Structure and Sustainability

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A. INTRODUCTION

LIGHTNESS AND SUSTAINABILITY

The role of the architect is to manifest to us through built form who we might ideally be. An idea that buildings, or more specifically our constructed environment, can convey the very aspirations of the society to which it serves. And it is our contemporary society that perhaps for the first time in history at both a global and local level is concerned with our ongoing environmental viability.

Sustainability therefore lies at the philosophical heart of this discussion. It is one of the reasons we advocate for lightness. For in this very lightness are the inherent qualities of minimal material use for maximum outcome. The minimisation of our footprint on the planet, to use only what we need, to do more for less, is perhaps our only way forward. There is a natural balance in this. All things in their place.

CAMPING

'The very simplicity and nakedness of Mans life in the primitive ages imply this advantage at least, that they left him still but a sojourner in nature…….He dwelt, as it were, in a tent in this world……But lo! Men have become tools of their tools……We no longer camp as for a night but have settled down on earth and forgotten heaven'. Thoreau

Through much of our recent industrialised history the intimate connection we once had with the organic world has diminished. We have sought to 'walk on' the planet rather than 'walk with' it. I am sure this lies as the basis of Philip Cox's early work and the ongoing evolution of the practice. Much of our early work has been described as more akin to the tent than the cave. Lightweight, efficient and optimised with great structural clarity. And with this a recognition and acknowledgment of the temporary nature our time here.

The origins of our practice have a major interest in an Australian 'functional tradition' of construction, structural innovation and structural expression. A direct and honest approach to delivering buildings in a constrained environment. Inspiration was derived from big vernacular buildings of rural Australia in which an honest expression of structure can lead to a building language that brings the structural and architectural disciplines together. This direct approach through minimal and efficient material use leads to an enduring architecture. A sustainability through constraint. Not a façade or image based technique. And with it a process of ongoing experimentation through constraint in a material, time and cost sense. And constraint can generate innovation. This is the culture of our practice.

AN ORGANIC RESPONSE

As Philip Cox has written, architecture can be considered a living thing which has to respond as any organic object. All things in nature have structure and form as entity and context merge in one organic relationship. Nature itself conveys structural economy and expression. Form and function relate seamlessly. Inbuilt in to all of this are dynamics that ensure a continuous stability, relevance and ultimately beauty.

MELBOURNE RECTANGULAR STADIUM

'Let's go camping with paraphernalia competent to make us masters of our environment and time.'
Buckminster Fuller

The merging of both a sustainable design and an organic form through structural evolution lie within the design for this new sporting arena.

The Melbourne Rectangular Stadium continues the strong architectural lineage of Melbourne's sports and entertainment precinct evidenced since 1956 by the Myer Music Bowl and Olympic Pool Complex, and later by Rod Laver Arena and the Melbourne Cricket Ground. The project represents a complete integration between architecture and engineering - every element of the design has a purpose and has been optimised for its specific application. The sculptural qualities of the design are a result of function and structure.

The stadium has been designed with a unique and dynamic form that is innovative and memorable. At the heart of the design is the bioframe, a lightweight steel design based on the inherent structural efficiencies of the geodesic dome, which allows for 50% less steel than a typical cantilever roof structure. This structure is skinned in a triangular panelised facade made up of a combination of glass, metal and louvers. Together the bioframe and the skin form a highly sculptural, non-industrial kind of building, providing a new image for a stadium that moves away from industrial aesthetic to organic design.

The collaborative design process undertaken by Cox Architects and the engineers Arup has allowed the bioframe to provide depth of structure instead of just using beam depth, resulting in a hybrid structure of shell, cantilever and arch support across the length of the building.

Critical to this outcome was the idea that the building should not use any more or any less material than absolutely required in its construction. The environmental footprint of all our new buildings now needs to be paramount in our thinking if we are to create truly sustainable architecture.

In addition, the stadium is designed to express the energy and dramatic activity which takes place within. It achieves this through the geodesic dome which encloses the structure of the seating bowl, and expresses the sense of theatre that is so important in helping to create a great event – an atmosphere which cannot be captured through television. Essentially the form of the bowl has been driven by the aspiration to optimise seating locations and allow sun penetration onto the grass, providing an optimal experience for both spectators and players.

ADELAIDE OVAL

During its 130-year history, Adelaide Oval's built form has been developed in order to improve facilities and keep pace with expectations of the general public. In collaboration with Hassell, Cox Architects are now designing the Western Grandstand redevelopment as an expression of "pavilions in the park", breaking a larger structure down so that it sits appropriately within its environmental context of river, parkland and city backdrop.

As with the Melbourne Rectangular Stadium, the Western Grandtand redevelopment is designed to strengthen the ground's attributes whilst providing high quality facilities for patrons, players, sponsors and media. The ground's capacity for football and cricket will be for over 35,000 seats and will be designed to host soccer, rugby league, union and concerts. The design of lightweight roof structure allows us to achieve all of this while maintaining the atmosphere of a country cricket ground. The diagrid-with-cantilever structure is broken up into five major areas with a focus on the central members pavilion, providing a tent-like structure which sits lightly upon the grandstand, ringing true to the "pavilion".

Designed in partnership with Aurecon, the freespan truss design of the roof ensures column-free viewing as well as protection for the spectators from the elements. The non-continuous varying height curved roof is a design reference to the tent-like roofs of the Chappell Stands and the curved ridge and gables of the Bradman Stand. Its scale and proportion are in context with the Oval and draw attention to the middle of the stand as the centerpiece of the western grandstand.

EASTERN LEARNING HUB, THE UNIVERSITY OF MELBOURNE

The pavilion is also an important structure in the creation of a new learning landscape for The University of Melbourne. Using structure as the public realm, events platforms have been created to acknowledge and make use of the "in between" spaces of the university's Parkville campus. Informal working and social spaces that are geared towards individual and group learning have been provided for students and teachers. In particular, the outer pavilions, which take the form of folded plates, provide both shelter and the ability to inhabit a sculptural piece.

These new environments constitute of cellular and open plan spaces in three different buildings, a large-volume gallery space to accommodate mixed uses and new external pavilion structures on an existing plaza space. Although these environments are not physically connected, lightweight, expressed steel structures provide a common element to link the building components together.

Student Services Centre:

- Expressed steel structural elements both internally and externally.
- Primary deep steel members in contrast to the light steel connections against neighbouring buildings.
- Raking steel facades supporting glazing and louver systems.
- Primary steel roof members supporting skylights and ceilings.

Frank Tate Plaza / Pavilion:

- Expressed steel structural elements both internally and externally.
- Use of steel structural framing members to achieve desired roof and cladding geometries.
- Weaving of steel and timber elements to create simple but effective working environments.

The Eastern Learning Hub provides a new learning landscape, embracing its physical, academic and social context to provide a total environment.

MELBOURNE AND OLYMPIC PARKS

In conjunction with Populous, Cox has developed four masterplan options for the Melbourne Park site and its flagship event, the Australian Open. Although at only masterplan stage, the project endeavours to apply principles of lightness and organic design to invigorate the public realm.

Currently, the large entertainment venues that populate the length of Olympic Boulevard are viewed as positive elements around which all local activity is conducted. This masterplan proposes an alternate approach which focuses on the spaces between the major venues as the primary design initiative, in effect the "glue" which binds the precinct into a single, cohesive element and events space.

These structures that form the "glue" are efficient in their nature and optimised with great structural clarity, providing public connections in the form of town squares and verandahs. The hierarchy of these connections affords the precinct with quality and contemporary connections that link not only the large entertainment venues within the precinct but also the precinct to the adjoining Yarra River, network of parklands and Melbourne's urban context.

SINGAPORE MARINA BAY BRIDGE

Connections of cities and the various elements that they constitute are integral to how a city functions and the kind of culture that it may foster.

Bridges provide the ultimate opportunity for creative design and structural experimentation, particularly those dedicated to pedestrians and cyclists as they are not restricted by a vehicular element. The Singapore Marina Bay Bridge is one such piece of infrastructure. It links the Marina Centre with the Bayfront area taking up a continuous covered way and walk structure which varies in its form, being covered, semitransparent or pergola.

The bridge's structure has been inspired by the native fishing traps of the surrounding islands which are a helical form. This form is structurally perfect for a tensile bridge as it allows for overhead protection and yet is integral to the structure, continuing the practice's functional tradition of construction and structural innovation.

The bridge responds to the linking of different activities with a continuous shade structure that modifies to suit the particular function. Morphing into a structure designed to span the 250m-wide marina channel, the tensioned forces are also employed to create shading, optimising the lightweight form of the structure. The morphing form of the Singapore Marina Bay Bridge may also be interpreted as the evolving nature of our time, a time in which we use only what we need.

KURILPA BRIDGE

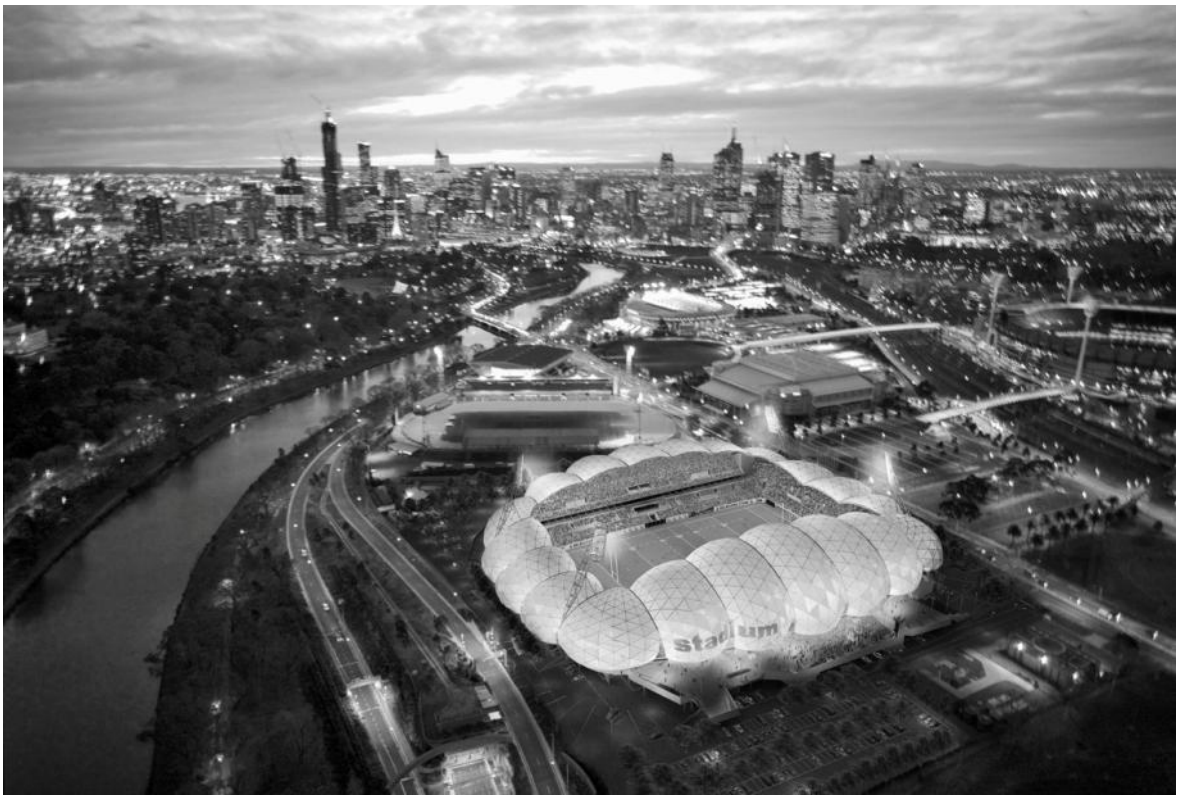
Another example of creative design and structural experimentation is the Kurilpa Bridge which crosses the Brisbane River directly upstream of the Goodwill Bridge, forming a pedestrian and cycle loop between Brisbane's CBD and South Bank.

With the aim of minimising scale against the Queensland Cultural Centre buildings on the South Bank side, the design employs the structural principle of 'tensegrity' to create a skeletal array of seemingly random masts, spans and cables which appear to 'dance' across the river. This principle was developed by the American engineer and inventor Richard Buckminster-Fuller in the mid 20th Century and later translated into a series of outdoor sculptural works by American artist Kenneth Snelson.

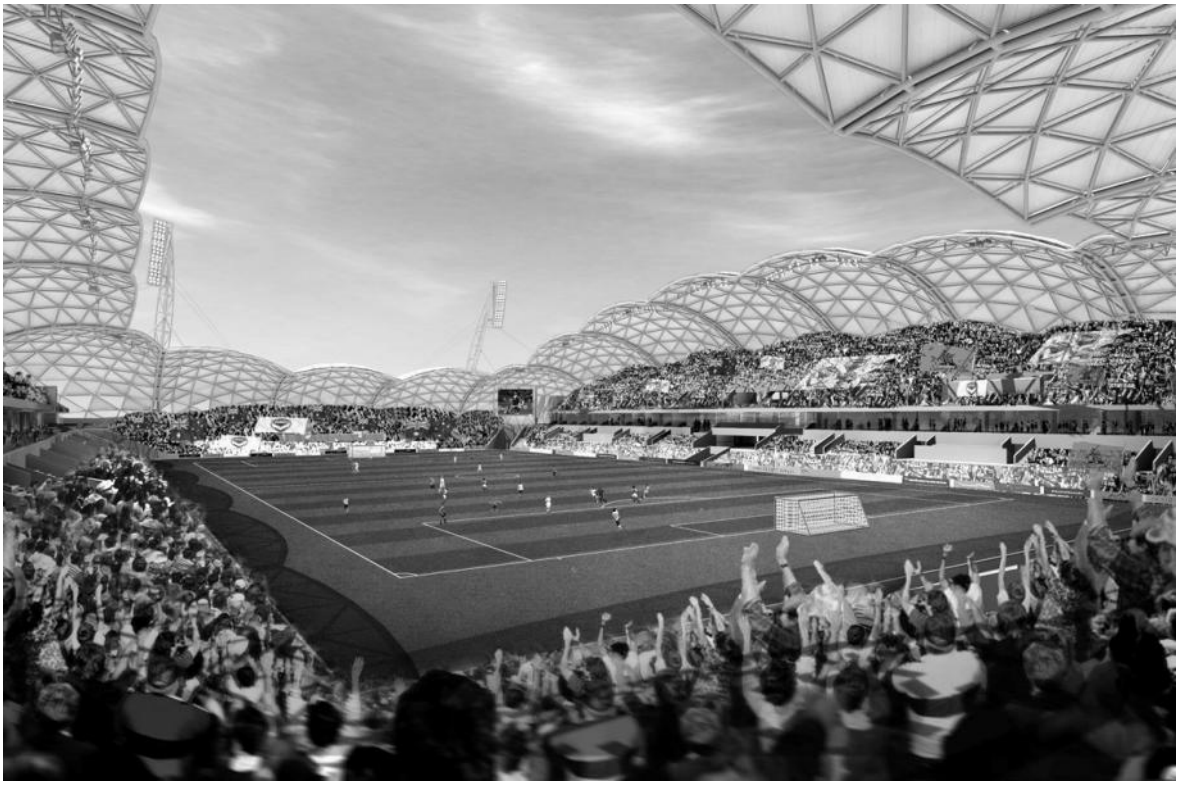
The structure produces a beam thickness of only 900mm throughout the bridge's 435 metre length, the main span being 125 metres. A looping ramp facilitates access up from a park at the southern end, this park having been an important historic meeting place for Aboriginal people crossing the river. To connect with the CBD, the bridge spans over the city's major freeway, descending into Tank Street near the Brisbane Magistrates Court.

CONCLUSION

The seemingly random masts, spans and cables which appear to 'dance' across the Brisbane River, enliven the public realm. Such is the attribute of lightweight structures. Their very nature encourages an ongoing experimentation through constraint of material, time and cost, and in turn the opportunity to generate creative and innovative architecture. The efficiency of form and function that is required of lightweight structures also requires a truly collaborative approach between architect and engineer, ensuring that each structure is efficient in its form and therefore sustainable in its application of materials.



1: Melbourne Rectangular Stadium



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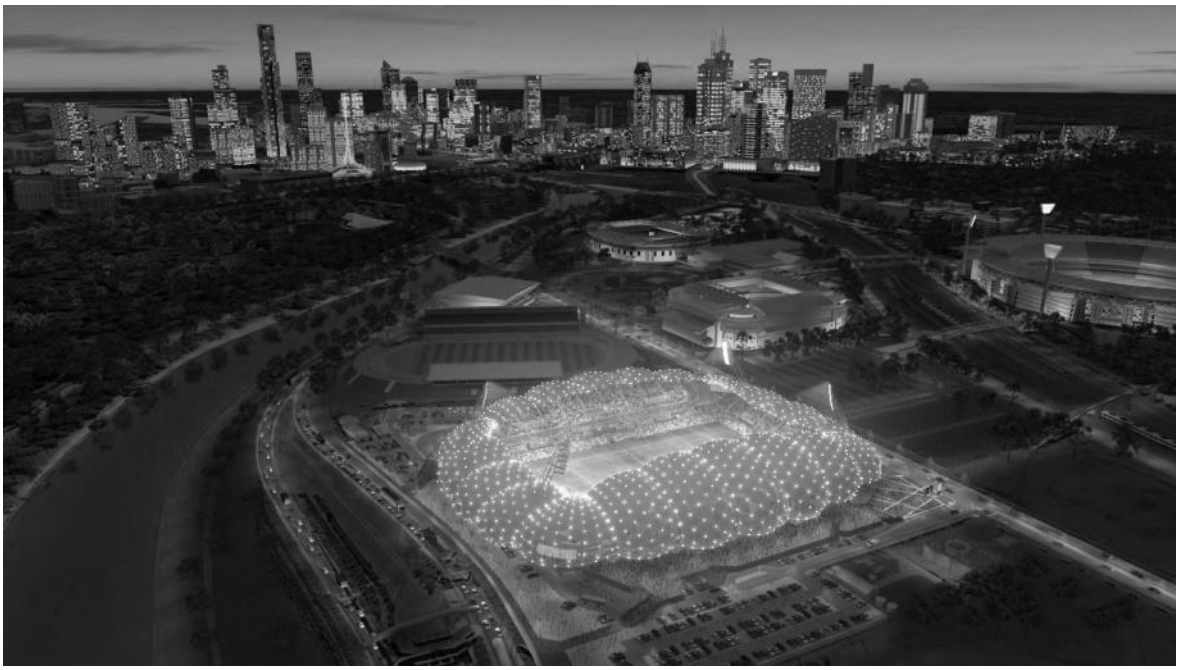
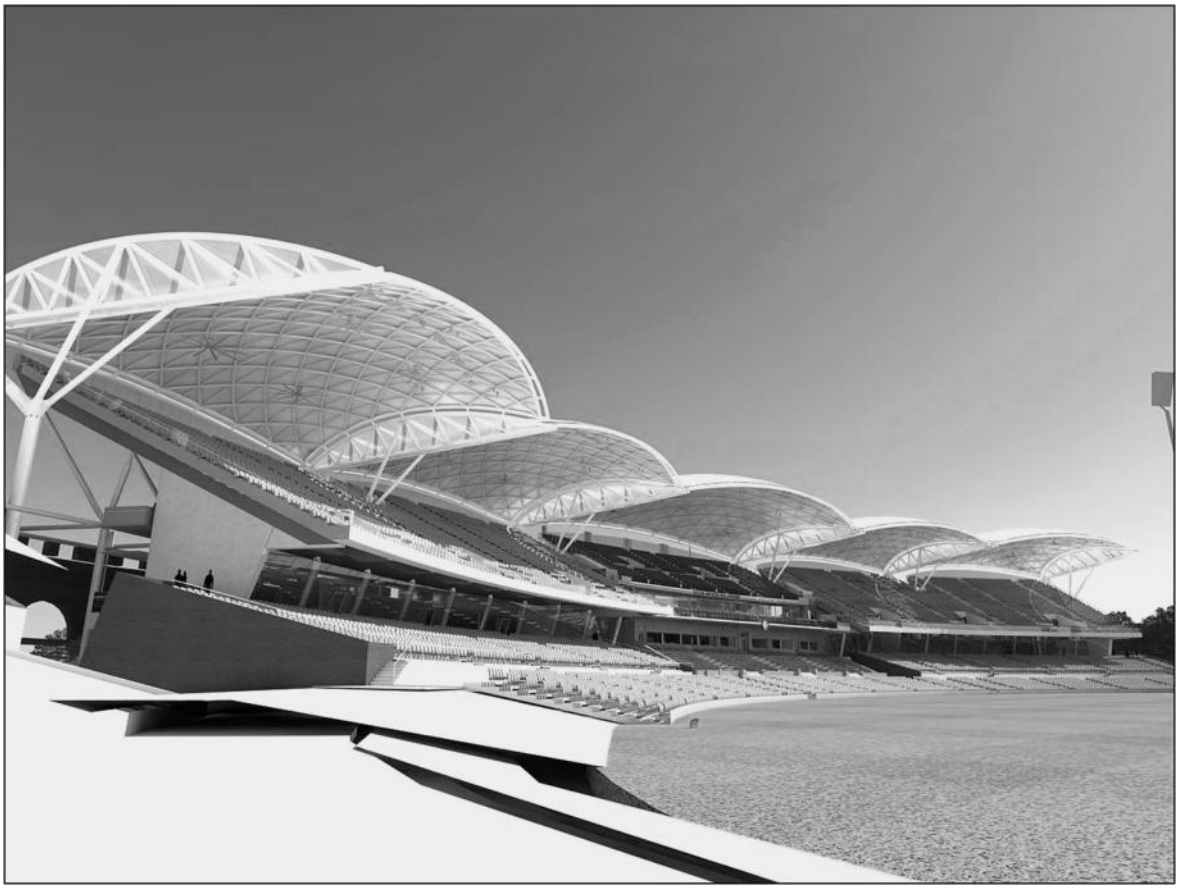


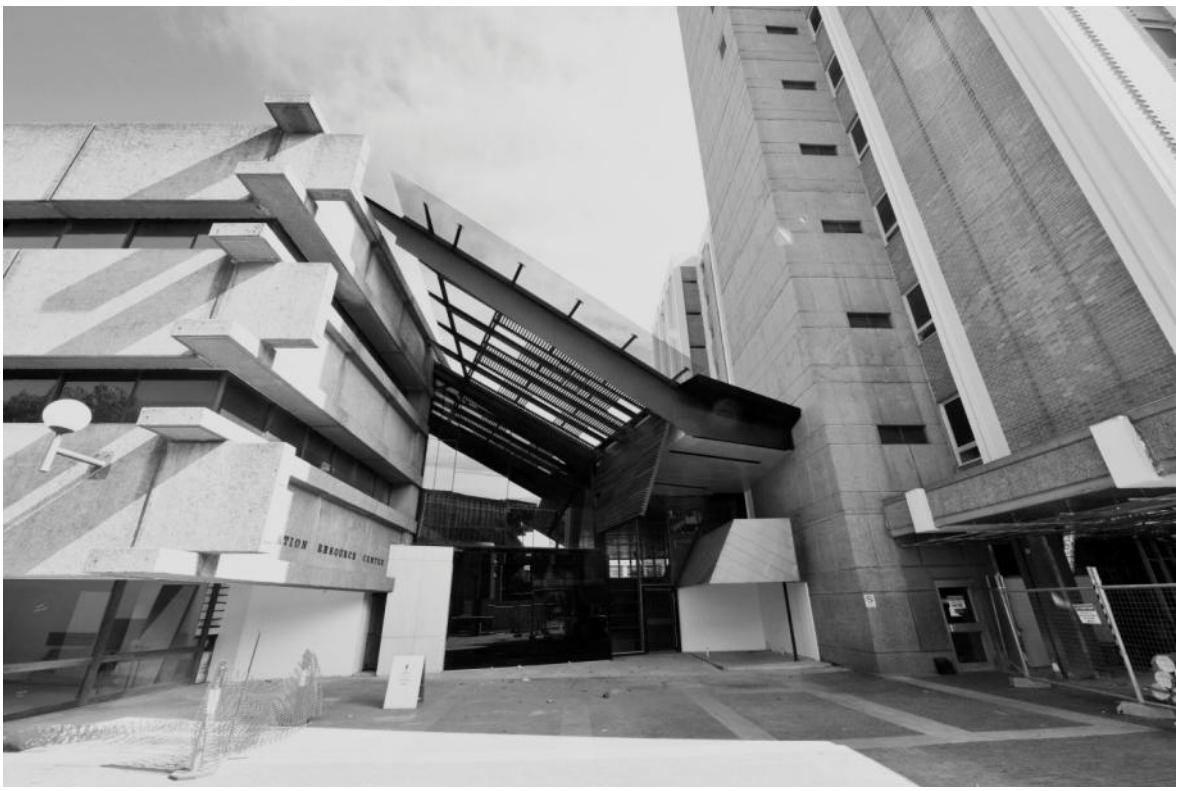
4: Melbourne Rectangular Stadium



5: Adelaide Oval

6: Adelaide Oval

7: Eastern Learning Hub, The University of Melbourne



8: Eastern Learning Hub, The University of Melbourne

9: Melbourne and Olympic Parks

10: Singapore Marina Bay Bridge

11: Kurilpa Bridge

12: Kurilpa Bridge