckland a short description of the situation follows.

With Auckland’s population ever increasing and possibly set to rise to 2.5 million in 2041, importance is being placed on increasing Auckland’s density.

Auckland is facing an urban transformation with over 600,000 new inhabitants to be meaningfully accommodated over the next 30 years. A quality compact urban form is required to ensure that this growth is contained, as far as possible, within the existing urban limits to primarily avoid unnecessary costs of new infrastructure and protect local food production sources.

Today with the advent of car, we have sprawled the low density suburban model far and wide in a manner that dissuades walking, and cycling, encourages the use of the motor car for mobility, reduces the viability of public transport, increases carbon emissions, erodes ‘neighbourliness’, increases the cost of living and eats into potentially productive land. 26

In order to combat the urban sprawl which is plaguing Auckland, the Auckland Plan proposes several models of higher density dwellings to set the standard for new developments in the city. Precedents they have identified as optimal include Kingston in Canberra (Australia), Vauban in Freiburg (Germany) and Dockside Green in the City of Victoria (Canada).

Focussing on the northern shore of the Mangere Inlet, an extension of Onehunga is proposed as discussed earlier and depicted in Figure 26.

The scale of the proposal is reminiscent of that in Kingston, Canberra with 3-4 storey units surrounding a common green, occupying 1 block (as pictured in Figure 44).

With this in mind two solutions were developed for the Auckland Olympic Park. First the “¼ acre dream” urban sprawl example which features predominantly two storey housing along with three to four storey town houses along the edge of the Olympic Park, pictured in Figure 46. This is very reminiscent of the Sydney Olympic Village from the 2000 Games which is suitable for the newly developed suburb of Homebush. However the scale and density would simply prove to be an extension of Onehunga without setting much of a standard for new urban housing.

The second example (see Figure 47) looks at raising this density to the levels proposed in the Auckland Plan as this solution respects the new Auckland Plan could prove to raise the standard of scale in Auckland to combat ever rising population levels. A good example of a successful development of this scale is the Vauban district in Freiburg, Germany (see appendix column for more info).

As the final outcome and form is strictly controlled by the IOC, the above examples can only be treated as comparative models. The document *Technical Manual on Olympic Village*[^27] sets the guidelines for Olympic Villages and applying these to Auckland could form a thesis in itself.

In the Vauban district in Freiburg, Germany the following criteria were incorporated into the scheme:

- Mixed use town centres with retail and commercial opportunities
- A diversity of housing choices in any given area – from large family homes to small units
- Strong support for the continuation of an urban design panel to review significant developments.
- High quality design of public places
- Streets should be developed and managed as public spaces rather than just movement corridors
- Before zoning for intensification a thorough assessment of heritage values must be undertaken
- An emphasis on the development producing renewable energy through photovoltaic panels, wind turbines and heat exchangers
- The built environment must enhance the natural environment
- New buildings should feature accessible design
- Support for low-impact urban design and water sensitive urban design principles
- Support for initiatives Crime Prevention Through Environmental Design
- Feature sustainable materials
- Materiality and detailing that breaks down the scale of the larger townhouses as their appearance may seem “threatening” to Aucklanders
- Car parks on the periphery of the development, cutting down vehicular traffic within

Final Images from Masterplanning Phase

Figure 48 _ Model of Auckland Olympic Park

Figure 49 _ View towards Auckland Olympic Park from Westfield Train Station
Figure 50 _ View over Auckland Olympic Park with the Aquatic Centre in the foreground
Part 1. Conclusion

Is the Olympic City a representation of a vision or of a reality, a city or an image, a global or a local environment, an inherited ideal or an imaginary form, a fertile or sterile utopia, a glorification of a past or a present commodity?  

The defining quote from Stephany Tzanoudaki above of the role design plays in the characterization of an Olympic Games has been a guide throughout the process of establishing a masterplan of the Auckland Olympic Park. As mentioned in the introduction, one of the most important factors to observe is capturing “Aucklandness” and translating it into the masterplan. Auckland would, realistically, never be chosen as an Olympic Host City due to economic or infrastructural reasons but rather as an interpretation of Pierre de Coubertin’s ideal Olympic City. In a constant search for a city’s own translation of Coubertin’s vision, Auckland could provide a raw, natural setting in which the beautiful landscape forms the backdrop to the games, as requested by de Coubertin.

As the modern Olympics are, essentially, an idealised perception of ancient Olympia, or more precisely de Coubertin’s eclectic view of reality, previous Games have strived to link the Olympic past and present aesthetically. De Coubertin gave a significant role to the Arts, inspired by their role in ancient Olympia, aiming to restore the Olympiad to its primal beauty. As the modern Olympic Games evolved, it became evident that Olympism lacked a particular aesthetic expression. This made de Coubertin look for influences from other theorists, most notably from the English art critic and social reformer, John Ruskin.

Through Ruskin’s theories, de Coubertin concluded that he saw “architecture as an expression of man’s inter-relationship with his natural surrounding” which “expresses social history”. For him “original beauty” was something vital and long lasting, similar to the truth of fact found in Ruskin’s words. In an example that he gave of the architecture of the Athens stadium, he supported the idea that different environments were not suitable for the same form, such as the one found in the lines and shape of the ancient stadium. He claimed that, “As pleasing as it may be that the stadium in Athens could be brought back from ruins and rebuilt, it would nonetheless be regrettable to see newer cities try to build similar structures. Such modern structures would lack the historical glory and the special beauty of the unique landscape of Athens.”

Historically the association of Olympia and ‘landscape’ has been only been attempted in a few past Olympics, most notably in Sydney 2000, where Homebush provided the backdrop to the Games. The 1972 Games in Munich incorporated an artificial landscape into which the Olympic stadia were ‘sunk’ as well as organic roof forms which ‘draped’ the structures into the landscape.

The infamous Berlin 1936 Games were portrayed through Leni Riefenstahl’s film which tried to link the past and present Olympic ideals. It celebrates ‘victory’ depicting athletes performing slow-motion actions amongst ‘raw nature’, linking past and present ideals with the intended result being ‘primal beauty’. The design proposal itself on the outskirts of Berlin came reconciled with

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30 Ibid. 49
31 Pierre de Coubertin, Olympisme. Selected Writings (translated by Norbert Muller), (Lausanne, Switzerland: IOC 2000), 614.
the general plans for urban reformation, combining the best features of the city’s urban and rural character. Monumental architecture took centre stage with large neo-classical loggias and facades framing the new Olympic stadium, the largest in the world at the time. Along with the architectural style, other Ancient Greek influences included Dietrich Eckart’s open air theatre, the “Waldbühne”, which simply copied amphitheatres from that time. Ultimately this symbolism and the visual forms served as a means for political propaganda with the National Socialist Party proclaiming themselves “rivals of the Classical Greeks as leaders of a golden age”.32

With the above in mind and de Coubertin’s visions of reviving the Olympic Ideal, restoring the Olympiad to its “primal beauty”, the “spring of mankind” and a “festival of universal youth”33, it was challenging to find an appropriate approach to the Auckland Olympic City. As the Olympic Park is technically a utopia, the question is what sort of utopia? Ideal, imaginary or sterile?

“The danger however of an Olympic city based on the model of an ideal city, is that it uses all its energy to identify the ideal of Olympism with the ideals of a city. Even though it succeeds in breaking the barriers between the Olympic city and the city’s wider territory, it creates new barriers between the city and the rest of the world, ignoring Olympism’s universal principles and cosmic values.”34

An excellent example of an Olympic City successfully navigating these constraints is Barcelona which hosted the Games in 1992. The city was not re-invented or re-placed. It was re-formed and re-generated. Those involved with the city’s planning aimed at bringing back to life the city’s geographical boundaries, the coast and the hill, and linking them with the rest...
of the urban network. The Olympic City of Barcelona is the first in the history of modern Olympism which was not afraid to construct plans based on an ‘ideal city’ concept, proving that the city can represent something much more than the portrait of a temporary ‘utopia’. The Olympic City of Barcelona managed to differ by becoming a natural part of the city and not a framed and illusionary space. “The ephemeral nature of the event was conceived as a means of regenerating the city and a celebration of what was actually achieved during the Olympiad.”

The Mangere Inlet site in Auckland is similar to the Parc de Mar Olympic Area in the south-eastern end of Barcelona, where the Olympic Village is sited, in that it used to be occupied by empty warehouses and alongside a coast which had been turned into a dump for household rubbish and industrial waste. The whole area had been cut off and isolated because of two railway lines which had created a physical barrier between the coastline and the rest of the city. The Mangere Site is also enclosed and even defined by the infrastructure to the east and west as well as the surrounding industrial area.

Agreeing with de Coubertin’s visions of tying the ideals of the ancient Olympiad to the modern one, the Auckland Olympic Park looked at reforming the forgotten Mangere Inlet. By giving the foreshore back some of its original shape and drawing views out to the Manukau Heads and Mount Mangere, it recognises the importance of “Aucklandness”; to be aware of the natural surroundings. Integrating the Olympic Park into the broader city context and surrounding neighbourhoods only serves to further the Park’s ability to connect with local people. It uniquely portrays Auckland and responds to the city, whilst the city will respond to it. The desire for a harmonious combination between man-made structures and the city’s natural environment and landscape, produce, according to de Coubertin’s words:

“A building silhouette and a landscape that would be on equal terms; that would be harmonious: terraces, flights of embankments and inclined planes... would be one of the most certain sources of eurhythmy for the Olympic City and a guarantee of ample beauty and majestic grandeur for the ceremonies which would take place there.”

35 De Coubertin, Olympism, 629
Figure 52. Seating for diving pools overlooking Barcelona from 1992 Olympic Games.

Figure 53. Diving pools from 1992 Olympic Games at dusk.
Part 2 - Auckland Olympic Stadium
Congenial Movements
The geometry of movement

With the masterplanning complete, the focus shifts to the Auckland Olympic Stadium, which is the main athletic venue as well as the location for the opening and closing ceremonies of the Games. As has only been hinted before, it is now time to divulge the driver of all design decisions from this point onwards. It is based on the theories of empathetic kinaesthetics, or congenial movement. What this means is that at its core, the relationship between sport and architecture, is the ability to express the geometry of movement of sport in the static characteristics of architecture so that everybody can relate the movements of athletes to the design of the stadium.

So, how is movement intrinsically tied to sport? It can be considered a way of defining sport itself. One may argue whether motorsports, darts or chess are sports as such—and it is the geometry of movement which decides the outcome. Take for example chess; the placement of the chess pieces by the player influences the outcome of the game. However the actual motion vectors of the chess pieces by the player’s hand do not have an effect on the game, so it cannot be classified as a sport. Darts on the other hand heavily relies on the geometry of movement implied on the dart by the thrower and the same analogy can be bestowed upon motorsport.

Movement or kinaesthetics is hard to discern in architecture as in most cases it is motionless. Theories instead arise about how users of a building might react to it in their motions and embodiment of architecture, also referred to as corporeality,

which was first explored by Vitruvius. When observed in physics, motion is a change in position of an object with respect to time and its reference point, typically described in terms of displacement, velocity, acceleration, and time. Motion is observed by attaching a frame of reference to a body and measuring its change in position relative to another reference frame. Seeing that these themes of velocity, acceleration and momentum are difficult to physically manifest into inert architecture one has to look at how other disciplines have approached the problem.

Before exploring that, another term needs to be explored: empathy. Most often this term is used to describe compassion or

Figure 54 _ 30 Bullet Piercing an Apple (1964) by Harold E. Edgerton

37 “Motion,” HyperPhysics, accessed February 2, 2013, http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
sympathy towards another. However in the late 19th century it was translated, so to speak, into aesthetical discourse. Empathy is at the core of our understanding of motion and will need to be discussed in detail first under the next heading, as a particular kind of kinaesthetics is the driver of this project—Empathetic Kinaesthesia.

It is important to stress that the themes introduced in this section are the key to creating architecture specifically for sporting facilities such as stadia. Without being physically and/or emotionally moved as an audience member or athlete—what is the point in sport? For an athlete it might be a way of making a living, but for the majority of people, sport is a method whereby one can test the limits of the body, bond with other humans in a team environment or keep up a desired physical appearance. How architecture may aid in this process is what is of most concern here, and so motion and empathy lie at the heart of this design problem.

“Complete empathy means the complete absorption of myself into the object perceived optically and into that which I experience within it. Such complete empathy may be called aesthetic empathy”

In order to gain an insight into the roles motion and empathy play in the designing of sporting facilities a specific period of aesthetic theory has been selected as a basis for enriching this discourse. The period in question spans from the 1870’s to the 1920’s and is culturally centred in a German society which was then grappling for new theories in aesthetics. It is a period best remembered for the transition from idealism to realism, or from metaphysical speculation to scientific positivism, the need to scientifically define feeling.

It is here that we can appropriately introduce the first proponent to put ink on paper in this regard; Robert Vischer. Although there were others who thought along similar lines, Immanuel Kant, Arthur Schopenhauer, Wilhelm Dilthey to name a few—none really coined a convenient term for transgressing emotions to objects. The term he came up with was Einfühlung, which roughly translates to in-feeling, now more commonly known as empathy. Vischer responds to questions asked by his father, Friedrich, such as “how do we arrive at this deep, dark, secure, intimate, yet free, unifying and contractive feeling [Zusammenfühlung]?” by describing a process starting with our unconscious sensory stimuli.

As this process will be expanded in the next section, it is important to focus on the links to motion that Vischer and subsequent authors present. Vischer alludes to a kinaesthetic “responsive feeling” as a result of the sensory “immediate feeling”, a direct discontinuation of the external sensation into an internal one; which “places this distinction at the head of my [Vischer’s] basic scheme...distinguishing between sensory and kinaesthetic empathy.”

The next contributor to the discussion was the Swiss aesthetician Heinrich Wölfflin, who asked the question: “How is it possible that architectural forms are able to express emotion or mood?” Wölfflin differs from Vischer in promoting an outside-in as opposed to an inside-out approach. What is meant by this is that Wölfflin is little interested in what subjective feelings we transmit to the object, but rather assesses the situation from a purely objective stance. He sees a more credible empathy as one in which our corporeal form is tested against the object in question in terms of proportion, stature, rhythm, etc. It is through this experiential understanding of an object that we can relate its motion to the motions our body can carry out.

The last paper from the 19th century to have an impact on the topic of empathy was The Essence of Architectural Creation by August Schmarsow. This paper was far more ‘architectural’ than the ones discussed before as Schmarsow, from an anti-formal perspective, saw the essence of the idea behind a given building as being of more importance than the building itself. His ideas do, however, cross over with Wölfflin’s when he takes into account the body image of a building and how we can relate it to our understanding of our own bodies “by enquiring into its axial system, we strive to open up a remote organism to the analogous feeling within ourselves.”

Wilhelm Worringer’s doctoral thesis, Abstraction and Empathy, lastly addresses the question of how civilizations had approached empathy towards works of art over the ages. The dichotomy

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39 Ibid 90.
between the terms in the title of Worringer’s thesis reveals the intrinsic “Kunstwollen” [art-will] primitive cultures displayed in their artworks. “Just as the desire for empathy as the basis for aesthetic experience finds satisfaction in organic beauty, so the desire for abstraction finds its beauty in the life-renouncing inorganic, in the crystalline, in a word, in all abstract regularity and necessity.”

In other words, empathy is understood through our understanding of the natural world, whereas all unnatural matter, as well as objects alien to us can be represented by abstract means.

The above mentioned aestheticians form the backbone of this thesis, along with mentions of a few others who can be called upon when explaining the practical application of empathetic kinaesthesia. As these theories are the onset of a new way of perceiving the world around us, they are also intrinsically focussed on the issue. By Worringer’s time the term empathy (in terms of aesthetics) had already been diluted and distorted to the point of its application almost anywhere in the Arts, so relying on the initial theories keeps us closer to the main issue. Let us now go a bit deeper into the empathetic process in order to apply it to architecture at a later point.

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As mentioned, Robert Vischer bases his explanation of empathy on the process of ‘feeling’. This may be a very difficult term to deal with, as Vischer admits himself; “the psychological knowledge at my disposal is inadequate for this task”. For Vischer, ‘feeling’ can be broken down into three levels; immediate, responsive and empathetic. In order to clarify exactly how we empathise with an object, this procedure is the key, and it also allows us an insight to the application of kinaesthesia.

Immediate feeling (Zufühlung) can be described as an instinctive compatibility or incompatibility, with a presented visual image, a colour or a contour for instance. This is in most cases provided by the sensory organs, in particular the eyes. An obvious impulse is ‘seeing’ (Sehen) with the eyes which “is always a relatively unconscious process, for the impression received is still undifferentiated.” But in order to receive a deeper understanding of an object, ‘scanning’ (Schauen) is essential. This scanning can be achieved through two techniques; “defining the contours [of an object] with my fingertips” or “a mapping of the masses, where I run my hand, over the planes, convexities, and concavities of an object, the paths of light, the slopes, the ridges, and hollows of the mountain.” What Vischer is saying is that ‘haptic seeing’ as opposed to ‘visual seeing’ is a far more sufficient way to appreciate an object wholly.

The next important step involves transferring these ‘immediate feelings’ into ‘responsive feelings’ (Nachfühlung), which translate the impulsive, direct and external stimuli into internal ones; nerve and muscle sensations. This is done by picking out aspects of the given object that may invoke congenial movements in us, simple movements which we experience constantly in our lives. An example of this is the perception of a simple line. Lines that are oriented horizontally or vertically are easily scanned as they lie in line with our eyes, which find the motion up and down, or side to side pleasing. The issue comes when we observe a line placed obliquely; here the eye would prefer “to travel in an arc” as opposed to on the diagonal and even further “a zigzag line is also initially offensive, for it requires unfamiliar and rapid changes of movement.”

This obviously also implies that objects that reflect our bodily form are also easily understood and ‘grasped’. These aspects of corporality or anthropomorphism play an intrinsic part here—for instance: symmetry, proportion and gravity. As to symmetry, Vischer explains that symmetry is simply a reflection of our bodies in which “horizontal symmetry always presents a better effect than vertical symmetry because it is analogous to our body.” Wölfflin interestingly states that we have a demand for symmetry in which he cites a cup with only one handle; “to preserve symmetry [in an object] we unconsciously make the handle side the rear of the cup”; we view the cup from the back, so to speak, with the handle facing us. “If the cup has two handles, we turn it around again so that we interpret them as an analogy to our arms.”

Wölfllin provides us with answers again in the realm of proportion. He states that it is a difficult subject from a formal point of view, as a vast amount of theoretical proportions have been suggested to be most pleasing throughout time—the golden section being an example. He relies rather on our
bodily understanding of proportions in which we understand that homologous parts of our body repeat; “the arms and hands repeat the legs and feet, but in far more refined and perfect form...the chest repeats the shape of the abdomen...and the head is placed on the trunk so that the whole is terminated by the most sophisticated organ, the only one that is not homologous to any other.”50

Our knowledge and experience of the way gravity works on our body is further proof of our perceptional understanding of the ‘posture’ of objects. We can relate to horizontally placed objects as implementing ‘lying down’ or vertically articulated objects as ‘balancing’. We then attach these characteristics to object descriptions; “we say: there lies the picture gallery and here stands the tower.”51 Relating all this to architecture, Schmarsow postulates that “as soon as the central, vertical axis or true spine of the other system of coordinates facing us gains a solid form, as soon as this axis absorbs the extension of the two horizontal axes, the interior space of the architectural construct shrinks, and its nature is completely changed so that we now perceive it as a solid body.”

Vischer’s last step in the quest for true empathy is simply put: the projection of our “mental-sensory ego” into the given object. Interestingly, Vischer does not base his hypothesis on psychological studies, but on dream interpretation. He saw our imagination, our ‘abstract thoughts’ and ‘mental images’ as providing an insight into our true selves, revealed in dreams. This imagination of self is, obviously, completely subjective and personal. So, how does this become applicable to empathizing with a given object? “The imagining of the self becomes conscious when it relates itself, either positively or negatively, to an object or to an idea of an object”, and in effect we do this unconsciously every

The Canon of Polykleitos

In accordance with Wölflin’s theories of our relation of scale to our own bodies, is one of the first aesthetic treatises ever written; The Canon of Polykleitos which proposes a measurement module which can be applied universally to dimensioning. Polykleitos himself was a sculptor made famous for his statues which place most of their weight on one leg. To set up his measurement modules, Polykleitos examined homology in the proportions within the human body, e.g. between the lengths of phalanges in a finger from which he could generate graphs of ratios between elements to apply to his sculptural works. On the next two pages are some illustrations by Richard Tobin which break down these proportions and give us an insight as to what Wölflin was referencing.

night; “the dream—that blind half-brother of genius—shows us a mysterious combination of the two (physical and idealised object).”52 Furthermore, “daily experience or reality provides the material for dreams; they are formed by bodily stimuli”—so it becomes a vice versa process, in which our everyday bodily movements and interaction with objects around us provide the sources for our dreams, while they in turn evoke kinaesthetic responses; for instance in dreams of near death experiences. “If I am sleeping with my knee bent and I voluntarily stretch it out in response to a corrective muscle stimulus, I might imagine being thrown from a tower...On a larger scale, the change in the position of my knee might correspond to a changed distance (in the dream) from the ground.”53

As we near the conclusion, the key is that we now take these lessons from our dreams and apply them in the conscious realm. In the crux of the equation, a vice versa process once again results. In what Vischer calls our “walking imagination”, which after receiving an ‘immediate feeling’ (through the senses) from an object, translates them into ‘responsive feeling’ (nerve and muscle sensations) and lastly projects our “body-ego” into that given object. However, this total immersion with an object, line or idea is never a physical manifestation; “as soon as our idea of self is projected into it, it always becomes an imagined object: an appearance. The way in which the phenomenon is constructed also becomes an analogy for my own structure. I wrap myself within its contours as in a garment.”54

Whilst not describing such an elaborate process, Wölfflin and Schmarsow also arrive at similar outcomes. However they also offer more insight into empathy in an architectural sense. Wölfflin, as already established, once again relies on our understanding of corporality stating that “our own bodily organization is the form through which we apprehend everything physical”55, the impulse to “dissolve a whole building into functioning members is to seek to feel every muscle in one’s body.”56 Nevertheless, he also warns that we should not literally represent a bodily form— “in employing its variants, architecture is not, of course, bound to the human analogy; it combines elements in a purely schematic way.”57

Schmarsow hints at Vischer’s process described above by alluding to the fact that our dreamworld unconsciousness needs to be transposed into conscious reality. A mere overview will not suffice. “As long as we are unable to carry out this redoubling of our consciousness and are unable to complement the outside vantage point with an interior view, the building remains for us a mere crystallization—like a rocky outcrop that rises before us—whether we view it frontally or from the other side, or even from above.”58 It is also in Schmarsow that we find an all encompassing quote:

“The linguistic terms that we use for space, such as ‘extension’, ‘expanse’, and ‘direction’, suggest continuous activity on our part as we transfer our own feelings of movement directly to the static spatial form. We cannot express its relation to ourselves in any way other than by imagining that we are in motion, measuring the length, width and depth, or by attributing to the static lines, surfaces, and volumes the movement that our eyes and our kinaesthetic sensations suggest to us, even though we survey the dimensions while standing still.”59

52 Ibid. 100.
53 Ibid. 100-101.
54 Ibid. 101.
55 Ibid. 157.
56 Ibid. 177.
57 Ibid. 172.
58 Ibid. 293.
59 Ibid. 291.
Motion as an Immobile Representation

In 1832, Père Prosper Enfantin declared that “architecture as a theory of construction is an incomplete art: the notion of mobility, of movement, is lacking in it.” The Industrial Revolution and its complex mechanical inventions, such as the railway, made the absence of motion in architecture even more conspicuous. Since the times of Vitruvius, architecture was considered the manifestation of space in time, but this notion was now under threat. But did this have to mean that architecture has to physically move? It is a romantic notion, with famous schemes such as Archigram’s Walking City (1964) coming to mind. A built example is Angelo Invernizzi’s Casa Girasole in Verona. Constructed in 1929-1935, it constitutes an L-shaped floor plan which rotates around the elbow of the L in order to optimise light from the sun tracking across the sky. One quickly realises that only one half may benefit as the other sits perpendicularly to it and, so, is at right angles to the optimum. So, buildings as a whole which continuously, physically move are not a desired or a very viable option as other technologies are far more efficient. Why take one’s whole house to work if a car or train is a more adequate option? That is not to say that architecture does not physically move—doors and windows open, people ride in elevators, water runs through pipes, etc. It is simply a question of the degree to which these actions take place.

Architecture is in fact far more successful at representing movement and it shamelessly looks into other artistic disciplines for inspiration. As indicated by the aforementioned theorists, empathetic understanding of motion is the key.

Primitive man is said to “have attributed the beauty of pure forms (such as colour) or a landscape to a kind of emotional investment on our part, to a vague and somewhat mysterious reading of our emotions into the forms we perceive.” And so the first attempts at translating our understanding of ourselves and our emotions into physical objects would have come from studying the natural world. Cave paintings represent hunting and hunted animals in motion as their outlines are blurred and repeated in order to emphasize their momentum across a plain. Worringer states that “aesthetic pleasure is objectified self-pleasure. The value of a line, or a form is for us the values of life contained in it. It gets its beauty only through our essential feeling that we let deeply sink into it.” Primitive man, by understanding that when one moves one changes location, discerned that in order to represent this, one had to display the same object in an empathetic understanding of motion is the key.


Mallgrave, Empathy, Form, and Space, 19.

Worringer, Abstraction and Empathy, 18.
iteration of positional shifts.63

Through kinaesthetic bodily experience, blurring and iterations have been employed by painters to successfully represent motion, which similar artforms such as photography have adapted with more accuracy. French philosopher Henri Bergson wrote: “Here, for example, is my hand, placed at the point A. I carry it to the point B, passing at one stroke through the interval between them. There are two things in this movement: an image which I see, and an act of which my muscular sense makes my consciousness aware. My consciousness gives me the inward feeling of a single fact, for in A was rest, in B there is again rest, and between A and B is placed an indivisible or at least an undivided act, the passage from rest to rest which is movement itself...[therefore]movement is indivisible; it is only the trajectory of a moving body that is divisible.”64 It is this division of trajectory that photography can engineer with ease and accuracy.

This is shown most effectively through the work of American photographer Harold Eugene Edgerton who is largely credited for his use of a stroboscope. The stroboscope let him capture iterations of a moving body at incredibly high frequencies, so that when the film was developed, these iterations (or divisions of trajectory as Bergson would put it) could be overlaid onto one image. We can also make links to sports photography as his subjects were commonly athletes.

Difficulties arise when considering the three-dimensional arts that deal more intrinsically with space, we can observe a different approach to kinaesthetic representation, for example in sculpture. Lessing articulates the differences between arts of time and arts of space in his influential paper *Laocoön*\(^\text{65}\). However, this was later refuted by Paul Klee in his 1920 article *Creative Credo*. Klee directly addresses Lessing, stating “much fuss is made about the difference between temporal and spatial art”. Dismissing his ideas as nothing more than a “scholastic delusion”, Klee made the claim that “space, too, is a temporal concept”. To undermine Lessing’s insistence that the sculptor must renounce the element of time, Klee pointed to the temporal processes of making and looking at a work of art.\(^\text{66}\) When determining space as being temporary and mobile, how does sculpture seek to enclose and control it through static means? An answer is offered by the Italian futurist Umberto Boccioni who proposed a synthesised solution, a double concept of form.

Boccioni advocated a combination of seemingly ambiguous concepts: form in movement (relative movement) and movement in form (absolute movement). He states that “a body in movement is not for me a body studied when immobile and afterwards modelled as though it were in motion. It is, on the


expresses its continuity in space.\textsuperscript{67} This characteristic of forms which continuously contort themselves, as well as the space in and around them, can be clearly appreciated in Boccioni’s sculptures.

As we have already seen, other artistic disciplines readily draw from personal experience in order to express motion. The last artform which needs to be related to motion is of course music from which the most clues for architecture can be drawn, as it can be genuinely formal and nonrepresentational by its nature. Once again the dichotomy of iterations vs. continuous flux emerges as both can be present in music. Seemingly agreeing with Boccioni’s interpretation of motion as continuous flux, Bergson relates this notion to music in the form of a melody. He says that it is essentially changing; it would not be the same melody if it did not unfold over time, or if only one note played. It is in a sense

Harold Eugene Edgerton’s stroboscope photography technique illustrates movement in a single static image in an extremely efficient way, however it is worth mentioning Eadweard Muybridge. He was English born, but only had his photography career take off once he emigrated to the USA. Around the time theories centred on empathy emerged in Europe, Muybridge entered a very productive period at the University of Pennsylvania in Philadelphia, producing over 100,000 images of animals and humans in motion, capturing what the human eye could not distinguish as separate movements.

One of his most accomplished works was the so-called \textit{Sallie Gardner at a Gallop} which resulted from a bet over whether a horse lifts all four legs off the ground whilst galloping. Muybridge took the series of photos on 15 June 1878 at Stanford's Palo Alto Stock Farm by placing numerous large glass-plate cameras in a line along the edge of a straight track and the shutter of each was triggered by a thread as the horse passed. He copied the images in the form of silhouettes onto a disc to be viewed in a machine he had invented, which he called a zoopraxiscope. This device was later regarded as an early movie projector, and the process as an intermediate stage toward motion pictures or cinematography.

The images do display all four legs of the horse lifted off the ground in the gallop, winning the bet for Muybridge; but of concern to us is that his technique was a further method of describing movement. It is obviously an iteration based approach, akin to prehistoric man’s attempts to understand motion.

\textbf{Source:} Eadweard Muybridge, \textit{Muybridge's Complete Human and Animal Locomotion: All 781 Plates from the 1887 Animal Locomotion} (Mineola, NY: Dover Publ., 1887)

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an “indivisible whole, organic in its completeness”. If one had to measure and record each note with a stopwatch as it reaches one’s ear, these isolated notes do not constitute the melody itself; the melody does not change, rather it is the change.68

On the other hand, rhythm in music can be said to represent iterations which once again originates from empathetic motion. Vischer calls these sensations “a harmonic series of successful self-motions”69. These are said to linger in the finished product as “the harmonious ensemble is to such an extent elevated into a rhythmic motion, and even though the artist with his finishing touches returns it to its original state of simultaneity, the motion can still be felt.”70

Wölfflin goes into more detail than Vischer by exemplifying the “self-motions” of breathing and heartbeats71 and that we are able to empathise with other people’s self-motions; “the rhythm of breathing that we perceive in others is what is most easily transferred to us.”72 Where this rhythm can be most easily appreciated in architecture, according to Wölfflin, is in colonnades. The regularity of column spacing in a building is to be expected and can be related to controlled breathing. However, interesting anomalies arise when a second element is introduced in the intercolumniation or the colonniation does not adhere to a hit-and-miss sequence. An example would be the Michaelskirche in Hildesheim where piers are placed after every two columns which Wölfflin relates to as “weaker members placed between stronger ones, as in the case with music where light accompanying figures may fit into a slower-moving principle theme.”73

When elements are introduced into a colonnade that have their own rhythm sequence independent from the column rhythm, such as triglyphs in Greek temples, the element “resting directly over the column will acquire an additional emphasis...and its role in the overall impression is not to be underestimated.”74 This can be measured and related to our inner “self-motions”, in the form of footsteps. Imagine two people walking down an echoing tunnel. If person A walks at a 4/4 time signature and person B walks at a 3/4 time signature, every fourth step for person A and every third from person B will naturally coincide, provided they start their walking sequences at the same time. The ‘emphasis’ is the footfalls occurring at the same time and producing a louder sound to our ears, which is what Wöfflin would have meant when, with a triglyph landing on top of a column, the same rhythm sequence mentioned above applied to a colonnade.

Of course this interplay of time signatures amounts to what we may interpret as a melody. Once again we can discern individual notes, and the melody constitutes change itself. As the accentuated beat does not fall on the same foot but changes (from | to - and back again in the example above); the pace becomes light

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68 Bergson, *Creative Evolution*, 82.
70 Ibid. 117.
71 Ibid. 173.
72 Ibid. 156.
73 Ibid. 174.
74 Ibid. 174.
and gliding. Essentially, this was explored in detail by Baroque architects of the 17th century. This synthesis of iterations and continuous flux has been translated into the organisation of repeated architectural elements throughout time. So, it is time to pick out a few specific examples of buildings which intrinsically deal with motion and analyse where their inspiration stems from.

Figure 62 _ 4/4 time signature compared to a 3/4 time signature

Above is a further example of iteration based representation of motion in a static image. In this case the iterations are so close together that they overlap and depict an overall movement with clarity even though the image is a flurry of lines and shapes.

Figure 63 _ Marcel Duchamp’s Nude Descending a Staircase, No.2
Architectural Manifestations of Kinaesthesia

In order to illustrate the way architecture borrows techniques of kinaesthetic representation from other disciplines, some examples are in order. These examples of individual buildings, architects and entire styles have been selected to demonstrate the range of ways to portray motion which will become apparent when translated into the proposed Olympic stadium.

- Victor Horta and Henry van de Velde

Proponents of Jugendstil (or Art Nouveau), such as Victor Horta and Henry van de Velde, are arguably the first post-classicists to explore ‘movement’ as an architectural feature. Debatably, Jugendstil relied a lot on ornamentation to bring across conceptualized motion. Van de Velde developed a system of “dynamographic” and “counterlines” in order to think of lines as forces. “A line is a force which functions similarly to all elementary forces: if a number of contradictory lines are brought together they will have similar effects as the interaction of contradictory elementary forces...when I say that the line is a force I make an entirely factual statement: the line borrows its energy from the person who traces it. In this process nothing gets lost either of the energy or of the force.” This force or “spirit” as August Endell, architect and theoretician from the Jugendstil era, called it, was present in every beautiful object. Endell even related this spirit of dynamism to the scale of modern cities, criticising the lack of expressive movement in cities such as Berlin; “I want only to discuss the design of the modern city, which is, with fewer exceptions loathsome.”

The sweeping curves and contorting lines can clearly be traced back to sculpture, in the way that Umberto Boccioni talked about his work. The trajectories of the lines are not broken into iterations but rather explore an entire transgression of motion with no states of rest apparent, “unique forms that expresses their continuity in space”.

Figure 64: Main foyer of Hôtel Tassel in Brussels, Belgium by Victor Horta

75 Jormakka, _Flying Dutchmen_, 8.
76 August Endell, _Die Schönheit der großen Stadt_, (Stuttgart: Strecker und Schröder, 1908), 47.
• Erich Mendelsohn’s Berliner Tageblatt Building

In a lecture that took place in Berlin in 1919 titled “The Problem of a New Architecture”, German architect Erich Mendelsohn spoke of a need for awareness of new construction technologies and a modern understanding of space. In a follow up lecture to this in 1923 in Amsterdam he answered the question to the “problem”; embrace this change, “we, the people of today, are not afraid of it.”

In order for architecture to understand this new way of thinking, Mendelsohn proposes, it should look towards the machine, in his lecture “The International Consensus on the New Architectural Concept, or Dynamics and Function.” He postulates that the extremely mechanical and honest expression of forces by engineered machinery and structures such as ships, cranes, bridges and aeroplanes can be a starting point for architecture. He concedes that architects should not deliberately mimic active motion; “it is a complete misjudgment of architecture’s nature to attempt to transfer these laws of motion onto architecture...whereas the machine always carries out work and enforces or overcomes power, architecture is only the expression of powers whose effect is achieved through the static gravity of construction.”

Mendelsohn, through a series of examples, suggests that the tectonic expression of acting forces can reinforce the motion and drama of a whole building; “dynamics in architecture are the logical expression of vital forces active in the construction materials and the accompanying danger of a loss of self-control.” In effect Mendelsohn straddles the iteration vs. continuous flux debate. This can be illustrated by his example.

78 Ibid. 26.
79 Ibid. 33.
of his Berliner Tageblatt Building, which looks to metaphorically dissect motion. Mendelsohn relates the way “a jetty uses the force of its construction to counter the impact of the unstoppable and intruding breakers that literally grab at its woodwork” to how “this effect only occurs in a figurative manner in the case of a city corner building⁸⁰, in this case the above mentioned building which sits on the corner of a busy intersection in the inner city of Berlin. Again he concedes that the building does not literally absorb any forces. However, “the building both visibly encompasses in its overall expression the high speed of traffic, where the tendency towards motion is raised to an extreme, and at the same time the balances of its forces soothes the frenetic pace of the street and the passerby.”⁸¹

What is meant by “balancing of forces” are the vertical elements that break up the elongated horizontals, in particular the columns and mullions that hold up the facade. They can be seen as elements which become “an immobile pillar amidst the turbulence of the street,”⁸² or iterations of a sweeping movement. This is clearly illustrated by the spacing of mullions, which increases as they round the corner, emphasizing the vectors of the motion at that point. The mullions in themselves express their constructive forces as they taper out vertically to receive the canopies that runs continuously over the horizontal bands of windows.

Other seminal buildings by Mendelsohn continue this theme of one sweeping move that describes an ideal motion, but, unlike Boccioni’s sculpture, this organic form is broken into iterations which stabilise it and describe the movement the organic mass is articulating. “We have seemingly freed ourselves from gravity...a new rhythmseizes the world, a new movement.”⁸³

• Sporting facilities by Enric Miralles

The Catalan architect Enric Miralles employs what one could call an opposing design process to Mendelsohn when conveying motion. Instead of generating an over-arching form which describes a certain movement, which is then segmented into iterations. Miralles produces instances which are iterated to portray motion as the instances alter one after the other. The separate instances are then circumscribed by an overall element, which in most cases is a simple extrusion between these instances. This allows Miralles to have explicit control over the forms of these iterations rather than the iterations being driven by a “continually fluctuating” form. Two sporting facilities will illustrate the technique.

The Leipzig Sports Hall very clearly iterates a sweeping motion
which folds back on itself. As can clearly seen in Miralles’ multilayered hard line drawing below, the iterated arches which support the roof-structure take precedence over the roof form, which simply acts as a reference, directing the trajectory of the overall motion. The arches both emphasize the centricity of the

Figure 66 _ Enric Miralles’ Leipzig Sports Hall

An interesting interpretation of movement can be found in the ceiling design in the lecture space of Alvar Aalto’s Viipuri Library. Yet another method of using movement to aid design; in this case the movement of sound waves which ‘wash over’ the ceiling surface and reflect down to the audience members in attendance during a speech. This movement of sound waves, although practically accounted for, is represented in the oscillating ceiling surface.

Figure 67 _ Acoustic analysis of the ceiling in Alvar Aalto’s Viipuri Library

Figure 68 _ Alvar Aalto’s Viipuri Library
playing field (dotted below) and radiate out to the surrounding landscape; “this is a construction that changes its interior form from a longitudinal building into a central meeting place. For this purpose we thought of a roof which was initially a dome and then turned into a bull, spreading two arms out to the landscape... the roof is a repetition of the shape of the playing fields that turn on their own axis.”\(^{84}\)

The second sporting facility by Miralles worth examining is the Olympic Archery Range for the 1992 Games in Barcelona. This project seeks to tectonically express the forces acting on the body whilst shooting an arrow. Concrete sheer walls nestle into the earth, providing a stable for the enfolding of the roof planes overhead. As the structural plan indicates, the roof planes float and project out from the building, once again reinforcing trajectory. These roof planes now serve as iterations, swivelling around axes which intersect out in the distance, presumably where the archery targets are located. The nature of their overlapping and extending past each other to demonstrate the complexity of forces at play.

Meanwhile, the sheer walls oscillating underneath can be understood as inward, space enclosing elements that actually counter the outward motion implied by the roof planes. “In this building the ground plan and the roof plane follow different strategies: one is curvilinear and organized along the long dimension, the other is rectilinear and grained along the short dimension. The undulating back wall of the changing rooms provides the berm and directs the actual path of movement. The roof planes direct visual attention ‘against the grain’ of the circulation.”\(^{85}\)

The active tension and compression perceived in individual members adds another layer of movement to the equation. “The tension between the opposing physical and visual cues results in a kind of contraposto-in-motion as the head and upper torso, attending to the floating landscape (the visual cues) above, rotate over the hips and legs while walking.”\(^{86}\) The anchoring of the outward projecting roof planes back to the ground acts to enunciate our understanding of an archer straining to draw a bow.

As we can see, Enric Miralles uses a range of techniques to portray motion in his works, which in large can be traced back to how other artistic disciplines address the representation of motion in a static entity. The arches of the Leipzig Sports Hall allude to the iterations achieved by Edgerton’s use of the strobe light effect in his photographs. The Archery Range, whilst also using a similar technique, looks even further back to our understanding of the corporeal form to help us empathise with the forces of the structure.

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86 Ibid. 123.
Dissimilar approaches are employed by the likes of the proponents of Jugendstil and Futurist architects such as Mendelsohn, but of importance is that their responses to movement stems from their own kinaesthetic experience and understanding. The complex nature of architecture allows for a more in-depth exploration of empathetic kinaesthesia as various representation techniques can be incorporated into one building, conceiving an intricate, layered image, which everybody can relate to.
Adaptive Sport Architecture
With global sporting events constantly producing “white elephants” the concept of sport stadia which are temporary, transformable and transportable (“3 T principle”) is finally coming to light with the London 2012 Games being the first to realise this concept. Although not all stadia adhere to the “3 T principle”, they are individually analysed in terms of their need after the Games, as has been applied to the Auckland Olympic Park masterplan.

With this in mind the focus now shifts to the Auckland Olympic Stadium and what might happen to it in “legacy mode”. The Athens 2004 and Beijing 2008 games have left uneconomical beasts which drain taxpayer money in order to sustain maintenance costs. London turned to an innovative approach which involved constructing a stadium comprising steel tubing which can easily be disassembled, altering the overall form. Thus, removing the top tiers of seating will result in the 80,000 seat athletic stadium being reduced to a 25,000 seat football stadium.

When analysing Auckland’s stadium situation there hardly seems a reason to add to the three existing stadia (Eden Park, Mt. Smart Stadium and North Harbour Stadium). Eden Park with its recent upgrade for the IRB Rugby World Cup will sustain another 20 years of use before needing further upgrading. Mt. Smart still serves as a rugby league and football venue, whilst North Harbour provides a secondary (or even tertiary) rugby/football park.

The question remains: what becomes of an 80,000 seat athletic stadium after it hosts an Olympic Games? The dilemma prompted a search for examples of stadia which have undergone change after their primary use as sporting grounds. The search ultimately produced few examples as stadia generally lived out their lives as stadia until they fell into decay. Notable examples worth mentioning are the Arles Amphitheatre and Highbury Stadium, reflecting ancient and modern interpretations of the same problem.

Arles Amphitheatre, in France, is a two-tiered Roman amphitheatre constructed in 90 AD which was capable of seating over 20,000 spectators, and was built to provide entertainment in the form of chariot races and hand-to-hand battles. Today, it draws large crowds for bullfighting, as well as plays and concerts in summer. Interestingly, with the fall of the Empire in the 5th century, the amphitheatre was transformed into a fortress with four towers and including more than 200 houses and two chapels. The amphitheatre became a town within Arles, with its public square located in the centre of the arena and two chapels, one in the centre, and another one at the base of the west tower.
new residential role continued until the expropriation started in
the late 18th century, which ended in 1830 when the first event
was organized in the arena—racing of the bulls to celebrate
the taking of Algiers.\textsuperscript{87} A less obvious version of this form of
transformation was undertaken in Lucca, Italy. The original
structure of the former amphitheatre is virtually indistinguishable,
however the overall form remains which frames the town square
nowadays.

The modern take on this is Highbury Stadium, Arsenal’s
former football ground in London, recently transformed into
luxury housing and renamed as Highbury Square. In this case
the actual grandstands themselves have been altered and “filled
in” to transform them into apartments. Appropriately the focal
point of the development is the former pitch where a new garden
has been laid out by Chelsea Gold Medal winner Christopher
Bradley-Hole; the two acre garden is formed from an abstract
composition of terraces, lawns, hedges and planters and is
punctuated by decorative features of glass-encased water walls.

To select an appropriate legacy application for the Auckland
Olympic Stadium it was sensible to categorise the possibilities
into five distinct groups:

1. Demolition

   Obviously not ideal. This option is most often employed when
it comes to stadium legacy. Materials may be recycled or reused,
allowing this option to be somewhat sustainable. Examples:
   • White City (London, 1908 Games)
   • Empire Stadium (London, 1948 Games)
   • Atlanta Fulton County Stadium

2. Completely relocate separate elements
   A relatively new concept. This calls for entire grandstands and/or playing surfaces to be separated, disassembled and shipped to other locations. This allows for sustainable reuse of grandstands with 3rd world countries benefitting by not having to bear construction costs if they import these already assembled elements. Examples:
   • 2022 FIFA World Cup stadia in Qatar (Al-Wakrah Stadium concept)

3. Partially relocate separate elements
   Another popular option which entails a stadium being partially demolished, or having certain grandstands removed, to reduce the overall capacity. This is often to accommodate sport codes other than athletics. Examples:
   • Stands used in 2007 ICC Cricket World Cup in West Indies
   • London 2012 Olympic venues
   • Rio de Janeiro 2016 Olympic venues

4. Relocate entirely
   Although logistically challenging and costly this option is amongst the most sustainable. By floating a stadium, its location possibilities are almost infinite. An Olympic stadium could be constructed on a floating raft which can be towed to the next large sporting event. Examples:
   • The Float at Marina Bay, Singapore
   • Floating OffShore Stadium, Qatar 2022 FIFA World Cup (concept)

5. Adaptive reuse
   This last option is the most flexible in terms of programme. Examples include Arles amphitheatre and Highbury Square of course, as well as the 2008 Beijing Olympic Stadium (The Bird’s Nest) which has been tipped to be converted into a shopping centre.

The breakdown of legacy options effectively allowed some options to be instantly dismissed. As constructing a stadium for a month-long event, only to demolish it is foolish—that option can be dropped. Due to New Zealand’s remote location it makes little sense to ship parts of the Olympic stadium to “neighbouring countries”. This would be feasible in the Middle East due to the close proximity of nations, as well as Asian and African markets. As already discussed, another functioning stadium is not necessary for Auckland, so reducing capacity will not achieve anything. The floating example is an intriguing one, as, after all, Auckland’s many harbours would allow this option. However an issue arises when taking account of cost and connections to transport infrastructure.

This leaves the adaptive reuse option. Highly sustainable, cost effective and flexible, this application of a stadium is a very rational choice. So, if Auckland were to host an Olympic Games in a newly constructed Olympic Stadium, what would be the most appropriate adaption programme?
Existing stadium

Demolition

 Completely relocate separate elements

 Partially relocate separate elements

 Relocate entirely

 Adaptive reuse
Legacy Programme

Having determined that an adaptive reuse of the Auckland Olympic Stadium is the most appropriate legacy application, the focus shifted to the possible programme. Considerations would include the sheer size of the overall building, the ‘bowl’ form of a stadium and the reuse of the primary/secondary structure. Programmatically the end use will have to deal with the location being geographically centred in Auckland, benefit from the transport network and play a vital role (civically, economically, sustainably, etc.) to greater Auckland. In terms of immediate context, the fact that the site is a half-island surrounded by sporting venues on relatively open parkland will also come into play.

After a lengthy elimination process two main concepts emerged:

i. An energy harvesting park
ii. A high performance sports centre.

The energy harvesting park would make excellent use of the overall shape of the pre-existing stadium to capture rainwater and solar gain. Wind and tidal turbines would also be a possibility due to noise levels not being an issue. The former grass pitch allows for an extension of the surrounding parkland to form a ‘common green’ where the public would be invited to linger and be educated by the latest energy harvesting technology.

The high performance sports centre would make use of surrounding sporting infrastructure to continue forming a central sporting legacy for all of Auckland. The entire region would benefit through not only providing for elite athletes but also for school-age children and university research programmes. The building itself centres itself around the track/field, which will be preserved with the former terraces transforming into usable spaces for auxiliary programmes.

The simple reason that this research paper explores the relationship between sport and architecture led to the second option being chosen. A high performance sports centre (HPC) allows for a more intimate and detailed look at the role architecture plays in the context of sport and most importantly it reflects the current trend of “flexible, reusable structures within the sporting industry”.

The high performance centre’s programme will look to accommodate a wide range of user groups with specific needs. These spaces catering for individual needs also need to consider the size and form of the stadium with their interaction, or isolation, from each other, their orientation and their accessibility playing a vital role in the form taken on by the adapted former stadium.

As a starting point, the following programmes/spaces provided by the legacy building could be incorporated (underline = preexisting):

- Gymnasiums
- HP athlete accommodation
- Nutrition laboratories
- University campus
- Office spaces (general)
- Conference centres
- Classrooms (for school excursions)
- Administration/reception
- Sports retail
- Restaurants

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• Hotel  
• Media training  
• Merchandising and tours  
• Catering  
• Spectator terraces  
• Concourses  

The general idea surrounding the experience of the building as a whole is one of centricity, community, practicality and accessibility. It makes sense to house functions with similar uses in close proximity to one another and in relation to the three-dimensional form of the building e.g gymnasiums + nutrition labs close to the track/field, general office spaces + hotel on the western side of the building with views out to Manukau Heads and Mount Mangere etc. These themes can be represented in a diagram (Figure 76) which shows the interactions between programmes and their location within the building.

Figure 76 _ Legacy relationship diagram

“The temporary and permanent designs (of Olympic venues) should look complete in each configuration, in recognition of the importance of integrating various formats of permanent and temporary structure and giving it a consistent architectural identity so they do not appear to be ‘add-ons’.”

Overall Form Considerations

In order to start the process of designing for the adapted legacy mode the building had to be considered as a whole in its immediate context, together with other conceptual aspirations.

One of the foremost considerations in stadium design is the orientation of the playing field or, in this case, the track. For athletic stadia, the track is recommended to be at a 15° slant to north. This optimal angle accounts for the sun tracking east to west and minimises its effect on the athletes and supporters. Of most importance is the ‘home straight’ (shown in green in Figure 77); the final stretch of track for most track running events. For the southern hemisphere it is recommended that the finish straight runs from north to south, prohibiting runners on the home straight from running ‘into the sun’. This means that the home straight is located on the western side of the ground.

The implications of this is that the western side of the stadium (shown in blue in Figure 77) is naturally the larger of the sides, as the higher priced tickets and VIP boxes will want to be located adjacent to the home straight.

This has further significance when considering the given site as the main view aspect is towards Mount Mangere and the Manukau Heads in the west. The initial inclination was to actually drop the western side in order to afford views to the mentioned landmarks (see Figure 80). However, this notion was quickly dismissed as the environmental conditions would never allow

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Figure 77 _ Legacy relationship diagram

Figure 78 _ Sightline from Olympic stadium to Mount Mangere

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for this. The issues being the predominant winds which originate from the south-west (see Figure 22) as well as the setting sun in the west. The conflict is clear; the desire for views in the direction of predominant winds and a setting sun.

What resulted is an understanding of two very different sides of the stadium at this infant stage. This led to the concept of ambiguity. The western side of the stadium (due to its exposure and size) is to be dynamic, elegant, translucent, lightweight, ‘flighty’, etc., while the eastern side should be reserved, grounded, heavy, entrenched etc., to emphasise the ambiguous nature of the whole. This differentiation can now be used as a formal driver, influencing everything from structural articulation of movement to spacial experience behind the terracing. An overall motion, or striving, towards Mount Mangere will also play a part in the landscaping around the stadium.
Figure 82 _ Sectional concept sketch of relation between stadium and the ground plane
Through a series of overlaying sketch exercises the stadium form eventually nestled itself into its immediate context. The grounded side to the east (which we shall now refer to as the “heavy terraces/side”) and the track surface literally found themselves dug into the half island as shown in the image on the previous page. This move solved a number of issues as now the “playing surface” in its lowered position relative to the ground level of the western side of the stadium (which we shall now refer to as the “lightweight terraces/side”) is protected from the setting western sun, the overall vertical scale of the stadium is diminished and the public concourse level is on the same level as the relative ground floor surrounding the stadium; the public can now enter and circulate around the stadium without having to move up or down a level.

Figure 84 shows how the concourse of the Olympic Park connects and wraps itself around the northern side of the stadium allowing access to both the heavy and lightweight terraces. The back-of-house area connects itself to the eastern side of the form whilst being accessed via the service road to the rest of the Olympic Park’s service areas. This connection will also cater for arriving athletes, VIP’s, the media, officials, event organisers etc.

Figure 83 _ (right) Sketching exercises in site placement

Figure 84 _ (overleaf) Final site placement sketch
Adapted Form

How does a stadium transform into a functioning high performance centre? How does ‘shell’ become ‘volume’? The issue centres on the impracticality of the existing curved bowl-like form of the terraces and the need for horizontal floor planes which serve almost all functions within a building.

This problem is dealt with quite clumsily in the previous examples of Arles Amphitheatre and Highbury Square where the terraces were completely removed. All that remains of the previous stadium in the case of the latter is some of the primary structure. This seems like an avoidance of the predicament of changing the ‘slanted’ surface of the terracing into horizontal or vertical elements.

An early solution that arose was the possibility to simply hinge the terraces where they meet upper concourses and rotate them into a horizontal position. The space created below could then be filled in with floors and support structure. As shown in Figure 86, there are two structural systems in play; i. the exterior structure functioning as an exoskeleton, shielding the interior from the elements and ii. the interior structure comprising of the terraces, concourses and emergency egress routes. Another thought was that the outer structure functions as a ‘crane’ to pull up the terraces via cables, into position for the legacy mode.

Problems arose when considering the 3D form of the terracing bowls as the curved geometry would not allow the tilting up action to take place. The split sections would have conflicting geometry once ‘flipped up’ into a horizontal position and the resulting floor planes would also be curved (see Figure 88). The seating bowl had to be designed in detail first in order to proceed.

Another issue was the cables that pulled the terraces into position from the outer structure were initially connected up in the Olympic mode as this would hinder spectator views during the games. The decision was then to have them in place in order to connect them up in the transition phase.
Figure 87: Model with ‘flip up’ terraces

Figure 88: Conflicting geometry in ‘flipped up’ curved seating sections
Sightlines dictate most of seating bowl arrangement including terrace angle (steepness), distance from playing surface, etc. A proven formula was employed in order to determine the overall form of the seating bowl as described in *Stadia: A Design and Development Guide* where $D = \text{distance to focus}$, $C = 'C' \text{ value (average distance from eyes to top of head)}$, $T = \text{tread width}$, $N = \text{riser height}$ and $R = \text{riser height from focus}$:

$$N = \frac{[(R+C) \times (D+T)]}{D} - R$$

Thus the equation for the riser height is:

This served to set up the sightlines and the form of the seating bowl. An initial ideas which has been carried right through the design process was to have two tiers in the heavy terraces and three tiers in the lightweight terraces, due to the latter's larger scale. What resulted was the upper tier of the heavy terraces splitting once it reaches the lightweight terraces in order to create a 3rd tier as can be seen in the image below. This lower section on the upper tier will accommodate VIP and media boxes.

Once these factors had been decided and the sightlines calculated, the overall form was tweaked to create a seating bowl that flared up on the sides facing the straight stretches of the running track and contracting when on axis with the curves of the running track. This move makes functional sense by packing in more spectators to the better views and adding drama and movement in the overall form in an aesthetic sense through the swooping lines of the seating rows which no longer run horizontal like in a traditional stadium. An audience member experiencing a sporting event unfolding in front of them, would sense their immediate neighbours being seated slightly above or below them, and a view down the seating row would confirm audience members in the same row dropping away or rising up from where one might be sitting. This analogy is a hint at the ‘continuous flux’ technique employed by sculptors to convey motion. We as audience members would be able to actively empathise with
the fluid movement exhibited in front of us by the athletes and swooping form of the seating bowl.

The issue around the transforming tiers in the lightweight terraces once again came to the forefront with various iterations finally leading to a model in which the tiers were split into flat sections, separated by gaps. These gaps would accommodate the mechanism for rotating the sections into place and disable conflicting geometry as previously discussed.

The sections had to be continuously refined in shape and angle until the track and central field were visible from any point within the seating bowl as shown in the images above.
With the seating bowl for the Olympic mode refined, the focus shifted back to the legacy mode transformation. Here the analogy of the two ambiguous halves (lightweight and heavy terraces) was articulated in greater detail. The lightweight terraces, now in their more dynamic form, look at being the more intelligent and rational side, whereas the heavy side took to being the permanent, unintelligent and fixed side. This allowed the lightweight terraces to house the “office building-like” functions, such as the gymnasium hotels, university campus, etc. On the other hand the heavy terraces would keep their seating tiers in place, serving as lecture theatres, conference centres and public viewing for training sessions from visiting international teams/athletes e.g. visiting rugby teams or star athletes would be accommodated in the hotel and have the opportunity to have public trainings in front of fans who will be able to watch from retained tiers in the heavy terraces.

What the split sections of the lightweight terraces now helped set up were separate ‘pods’ which would house the different programmes discussed earlier. This splitting of the forms can be seen in Figure 95. They would still be linked by the concourses on the outside which serve as overall circulation.

In order to accommodate lecture theatres and conference centres in the heavy terraces, where the seating tiers essentially do not change, the need for enclosure becomes an issue. What is proposed is that a facade be dropped down from the roof, as can be seen in the Figures on the opposite page. A stage can then be constructed for the speaker.

The dichotomy between the halves now allows for articulation of motion, which is understood through kinaesthetic empathy. Two separate languages developed; the lightweight terraces and the heavy terraces both took on ‘iteration based’ and ‘continuous flux’ representation techniques, albeit in different extremes. As would be expected, the lightweight side strove to express congenial movement as we understand it, smooth, flowing and organic—whilst the heavy side took on erratic and uncongenial motion. These design iterations will be expanded on in the next chapter as we break down the separate elements in the stadium and analyse their ability to define kinaesthetic movements. What
is of essence in concluding this chapter is the idealisation of the legacy transformation as shown on the next page.
5 A Stadium Set in Motion
This final chapter seeks to illustrate the changes and developments undergone by the remaining parts of the Auckland Olympic Stadium and, where possible, integrating theories explored in Chapter 3 whilst keeping in mind the two life cycle stages of the stadium; the Olympic and legacy modes.

The image to the right from the final interim presentation will serve as a key to the separate parts of the stadium which will be focussed on.
Figure 98 _ Exploded axonometric diagram of Auckland Olympic Stadium
The previous chapter displayed some figures which indicated parts of the whole divided up into segments, but what constitutes this segmentation and why has it been implemented? The divisions were generated from theories explored in Chapter 3—the iteration based techniques of expressing motion, such as cave paintings or the photography of Edgerton. These iterations are set up by a series of axes which swivel and wheel their way around the stadium in the form of radial divisions, controlling all applications from seating tiers to the spacing of emergency egress routes.

As already established, the lightweight terraces are the more flighty and dinamically articulated of the sides. The radial axes (as can be seen in Figure 99) rotate from a central line of the pitch at 15° iterations, spaced 7m apart at a time. What results is a very smooth transition between each segment, which also has a 2° gap from its neighbouring segments to allow space for the wedges of terracing to swivel up in legacy mode.

On the other hand, the heavy side is divided into uneven segments, rotating in angles between 5-20° from the very centre of stadium. The seeming randomness of the angle of division plays on the fact that this side is the erratic, irrational half and also allows for varying sizes of auditoria in the legacy phase. These separate auditoria can then be accessed via the concourses that remain. As the figures on the opposite page display, these initial radial divisions set up consequent axes in their centres as well as further divisions of the heavy terraces (Figure 102) which will be covered in that particular section. The separate radiating axes to the north of the lightweight side set up a formal entrance zone. So, in summary, the separate elements repeated around the stadium in a radial manner are ‘iteration based’ in expressing kinaesthesia, whilst the larger forms such as the outer cladding and the seating bowl are essentially ‘continuously fluctuating’; a hybrid ‘Miralles’ approach. This process reminds us that motion is observed by attaching a frame of reference to a body and measuring its change in position relative to another reference frame.91

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91 “Motion” HyperPhysics, accessed February 2, 2013, http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

Figure 99 _ Primary radial divisions

Radial Divisions
Figure 100 _ Primary radial divisions

Figure 101 _ Primary radial divisions + central instances

Figure 102 _ Primary radial divisions + central instances + further intermediate divisions

Figure 103 _ Radial repetition of the folding mechanism

Figure 104 _ Radial repetition of the primary structure on lightweight side

Figure 105 _ Radial division of lightweight side’s weather skin
The basement an area requiring a practical solution. The basement is part of the private goings-on underneath the stadium, out of sight of the public. In large part it houses sections reserved for the athletes and their management, officials, media, event organisers, security personnel, stewards, caterers, groundstaff etc. The spaces are divided in radial divisions from the centre of the pitch above, allowing persons using these areas to sense the centricity of the rest of the stadium which is out of sight. This penetration produces a far more layered effect, as opposed to simply planning the basement from a strictly functional point of view.

Of great importance are the transitional spaces to and from the basement. These include five ambulance access routes and the large back-of-house service entry. This entry provides a private entry point for all the personnel mentioned above; essentially allowing an athlete to arrive and pass to the changing area along a private path available only to athletes and their management, passing by reception, catering and massage areas along the way.

The western side (under the lightweight terraces) houses mostly athletes and officials, whilst the rest is divided amongst the other user groups. In the legacy phase these areas will remain to be used by pre-existing user groups while areas formerly used by media, event organisation, etc. will be converted to additional changing rooms for high performance athletes.
Figure 107 _ Diagram of basement layout
To conclude the transformation stage of the seating tiers we have to look into the folding mechanism that drives the change. As articulated previously, the need to produce flat horizontal surfaces from inclined seating tears was the key. So instead of simply hinging the tears from the upper end, as shown in Figure 86, a more intricate solution is called upon as the hinging resulted in a stepped form which is spatially uneconomical.

The new mechanism features an arm on which the upper two tiers swivel upon. In effect they undergo a double-movement by first reeling up with the arm and then rotating into place; thereby forming horizontal planes. These would then be extended out to form floor structures for the ‘office building pods’ they will house after being enclosed in facades. The rotating arms would be retained as part of the structure and form the vertical circulation cores for each pod.

Figure 108 _ Seating bowl folding mechanism positional shift

Figure 109 _ Model of proposed folding mechanism
The above design was for an entry for the Stockholm Olympic Stadium Olympic Bid. The organizers had implied that they wished to have an 80,000-seat stadium for the 2004 Olympics. After 3 years they proposed that they would like this structure to be removed and replaced with a 20,000 seat indoor arena where possible re-using as much of the original stadium.

This proved to be a challenging problem but eventually a design was produce that re-used all the original components largely without alteration. The resultant arena building was very much an evolved form. By using computers to 'evolve' a solution it was possible to 'fold' the stadium closed much like flower petals. Once the arena roof was finely tuned it was opened back out and the stadium structure was then re-evaluated and fine tuned once more. This series of iterations eventually produced two distinctly different buildings using one set of components.

Concourses and Emergency Egress

From early on in the design process the concourses have afforded an opportunity to achieve something unpredictable in terms of stadium design. With the theories of kinaesthesia in mind, simple flat concourses tucked behind the tiers would not suffice. What developed were two levels of concourses which undulate around the stadium. The upper concourse split in two on the lightweight side, replicating the horizontal gapping of the terraces, and forming what will be henceforth referred to as concourses 1-3 (see Figure 98).

The innovative factor lies in the fact that concourses rise up along the back of the seating bowl, along the long sections adjacent to the long straights of the running track. The outcome is a dramatic series of forms, swooping in their ‘run’ around the stadium. They are hardly controlled or shaped by the radial divisions which govern most of the other building elements, instead they contiguously fluctuate with the seating tiers. Visual kinaesthesia becomes haptic kinaesthesia, our bodies rising and falling as we transverse around the stadium through gradual displacement. A more direct and vertical shift is allowed by the emergency egress stairs which are spaced according to the radial divisions. On the lightweight side, they run parallel to the edge of the concourses, whilst on the heavy side they rise perpendicularly; reinforcing the ambiguity of the two halves and the types of kinaesthesia they express.

We can also discern the analogy of ‘architectural promenades’ in these circulation mechanisms, akin to models of circulation explored by Le Corbusier and Rem Koolhaas. When observing the Villa Savoye we can see that Le Corbusier’s formal driver was the motion of a car as he determined the general form of the ground floor from the turning radius of a car, and used ramps, instead of stairs, for the main vertical circulation so that the smooth motion of a car may be continued. The architectural promenade culminates on the roof, where an opening in the garden wall represents the view through the windshield of a car.92 To this, Vischer would comment “the responsive sensation considers only the outline of the form (mountain silhouette) or follows the path of movement (flight of a bird apart from the movement itself), but it takes no account of the existence of the individual organism.” Le Corbusier is not literally representing a car, but what might be expected when experiencing the movement from within a motor vehicle.

Koolhaas investigates a form of architectural promenade in his proposal for the Jussieu Bibliothèque in Paris. The building can be interpreted as an extension of the city in the way the circulation ramps and inclined surfaces rotate up around the inside of the building, emulating streetscapes and relational interaction between ‘floors’. These surfaces become the floors themselves, “unraveling” upwards as Koolhaas puts it: “a stage for social appearance...a single trajectory, a warped interior boulevard.”93

92 Jormakka, 34.
Through diagrams and models, Koolhaas was able to establish what Vischer referred to as a ‘contour’ or ‘silhouette’ which the path of movement, or circulation, follows.

The concourses providing horizontal circulation and the emergency egress stairs providing vertical circulation in the Auckland Olympic Stadium also reflect a continuation of the public concourse which connects stadia in the Olympic Park. By entering the stadium on a level with concourse 1, there is no vertical barrier present. Ramps lead one straight on to the undulating form, or the ground, simply meeting the concourse arching round. As Figure 119 illustrates, a simple set of warping lines describe the character of the sweeping movement, not unlike a Boccioni sculpture.
Concourse 1 and concourse 2 along the lightweight terraces emulate a tried and tested trick of concourse design by running at the same height as the back end of the seating tiers. This affords the stadium users views to the action unfolding below whilst they walk along the concourse to find their seats, line up for refreshments, etc. a further mechanism to enhance interaction in the scheme, alike to Koolhaas’ split floor levels.

Furthermore, the gaps present in the lightweight terraces are an analogy to the way ancient Greek theatres were ‘staged’. They usually had the seating rows aligned up a hill with the stage in the foreground of a striking landscape, the setting adding drama to the plays. This technique is picked up on in the Auckland Olympic Stadium as the Manukau Harbour and Mount Mangere act as the ‘beautiful’ backdrop to the ‘play’ in the foreground, so it is only fair to highlight their importance as discussed in the early chapters through the horizontal slots. Koolhaas would comment: “the architecture presents a serene background against which ‘life’ unfolds in the foreground.”

In the legacy phase, the concourses remain in place and form the horizontal circulation between the pods and to the lecture theatres/conference centres. Concourse 1 will act as a public area, with the lift cores allowing one to get up to the pods above.

94 Ibid. 1328.
Figure 117 _ Early sketch illustrating gapping of terraces and concourses on lightweight side

Figure 118 _ Legacy mode showing concourses running through the pods

Figure 119 _ Conceptual image of the concourses
The last major elements needing articulation in the design of the Auckland Olympic Stadium are the outer structural building parts which form or support a weather skin. An entirely enclosed stadium was never the intention as a degree of exposure to the elements adds a factor of unpredictability and drama to a sporting event. Nevertheless, ensuring that the majority of spectators remain dry and out of direct sun is of concern. Once again a dichotomy of the halves presents an opportunity to test two contradicting kinaesthetic representations, so let us analyse them one at a time.

- Primary lightweight structure

An initial idea that has carried right through the design process of the lightweight terraces is that the smoothness and flight of this side needs to be justified with an outer facade which reflects this nature by wrapping up from the base and around to form the roof, as opposed to two separate components which break the overall flow. An appropriate primary structure to support this naturally involves a series of half-portals which act as ‘column’ and ‘rafter’ in one, so to speak, allowing the outer weather skin to wrap up similarly to a wall and over like a roofing surface.

In order to express lightness, a permeable and as translucent as possible final solution needed to be produced, enhancing our ability to empathise with the overall picture. However, the articulation of the individual primary structures can further amplify the feeling. So what was required was the simultaneous design of two elements; iterations of primary structure (describing iterations of a movement i.e. an Edgerton photograph) and an enclosing weather skin describing a continuous motion (i.e. a Boccioni sculpture) which is set up by the iterated primary structures. This allows a double take, a ‘Miralles’, if you like; the superimposition of the two techniques discussed earlier representing motion in a static image which allows one to empathise with it.

The spacing for these structures was selected to once again accord to the established radial divisions governing the stadium as a whole. A narrative of the trajectory of a javelin in flight was selected as a sensible motion path to be followed by the iterated structures, whilst they in themselves might resemble a balance of forces we can kinaesthetically relate to. So why a narrative? No other narrative directed the design elsewhere. It was in fact a retrospect of the initial theories of empathetic kinaesthesia. What matters most is the motion a given object undergoes and not the object itself. In effect it was the flight of a javelin that provided the so called narrative for the motion. However, as an individual this might not be discernible as we project our ‘body egos’ into the structure, allowing for differing interpretations. Nevertheless, the concepts of weightlessness, flight and sweeping motion are retained.

Initial concepts looked at tying back the half-portal structures, however, they needed ungrounding and a sense of balance on their own. The following images explore the design progression of the structures.
Figure 120 _ Sketch exploration of a javelin thrower

Figure 121 _ Tennis Serve by Harold Eugene Edgerton
At one point, however, the process led to an ignorance of Heinrich Wölfflin’s warning that by “employing its variants, architecture is not, of course, bound to the human analogy; it combines elements in a purely schematic way,”95 as the structures started overly resembling a corporeal form (see Figure 123). Once simplified and abstracted though, we are left with a solution which projects the lightness and elegance hoped for. It features a stem-like trunk which spreads into two arms to stabilize it and provide more dispersed structure, acting more efficiently in tension. As an overall object it conveys a sense of continuity, as the seemingly separate elements morph together in a seamless, organic mass, articulating agility and light-weightedness. The footing spays to meet the ground and a hole through the structure adds to a sense of ungrounding as well as allowing foot-traffic to pass through.

The iterated structures also change slightly in each instance, with the largest and widest structures in the ‘middle’ of the arrayed motion whilst the smallest and thinnest structures are found at the ‘initiation’ and ‘follow-through’. The weather skin can now be applied to emulate a continuous kinaesthetic movement.

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95 Mallgrave, *Empathy, Form, and Space*, 172.
Figure 123. Orthogonal views of developed primary structure
Figure 124 _ Model displaying primary structure supporting weather skin wrapping over it

Figure 125 _ Development of primary structure 'stem'
Figure 126: Iterated structures arranged in place
The ‘skin’, wrapping and sliding over the primary structure, looks to express a predominantly horizontal motion, one we might be able to relate to in terms of trajectory in sport as all bodies, alive or inert, are inevitably controlled by gravity. The arching of a javelin, the sprint of a runner and the leap of a long-jumper all exert a need for horizontal displacement with a tendency to escape gravity.

Early sketches indicate the horizontal bands of skin/membrane overlapping and opening up, but if one remembers the site conditions, the requirement for protection from the predominant westerly winds and setting sun resulted in a more airtight solution. The membrane bands themselves (most likely ETFE film) may vary in translucency, allowing a better view out at concourse levels and protected inclination at pod level with the ‘dappled’ texture adding dynamism as well as imitating the rippling water in the foreground. As for a patterning system was concerned, to break the skin into parts, several options were explored before settling on a curved concept which reinforces the flow of movement.

Figure 1.27 _ Weather skin pattern concepts

Figure 1.28 _ Weather skin sketches for the lightweight side
Figure 129: Final weather skin
• Heavy side structure

Having identified the form of the western, lightweight side, of the stadium, the response from the heavy eastern side was to be as radically ambiguous as possible. Primary concepts focussed on a cave-like interpretation by battering earth around this side to bury and add weight to the outcome. This notion was, however, replaced through stages of the design process; a structure emulating ‘heaviness’ need not be lazily buried. The earlier concrete shells had difficulty implying heaviness as they looked too delicate and their roundedness would have felt more in place on the other side. It could rather help emphasize the fluidity of the lightweight side by conveying 

un congenial motion.

So, what is meant by uncongenial motion and why is it necessary? If we look back at the theory explored earlier, we find the answers in Vischer. When analysing our responsive feelings to initial sensory stimuli, he indicates that “unpleasurable sensations are caused by stimuli that have an inhibitory effect, leading to unusual, difficult, and uncongenial movements.” When going further, he testifies their importance; “yet once these are compensated for and liberated with the aid of congenial movements, this contrast gives us an increased sensation of pleasure.” In effect, through the utilization of both extreme situations of ‘feeling’, the perceived stadium becomes a fluctuating roller coaster of emotion—a reflection of the drama in a sporting contest.

How might this uncongeniality then be represented? Once again the solution might be found in the simplest example; that of a line: “A zigzag line is initially offensive, for it requires unfamiliar and rapid changes of movement.” By using zigzagging, or jagged, lines to break up forms we arrive at this uncomfortable

96 Ibid. 95.
97 Ibid. 97.
Figure 131 _ Orthographic section through initial heavy side scheme
kinaesthetic sensation of unfamiliar movement. Furthermore, these implied forms can now be used in the context of providing shelter for the stadium. To mirror the overall horizontal motion of the lightweight skin, this heavy side sought verticality, not in a smooth parabolic form associated with an object lobbed in the air, but in a ‘harsh kink’ from the ground-plane upward. This kink then repeated itself to form the roof over the terraces below, all in precast concrete to convey material mass.

On a practical note, the surfaces extending into the landscape act as ramps for audience members to enter on and walk around the stadium. Where they meet the back-of-house service entry they bridge over the service road, so as not to inhibit vehicular traffic at that point.

To heighten our reaction to the form, light and material phenomena can be played with, “observed in the movements of the eye; then we are dealing with responsive sensations.” The patterning of the precast concrete sheer walls is set up by a series of ‘randomly’ placed lines which wrap vertically over the form and are ‘broken’ by diagonal lines which, as discussed before, irritate our natural eye movement. These lines also present an opportunity to bring light into the dark interior between the sheer walls and the terraces as they can be turned into glazing strips—in turn illuminating out at night through recessed lighting, creating an image of lightning streaking across the structure. In terms of materiality, a dark and rough finish to the concrete will enhance the ominousness of the form as it towers over us.

In the legacy mode, the auditoria and conference centres introduced in Chapter 4, are hung from the roof overhead with glazed facades viewing down upon the running track which can be blacked-out with drop down curtains for when in use during conferences or lectures.

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98 Ibid. 96.
Figure 134. Final sheers walls in position on heavy side.
From the initial stages of the design process of the Auckland Olympic Stadium it was evident that a legacy plan was not only essential, but an important driver in terms of every structural and aesthetic decision made. What was once considered beneficial, is now mandatory. The solving of complex spatial geometries, coupled with the need for intricate folding mechanisms to transform the stadium in the legacy phase, meant the design process was never linear but rather a simultaneous venture of designing for the present, providing for the future and incorporating theories from a century ago.

The constant battle between practicality and the theories of empathetic kinaesthesia have produced a hybrid, dynamic and intriguing result, perhaps something not expected in a stadium. The relevance of the theories has, hopefully, indicated their importance in producing an architectural experience worthy of such a sporting spectacle as the Olympic Games.

Hermann Lotze once stated: “No form is so unyielding that our imagination cannot project its life into it.”99 Whilst he may see this as being the case, the adaptation of the theories presented by Vischer, Wölflin, Schmarsow and Worringer amongst others, has allowed one to see and experience the intended articulations of movement presented with more clarity in the scheme, rather than just relying on Lotze’s claim. The simple motion set up by the radial divisions which govern most of the spacing and grids in the stadium, give the planning a rigid backbone and whilst one might not need to be aware of where the centre of the certain

series of radial axes might be, one can still relate the congenial movement of swinging an arm or rotating one’s head.

Through researching the methods which artistic disciplines had employed to represent motion in a static entity, two main techniques were identified; iterated instances describing positional changes and a continuously fluctuating representation of one motion in its entirety. These techniques were implemented where appropriate; however, a hybrid approach allowed greater possibilities. The seating bowl and the concourses emphasized a continuously fluctuating entity within the outer primary structure, which took on the combination of the two techniques of kinaesthetic representation.

An underlying contrast set up by the eastern ‘heavy’ and the western ‘lightweight’ sides of the stadium has also contributed to a dynamic whole in which extreme interpretations of empathy in a motion can be tested, one side influencing the contrariety to the other and the vice versa. This is translated into both the separate construction elements as well as the gestalt of an entire side. One may relate individual body parts to the elements or an entire sequence of motion to the overall impression.

If time allowed further articulations of empathetic kinaesthesia in smaller elements (such as the WC’s, stairwells, lighting, etc.) of the scheme would have contributed to a richer final solution, but ultimately the sheer range of scope explored did not allow for this.

Lastly, it is vital to stress that representations of the theories are simply interpretations. Yes, we may have an ability to project our imagination and corporeal form into an object, but this is a personal, individual experience—one that can only be influenced to a certain extent. Worringer proclaims this in his definitive quote from *Abstraction and Empathy*, “Aesthetic pleasure is objectified

self-indulgence." Our ‘mental-sensory ego’ belongs only to ourselves and so our interpretations and empathising abilities vary greatly. This project has sought to spark this ability within ourselves as we search for opportunities to transpose our internal emotions and kinaesthetic understanding into an external entity.

100 Worringer, Abstraction and Empathy, 4.
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Gracias Alicia. Siempre estabas aquí conmigo.