

**Exploring *folded space* in urban cape town:
Unfolding the Strand / Adderley Street junction**

Design Research Project APG5058S

Submitted in partial fulfilment of the requirements for the degree
Master of Architecture (Professional)

by

Mariet Willemse

September 2009

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Introduction

Preface

This thesis started with a personal interest as to what informs architectural form, specifically the folded, smooth or continuous form so visible in contemporary architecture. I was interested in the relationship between the formal 'folds' of contemporary architecture and the spatial theory of 'folded space'. In order to understand where these forms are coming from and whether or not the idea of 'folded space' could bring value to the construct of architecture in the South African context I had to gather a comprehensive understanding of the state of architecture in the 21st century and of course that meant researching the failures and successes of what went before.

I have learned that the obsession with folded form comes from contemporary architecture's preoccupation with connection and complexity in architecture. In short; Modernism sought to group, zone and separate different spatial programs which were often translated into pure geometric forms, Post-Modernism reacted against the monotony of Modernism by juxtaposing exaggerated oppositions in form and spaces. Today, in the transitional phase from the late 20th century to the beginnings of the 21st century, contemporary architecture still struggles with the theme of connection and complexity in architecture.

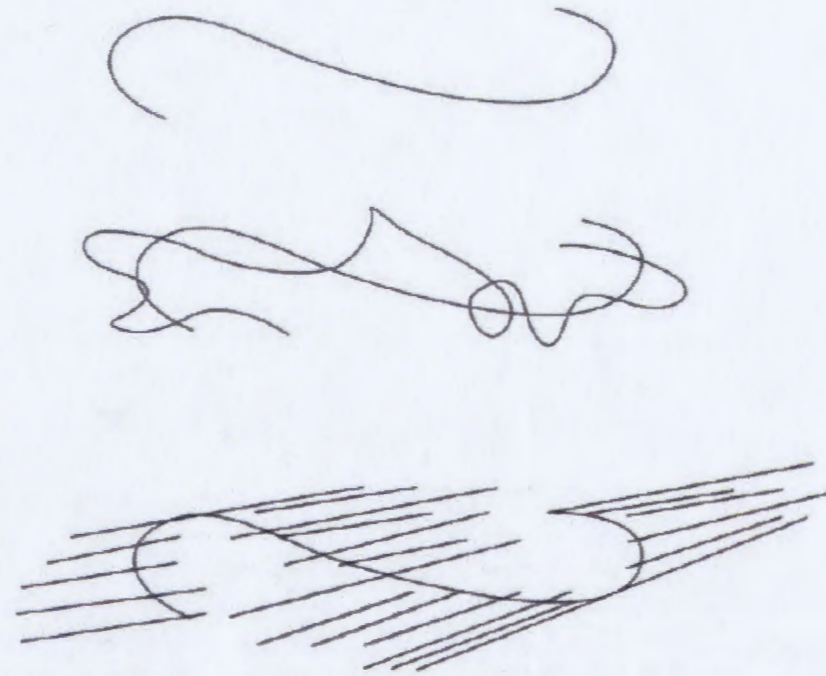
The idea of 'folded space' where previously unrelated elements are smoothly integrated within a continuous, but heterogeneous mixture seems to provide contemporary architects with an alternative to the purity of Modernism and the vulgar oppositions of Post-modernism.

So the question contemporary architecture is faced with today is: How can architecture formulate a continuous mixture which still allows for variety complexity?

The theory investigation concluded that the relevance of the folded space in the South African context could be the realization that through the folding or blurring of the relationship between previously unrelated programs, spaces and the building and its urban context, new and interesting social interactions might arise.

The corner of Strand and Adderley Street on the station site proved an appropriate site on which to test this theory of 'folded space' on both a social and a spatial level. Although the site is situated on the most important intersection in the city it is known for its clear separations and barriers. The three levels in the center of the city, the underground, the ground and the above ground / station roof are separated both spatially and socially.

The design project strives to experiment with ways in which to 'fold' the distinct spaces that are imminent, but repressed on this corner site in the heart of Cape Town's city. Through folding or connecting these spaces and programs that were previously separated the architecture will aim to act as a 'platform for social encounters amongst its users.



Diagrams by Paul Klee, taken from the book, *The Fold: Leibniz and the Baroque*: 'Inflection is the ideal genetic element of the variable curve or fold. Inflection is the authentic tom, the elastic point. That is what Klee extracts as the genetic element of the active, spontaneous line.'

Structure of the document

This document will aim to function as a guide to the theoretical, conceptual and design thinking that lead to my final design project or thesis. Although the process did not occur in a linear fashion, the document has been structured in such a way as to make the ideas clear and simple to the reader.

The document is divided into 5 chapters.

The 1st chapter is concerned with locating the research topic by explaining its philosophical origins, locating its position in the 20th and 21st century architectural discourse and arguing the relevance of the idea to contemporary architectural discourse. International case and precedent studies are analyzed with particular emphasis on their contribution to the idea of folded space.

The 2nd chapter argues the relevance of the idea in the South African context. Design speculations are introduced as to the relevance of possible architectural interpretations of the concept of *'folded space'* in the South African context. Local case and precedent studies are analyzed with particular emphasis on their contribution to the idea of *'folded space'*.

The 3rd chapter introduces the site chosen on which to explore the architectural idea of *'folded space'*. The choice of site is explained and located in its greater context. The site's historical, social and spatial context is analyzed through mapping and diagrams; an urban design proposal is subsequently formulated.

The 4th chapter introduces the conceptual ideas, through mapping, diagrams and conceptual models.

The 5th chapter explores ideas for making the building.

Finally the last chapter concludes by summarizing the process undergone and the main ideas for the design project.

1] Research topic: *Folded* form vs. *Folded* space

Introduction

Today, in the transitional phase from the late 20th century to the beginnings of the 21st century, contemporary architecture finds itself in an uneasy space, not wanting to associate itself with either the monotony of Modernism or the exaggerated oppositions of Post-modernism.

The idea of *the fold* where previously unrelated elements are smoothly integrated within a continuous mixture seems to provide contemporary architects with an alternative to the purity of Modernism and the vulgar oppositions of Post-modernism.

But what does the idea of the fold bring to the discourse of architecture, more than the obvious formal reading of a floor turning into a wall, turning into a roof and back into the wall? Is there more than this formal reading to the idea of the fold?

John Rajchman opens an essay which considers *folding* in the work of Peter Eisenman with the following suggestion:

*"It can happen, as in the Baroque, that an architectural invention is enveloped in a larger event, implicated in a larger question that arises in our space, complicating it and our vision of it. A formal trait in architecture may then become part of the crystallization of something unknown that is knocking at the door, something unforeseen that we can only experiment with or play within our seeing, our thinking, our creations."*¹

Rajchman thereby implies that the formal traits of *folding* in architecture could possibly relate to a search for a new conception and understanding of spatial relationships and ways of conceiving architecture in the 21st century.

This theory project will aim to uncover whether the idea of *the fold* can bring more to the construct of architecture than the limited formality of folded forms.

¹ Rajchman, J, *Constructions*, MIT, Cambridge, 1998

Daniel Libeskind 1995



Pieter Eisenman --1996



Rem Koolhaas -- 2004



Frank Gehry. 1997



UN Studio 2005



The philosophical origins of 'the fold'

In architecture the idea of *the fold* or *folded space* has been articulated through a diverse range of formal, spatial and programmatic interpretations by various architects and architectural movements in the 20th and 21st century.² The origins of the idea can however always be traced to the writings of the French philosopher Gilles Deleuze.

In order to acquire a comprehensive understanding of the concept of *'the fold'* it is critical to understand the philosophical background of the idea and the thoughts that preoccupied its author.

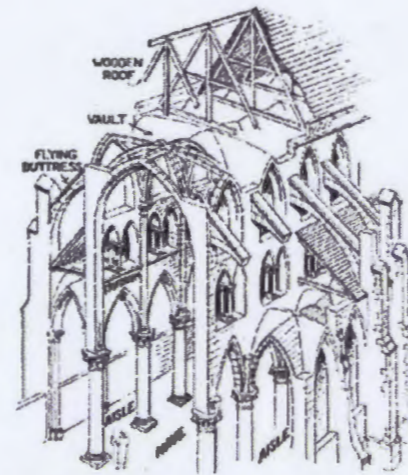
Gilles Deleuze (1925-95) is known above all as a theorist of flux, plurality, movement and complexity. He rejected the more traditional concepts of sameness and representation in favour of repetition, proliferation and difference. He elaborated a series of concepts such as the *'monad'*, the *'straited'*, the *'rhizome'* and the *'fold'*. These contributions acquired him a reputation as one of the most innovative thinkers of the twentieth century, an age increasingly preoccupied with the question of complexity. In fact, Michel Foucault once predicted that the twentieth century will one day be known as Deleuzian.³

In his book, *A Thousand Plateaus* (1979), Deleuze first explored his concept of the distinction between smooth and striated space, preceding his theory of the 'fold'. The book already reflects Deleuze's increasing preoccupation with the theme of connection. In his later book entitled, *Le Pli or The Fold: Leibniz and the Baroque* (1988) Deleuze considers this new spatial realm by exploring Gottfried Leibniz's notion of the fold. The mathematician, Leibniz, first conceived of matter as explosive. Turning his back on Cartesian rationalism, he argued that the smallest element in the labyrinth of the continuous is not the point but the fold.

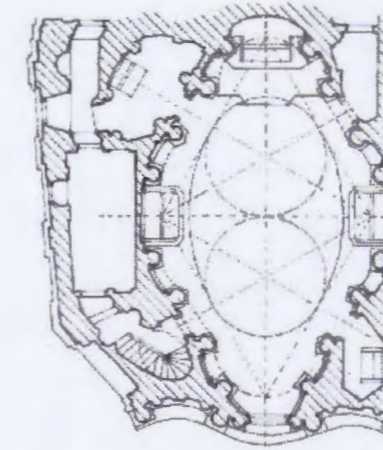
This idea of Leibniz, Deleuze argues, informs not just his philosophical thought but the entire baroque era in which he wrote that is, Leibniz's concepts cannot be understood outside of the curvilinear or folded shapes of baroque architecture. Whereas the fold for Leibniz possessed a metaphysical dimension (joining the soul to the mind), the idea also possessed the material dimension of a pleat or a crease, a joining but also a division of matter, which Deleuze found relevant to the debate of complexity in spatial relationships near the end of the 20th century.

Inspired by Leibniz's theory, Deleuze is no longer concerned with the framing of space, but rather a temporal modulation that implies a continual variation of matter. He claims that the continual variation of matter is characterized through the agency of the fold.⁴

Inspired by Leibniz's theory, Deleuze is no longer concerned with the framing of space, but rather a temporal modulation that implies a continual variation of matter. He claims that the continual variation of matter is characterized through the agency of the fold. He differentiates between the Gothic, which privileges the elements of construction, frame and enclosure, and the Baroque, which emphasizes matter, where the mass overflows its boundaries because it cannot be contained by the frame which eventually disappears.



Gothic: articulates elements of construction



Baroque: mass overflows boundaries of frame

There is a word related to the folding family of which Deleuze is fond above all others: the word *multiple*, which goes back to the Latin *"enfolding"*. Thus on the first page of his book, *The Fold*, he declares: *"The multiple is not only what has many parts, but what is folded in many ways."*⁵ Multiplicity as articulated by Deleuze thus involves a peculiar type of complexity - a complexity in divergence where it is not a matter of finding the unity of a manifold but rather, of seeing unity as a holding together of a previous dispersion.⁶

This concept of - *complexity in divergence* or *folding in difference* thus does not reduce complex relations among distinct elements to a homogeneous unity, but rather anticipates a continuous and reversible dialogue between different entities that are held together.

In order to fully realize the potential of Deleuze's theory of *the fold* in architectural discourse it is therefore important to not only see *the fold* as a technical device that both separates and connects, but as a theory of becoming or being and a theory of multiplicity and dialogue - differentiation while maintaining a continuity. Deleuze explains,

*"Thus a continuous labyrinth is not a line dissolving into independent points, as flowing sand might dissolve into grains, but resembles a sheet of paper divided into infinite folds or separated into bending movements, each one determined by the consistent or conspiring surrounding... A fold is always folded within a fold, like a cavern in a cavern. The unit of matter, the smallest element of the labyrinth, is the fold, not the point which is never a part, but a simple extremity of the line."*⁷

But what could this mean for architecture?

A folding across lines could create uncertainty between boundaries, instead of defined boundaries of separation. Several folds could create a blurring of inside/outside, solid/void, and space to space thresholds, thereby reconceptualizing the traditional architectural notions of spatial connections and separations.

The idea of *the fold* could lead to a more informal way of designing, anticipating new and unexpected things to happen in between the folded programs, sites and users of the space. For example the relationship buildings have with people and the surrounding environment could through the blurring of boundaries encourage a constant dialogue. These uncertainties create the potential of a multiplicity of folding and unfolding; a re-reading of an architecture of becoming.

Thus, a building is not one space (an object) on one site but many spaces folded into many sites. Architecture conceived where there is a folding of space into other spaces.

For example, the problematic relation of ideas can develop new ways of seeing the relationship of architecture to environment; building to site and user to building. *The fold* can begin to reconsider questions of figure/ground contextualism. This new reading might reveal other conditions which may have always been immanent or repressed in the urban fabric.⁸

2 See section: Mapping the fold through 20th to 21st century architecture
3 Leach, N, Rethinking Architecture: A reader in Cultural Theory, Routledge, London, 1997
4 Deleuze, G, The Fold: (Le Pli), Leibniz and the baroque, The Athlone Press Ltd, 1993

5 Deleuze, G, The Fold: (Le Pli), Leibniz and the baroque, The Athlone Press Ltd, 1993
6 Rajchman, John, Constructions, Cambridge, MIT, 1998, p.14

7 Deleuze, G, The Fold: (Le Pli), Leibniz and the baroque, The Athlone Press Ltd, 1993
8 Krissel, M, Philosophy of Materials and Structures, 2004

Mapping the idea of *folded space* through 20th to 21st century architecture

This section will aim to argue that the issue of complexity in architecture (how to interrelate different programs, spaces and other disparities) has been evident in 20th and 21st century architecture and that the idea of connecting different entities through interconnected space as *the fold* suggests has been evident in architectural debates.

The first half of 20th century architecture was dominated by the modern movement, or Modernism. Modernism's complete devotion to the idea of progress, machine technology and mass-production, was further epitomized through a complete rejection of the past, the traditional together with any local customs or culture and thereby failed to acknowledge the complex relationship that exists between tradition and modernity. As Le Corbusier states in 'Towards a New Architecture', "There is no longer any question of custom, nor of tradition nor of adaption to utilitarian needs."⁹

There exist a complex set of multiples between the modern and the traditional. But Modernism, through rejecting traditional cultures and denying the complex relationship that exists between tradition and modernity, ignored the idea of the fold, the multiple and the complex, while propagating the power of the simple geometric form, uniformity through mass, machine production and the logic of order. There were however individuals within the modern movement who sought out and made a claim for spaces of interrelation and complexity.

Sigfried Giedion is described by Hilde Heynen (1999) as 'the Ghost-writer of Modernism'¹⁰, largely because Giedion, like many other architects and theorists were overshadowed by Le Corbusier's propagandistic style of advocating the modern movement. Giedion describes 20th century modern architecture as "a new tradition" and recognises a concept similar to that of the fold in the new construction methods brought about through the industrial revolution. In the same way that the baroque artists used formal folds and curves to create a multiple, interconnected sense of space, Giedion recognizes that the steel girder constructions, such as those used for 'the Eiffel Tower', allows for a 'new experience of space to constitute the foundation of the new architecture'. Giedion described this new experience of space as *Durchdringung*,

"...an essential characteristic of the new architecture: its capacity to interrelate different aspects of space with one another."¹¹



Eiffel Tower (1889), interior of pier. (From Sigfried Giedion, *Bauen in Frankreich*, Giedion comments: "Instead of a massive tower, an open framework condensed into minimal dimensions. The landscape enters through continuously changing snippets.")



Harbor of Marseilles. (Sigfried Giedion, *Bauen in Frankreich*) Giedion comments: "A mobile ferry suspended by cables from the footbridge high above the water connects traffic on the two sides of the harbour. This structure is not to be taken as a 'machine'. It cannot be excluded from the urban image, whose fantastic crowning it denotes. But its interplay with the city is neither 'spatial' nor 'plastic'. It engenders floating relations and interpretations. The boundaries of architecture are blurred."

In the same way that the fold implies multiplicity of space in the formal sense, but also freedom of interpretation and being, Giedion implied that *Durchdringung* stands for a weakening of hierarchical models on all levels architectural as well as social.

Unfortunately Sigfried Giedion's writings did not receive as much attention as Le Corbusier's and his ideas about this new experience of space did not carry much weight during the Modern Movement.

The evolution of The Other Tradition from within Modernism is largely due to defiant architects such as Alvar Aalto, Eileen Grey and Hugo Häring who opposed much of Le Corbusier's architectural propaganda during the meetings of the International Congress of Modern Architects. Hugo Häring, an architect, philosopher of high reputation in Germany disagreed with Le Corbusier in both fundamental values and the methods by which they were to be pursued. He saw Le Corbusier as promoting the imposition of geometrical order upon nature and upon the spontaneous and unpredictable manifestations of human society. Instead of rationalization Häring sought an understanding of life's complexity; instead of order, participation. The term Häring constantly uses is 'Leistungsform' which is the form that arises from performance or pattern of operations. Each task will, in his view, require its special order of performance to obtain fulfilment (St John Wilson).¹²

One notices in Hugo Häring's 'understanding of life's complexity' and 'instead of order, participation' similarities to the concept of the fold and its idea of 'multiplicity' and a 'continuously changing set of difference'¹³. Deleuze's explanation of *the fold* or of *unfolding* as a process of becoming is also similar to Häring's idea of a form that arises from performance or a pattern of operations.

The Other Tradition developed as a revolt within the Modern Movement, while Post Modernism developed as a reaction against the Modern Movement. In both cases these alternative movements proclaimed similarities with the concept of *the fold*, moving away from the pure, simplistic Modernist solution towards the complex and the multiple.

Although Charles Jencks would argue that there are many Post Modernisms, he does claim that there are a few shared values that unite every post-modern movement.

9 Le Corbusier, *Towards a new Architecture*, p.1-8, Dover publications, New York, 1986
 10 Heynen, H, *Architecture and modernity: a critique* Cambridge, Mass, MIT Press, 1999
 11 Giedion as quoted by Heynen, H, *Architecture and modernity: a critique* Cambridge, Mass, MIT Press, 1999

12 Colin St Wilson, *The Other Tradition of Modern Architecture: The Uncompleted Project*, Academy Editions, London, 1995

These shared values are Derrida's notion of *differance*, the idea of complexity and an intense commitment to pluralism. It is noteworthy that these values are once again comparable and in some aspects similar to the concept of 'the fold'.

In architecture the beginnings of the post-modern movement can be traced back to the early 1960's and the writings of Jane Jacobs and Robert Venturi. Both authors wrote best-sellers that challenged the over simplification of the modern movement through complexity theories. Venturi stated his opposition to Modernism's naïve simplicity in what he called the 'gentle manifestation' *Complexity and Contradiction in Architecture* (1966), while Jane Jacobs on a subtler note expressed her distain in - *The Death and Life of Great American Cities* (1961). At the time, cities were being disembowelled by a combination of modern planning theories that emphasised purity and functional separation, and an old time greed that exploited the idea of the city as a clean slate or tabula rasa. By contrast Jacobs' notions of the city as a complex emergent organisation and Venturi's 'obligation towards the difficult whole' were united to combat this oversimplification of Modernism and address the realities of economic and urban life.¹⁴

Charles Jencks defined Post-Modernism in 1978 as,

*"Double coding: the combination of Modern techniques with something else (usually traditional building) in order for architecture to communicate with the public and a concerned minority, usually other architects."*¹⁵

He claimed that Post-Modernism was a reaction to modernism that failed to remain credible partly because it did not communicate effectively with its ultimate users and partly because it did not make effective connections with the city and history. Post-Modernism then was a reaction to the hegemony of Modernism.

Jencks continues to describe the double coding or dual characteristics of Post-modernism as a state of schizophrenia: an architecture that is professionally based and popular, as well as one that is based on new techniques and old patterns. Jencks simplifies this double coding as a movement that is: elite/popular, accommodating/subversive and new/old.

13 Jencks, C, *Critical Modrnism: where is post modernism going?*, Wiley Academy, Great Brittan, 2007, p. 49
 14 *Ibid*, p.50
 15 *Ibid*, p.51

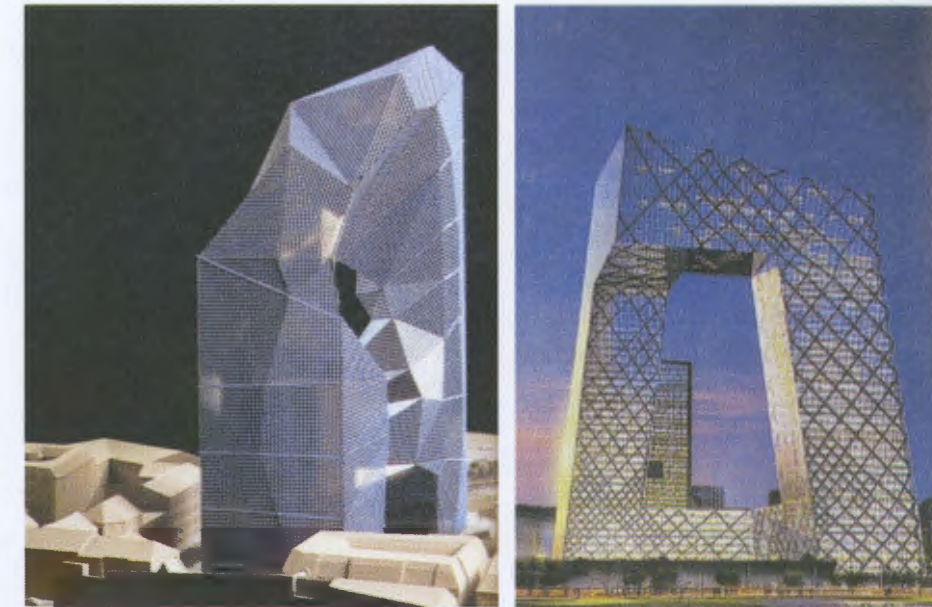
These exaggerated oppositions explain why the post-modern style is often so ironic. Jencks values this irony in Post-Modernism, because of irony's ability to say two different things at the same time. These ironies or contradictions translated into architecture are most evident in The Venturi house (1963-5) by Robert Venturi. The building became synonymous with Post-Modernism since it articulated Venturi's theory of complexity and contradiction. The overall form of the exterior is that of a split pediment, contrasted with modern volumetric elements. The inside spaces, as represented in plan and section, are complex and distorted in their shapes and interrelationships. They correspond to the complexities inherent in the domestic program as well as to some whimsies familiar to an individual house.¹⁶

The most significant difference between the values or ideas of Post-Modernism and the concept of *the fold* is the difference between the idea of double coding or plurality versus the concept of multiplicity of *the fold*. The idea of double coding in architecture resulted in exaggerated, binary oppositions juxtaposed in form and space, rather than form and space of difference, complexity and freedom of interpretation or being that the concept of *the fold* suggests.

Charles Jencks claims that the way pluralism was represented and included in what Venturi called 'the difficult whole' ¹⁷ created another departure point for post-modernism. During the 1970's the idea of 'folding in difference' was developed. This movement was lead by younger architects such as Pieter Eisenman and Rem Koolhaas, who found the strategies of the older Post-Modernists too oppositional and blatant. To them folding meant a more pliant way of pulling together a variety of opposite forces, so supple and integrated that it might look to the untutored eye as if it were reductionist or even modern. But the intentions of these architects were once again to deal with variety and complexity.

This idea of "folding in difference" is much closer to Deleuze's concept of the fold than earlier Post-Modern ideas. Since the idea of "folding in difference" recognizes the concept of pulling together a variety of opposite forces (differentiation), while maintaining a continuity, which is so integral to the concept of *the fold*.

16 Jencks, C, *Critical Modrnism: where is post modernism going?*, Wiley Academy, Great Brittan, 2007, p. 50
 17 *Ibid*, p. 59



Max Reinhardt Haus by Peter Eisenman

CCTV by Rem Koolhaas

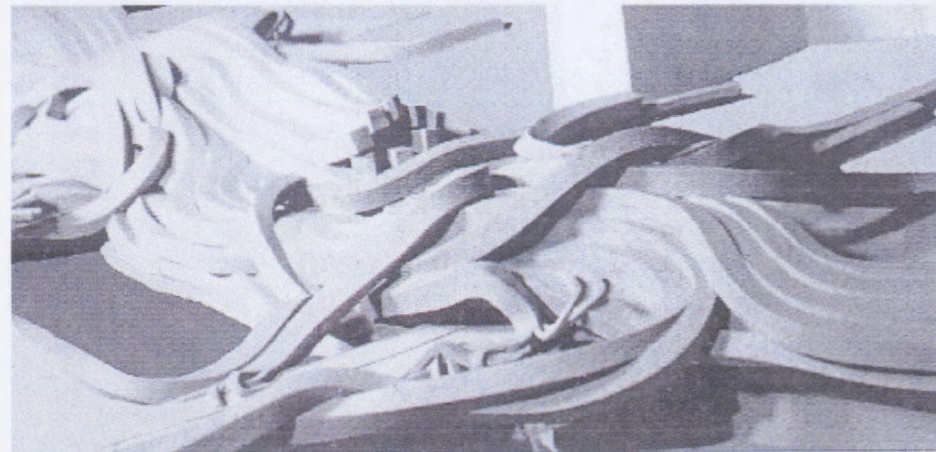
Similar to Post-Modernism, in fact Jencks would call it 'a' Post Modernism, Deconstructionism theorized the world as a site of differences in order that architecture could represent contradictions in form. The Deconstructivists originated their projects with the internal discontinuities they uncovered within buildings and sites. In a special edition of the journal AD, entitled: *Folding in Architecture* (2004), Greg Lynn argues that this contradictory logic of Deconstructivism is beginning to soften in order to exploit more fully the particularities of urban and cultural contexts.

The same architects that were preoccupied with the Deconstructivist way of working are beginning to employ urban strategies which exploit discontinuities, not by representing them in formal collisions, but by affiliating them with one another through continuous, flexible or folded systems.

At this point in time, late 20th century, early 21st century, Jeffrey Kipnis and Greg Lynn inspired by the concept of *The fold* as put forth by Gilles Deleuze, found in the theories of *The Fold* and the latest computer software technology a way to move beyond the contradictory collage of Stirling and the ironies of Venturi. In Kipnis and Greg Lynn's opinion the method of "folding in difference" could finally be explored to its full potential where variety and pluralism or rather multiplicity is allowed but subsumed into a supple, continuously changing whole. As Kipnis argues, it is coherent and congruent, able to handle multiple variables and yet still inclusive of difference.

Yet the resulting, computer generated architecture completely failed to express the complex theory of the fold. In Greg Lynn's Stranded Sears Tower, we can see the attempt at folding. The project takes the sears tower, which Lynn describes as a vertical group of nine towers, and reformulates the image of the American monument by laying the building on its side and straining it into 2025 strands, which are made to participate with their immediate context in a 'supple and plaint manner'. The strands exploit possible connections with and between adjacent buildings, sidewalks, bridges, tunnels and landforms.¹⁸

Lynn claims that the reconfigured tower is no longer a monolith, that it is irreducible to any single type. The critics responded that although it may not take the form of a monument in the traditional sense, it dominated its context nonetheless. The building is a super structure that is neither folded nor responsive to its context.¹⁹



Greg Lynn's Stranded Sears Towers (AD 1999)

18 Greg Lynn, Stranded Sears Tower, AD, *Folding in Architecture*, 2004, p.83
 19 Brott, S, Inside the fold, *the Form of Form*, AD, Vol. 69, 1999

Through mapping of the idea of *the fold* through the history of 20th and 21st century architecture I have learned that although the concept has been evident in the architectural discourse, the translation of the idea of folding into the construct of architecture has more often than not been misinterpreted as merely formal folded figures.

The possibilities of the concept of the fold to architecture, as speculated in the conclusion of the previous chapter: '*the philosophical origins of the fold*', are much more complex and thought provoking. The next chapter entitled, *International Folded Architecture*, aims to uncover whether some of these ideas has been translated into architecture.

Case studies exploring folding in architecture

To me the most valuable idea of the concept of *the fold* is the realization that through the folding or blurring of the relationship between different entities, such as: previously unrelated programs, the figure and ground, the building and its urban context, new and interesting relationships of social interchange might arise. Through the work of the following architects these ideas will be discussed.

Peter Eisenman: Unfolding Frankfurt

Unfolding the singularity of the Rebstock, Frankfurt, 1991-1994

Peter Eisenman's development of Rebstockpark, a twenty hectare plot on the outskirts of Frankfurt, into a residential and commercial block, is about *the fold*. Eisenman attempts to challenge the singularity of the German *Siedlung* through folding architectural and urban space into each other.

Eisenman believes that traditional architectural theory largely ignores the idea of the event. Rather it assumes that there are two static conditions of object: figure and ground. These in turn give rise to two dialectic modes of building:

1. The first mode: Figure/ground contextualism, which assumes that there is a reversible and interactive relationship between solid building blocks and the voids between them. (Eisenman attempts this mode through *folding the Rebstock park*)²⁰
2. The second mode: concerns the point block or linear slab isolated on a tabula rasa ground. Here there is no relationship between old and new or between figure and ground. Rather the ground is seen as a neutral, autonomous datum. (the existing *Siedlung*)

Eisenman seems to have a thorough understanding of the problems inherent in the urban condition of Frankfurt. He explains that in the late 18th and the early 19th centuries, the typical perimeter housing and commercial block in German cities defined both the street and the space of the interior court as positive. These spaces seemed literally to be carved out of a solid block of the urban condition.

20

Eisenman Architects, Unfolding Frankfurt, Ernst & Sohn, Berlin, 1991

In the mid-19th century, with the development of the grand boulevards and allées, a new kind of spatial structure appeared. The streets were still positive spaces but were now lined with ribbon buildings, whose rear yards became leftover space. This idea led to the development of the German *Siedlung* (multi-storey, linear block row housing), where, without adjacent streets, the backs and fronts of the buildings became the same. Here the open space was in a sense left over; the "ground" became a waste land. According to Eisenman the object buildings seemed detached, floating on a ground that was no longer active.²¹

In order to challenge what Eisenman calls 'the singularity of the German *Siedlung*', he proposes to read the object-figure/ground from another frame of reference. This new reading, he claims, might reveal other conditions which may have always been immanent or repressed in the urban fabric. In such a displacement, the new, rather than being understood as fundamentally different as the old, is seen instead as being merely slightly out of focus condition, then has the possibility of blurring or displacing the whole, that is both old and new. One such displacement possibility can be found in the form of *the fold*.

As inspired by Deleuze's reading of the fold, Eisenman goes on to explain that in the idea of the fold, form is seen not only as continuous but also as articulating a possible new relationship between vertical and horizontal, or between figure and ground, thereby breaking up the existing Cartesian order of space. Eisenman explains,

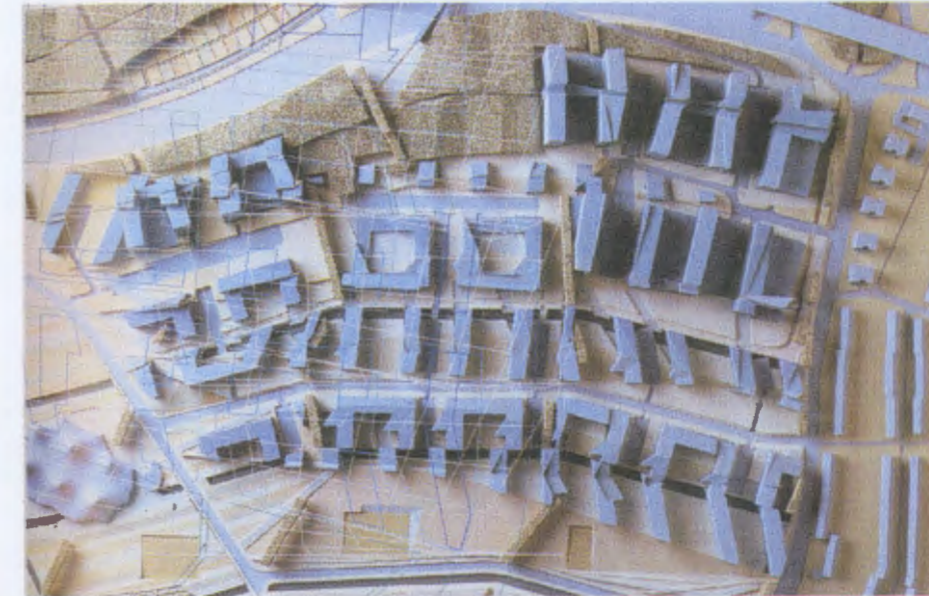
*"The idea of the fold gives the traditional idea of edge a dimension. Rather than being seen as an abrupt line, it now has a volumetric dimension that provides both mediation and a reframing of conditions such as old and new, transport and arrival, commerce and housing. The fold can then be used as both a formal device and as a way of projecting new social organizations into an existing urban environment."*²²

21

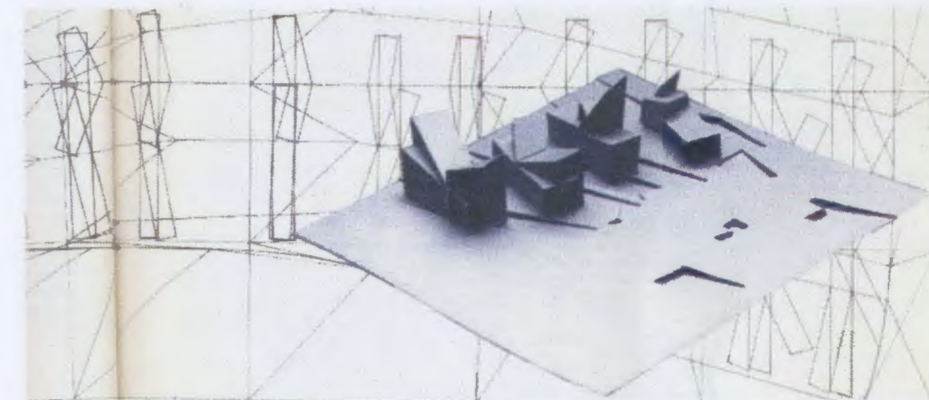
Eisenman, P, *Folding in Time: the singularity of Rebstock from Blurred Zones: Investigations of the Interstitial*: Eisenman Architects, 1988-1998, The Monacelli Press, Inc, New York, 2002, p.131

22

Folding in Architecture, AD, Greg Lynn, Wiley-Academy, 2004



Context model showing folded scheme



Concept model showing interactive figure | ground relationship

The articulation of the idea of the fold into the actual architectural and urban project of the Rebstock park, is however quite perverse. Eisenman starts by replicating the three building typologies (perimeter housing, commercial block and the Siedlung) which forms the urban fabric of Frankfurt on the site. These typologies are then arranged in a way to satisfy zoning and program development requirements of the competition brief.

He then goes through a lengthy process to develop a sophisticated set of grids, inspired by the mathematician, Rene Thom's folded catastrophe nets. These nets or grids (Eisenman is famous for manipulating grids to give rise to architectural form) are then used - through the use of computer programs - to alter, manipulate and fold the three building typologies on the site into and over each other and the existing urban context.

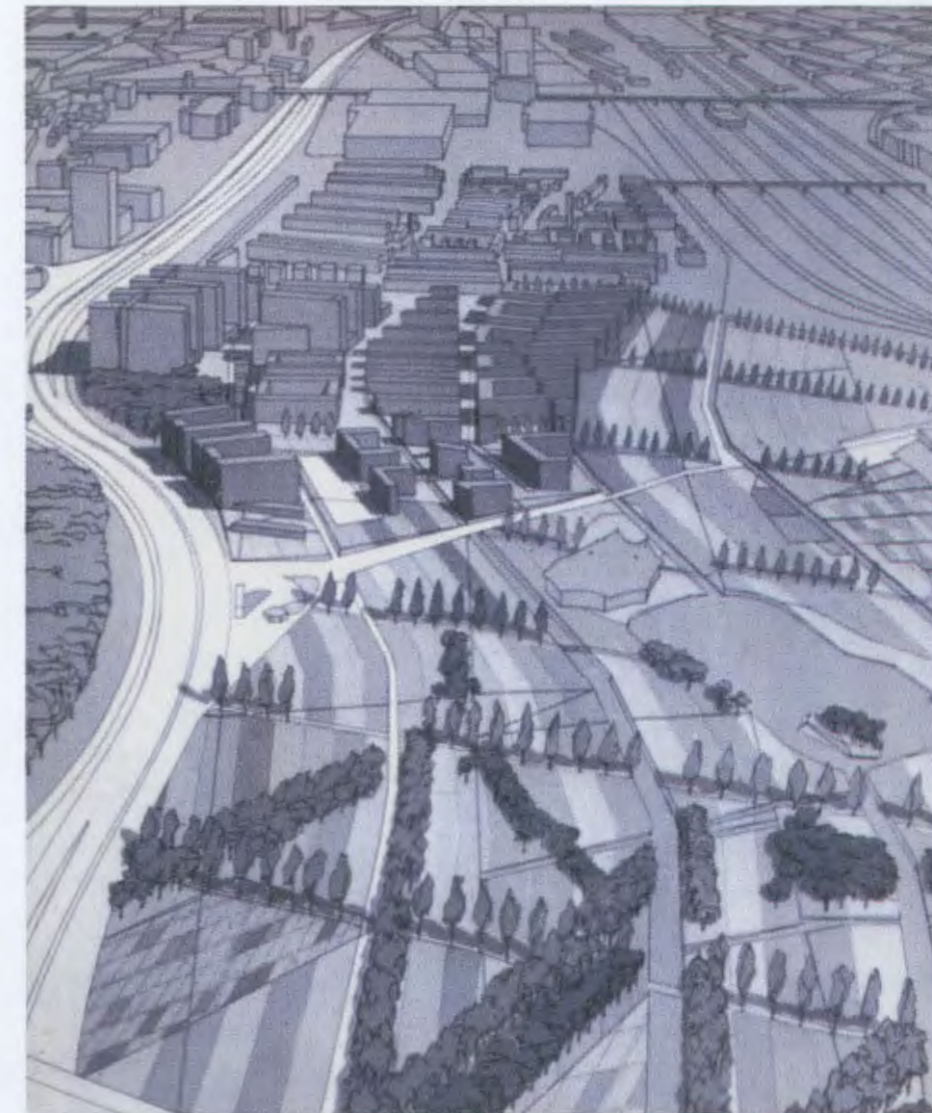
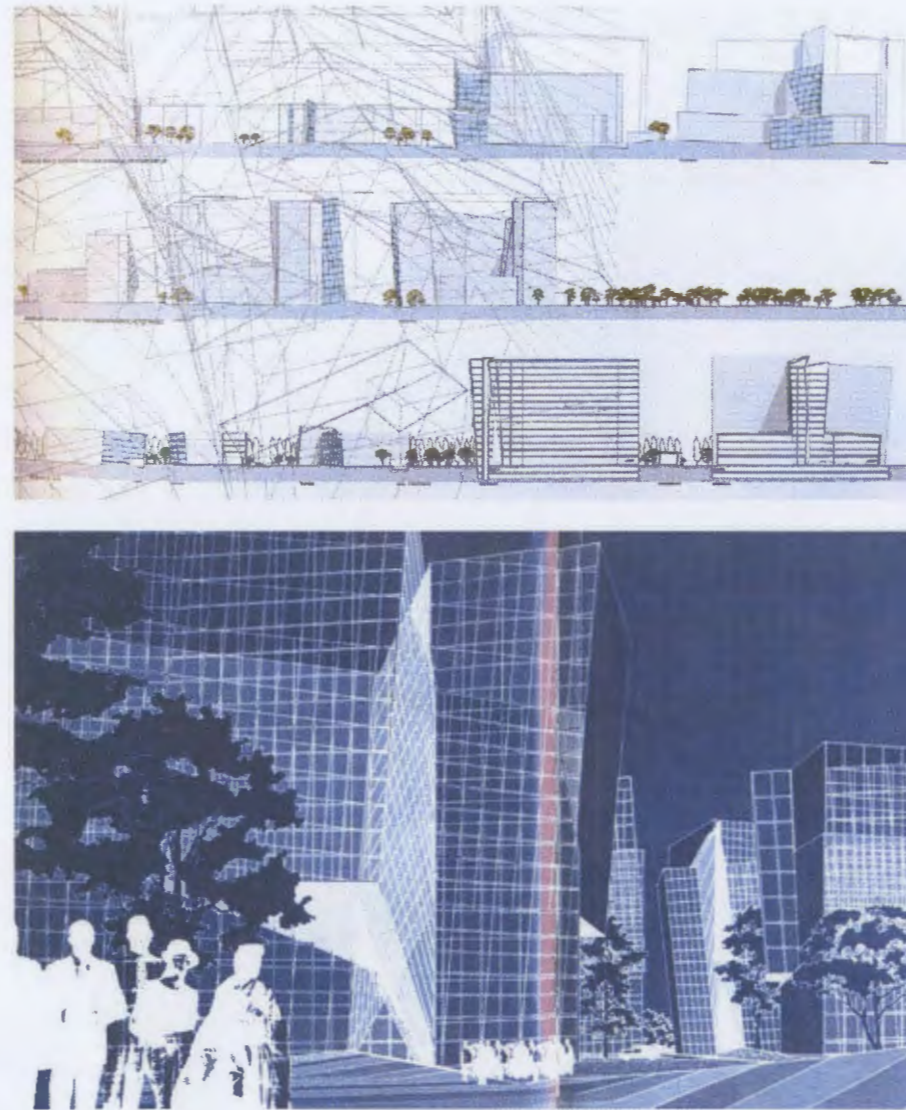
The intention was that through the folding process or the blurring of boundaries, the massing of the buildings, their volumetric configuration, the relationship with surrounding urban context and surrounding buildings, would be open for interpretation. This concept is similar to and definitely influenced by Deleuze's idea of *the fold* leading to an *informal* art of thinking whereby ideas are becoming: "*folding, unfolding, refolding*"²³.

Although this is an interesting idea to, through folding, introduce the informal, free and open interpretations into both the process and product of design, it is unclear how this has been achieved through Eisenman's winning competition entry for the Rebstock park.

Looking at the sections one can't help but wonder how the oblique angles challenged the idea of a building as an object or the figure / ground relationship. There appears to be no connection between the slightly slanted planes and the proposed blurring between boundaries that would lead to an open interpretation of the in between spaces.

Nowhere in Eisenman's writings or drawings does he refer to the actual people who will inhabit and interpret these spaces, rather extensive time is spent on articulating and emphasizing, through both drawings and writings the nature and complexity of the 'folding grid'. Therefore Eisenman's reading of the fold, although he writes otherwise, is simply a formal interpretation of the intricate theory of the fold.

23 Eisenman Architects , *Unfolding Frankfurt*, Ernst & Sohn, Berlin, 1991



Rem Koolhaas: The Folded Foyer

Although there exist some similarities, as Jencks mentions, in the work of Eisenman and Koolhaas in their response to complexity through "folding in difference" their approach to the application of the idea of *the fold* in architecture is fundamentally different.

Many contemporary buildings attempting to deal with the issue of complexity, those of Eisenman and Koolhaas among them, are designed with flowing and fragmented spaces, pursuing deliberate ambiguities of enclosure, visibility, and permeability.

In the same way that Eisenman attempts a blurring or folding between figure and ground in a formal sense, but also as a way of projecting new social organizations into an existing urban framework, Koolhaas plays with the tension between inside and outside, hoping to use the encounter structures of urban space to effect innovations in interior space.

Factory of learning: The Educatorium at Utrecht

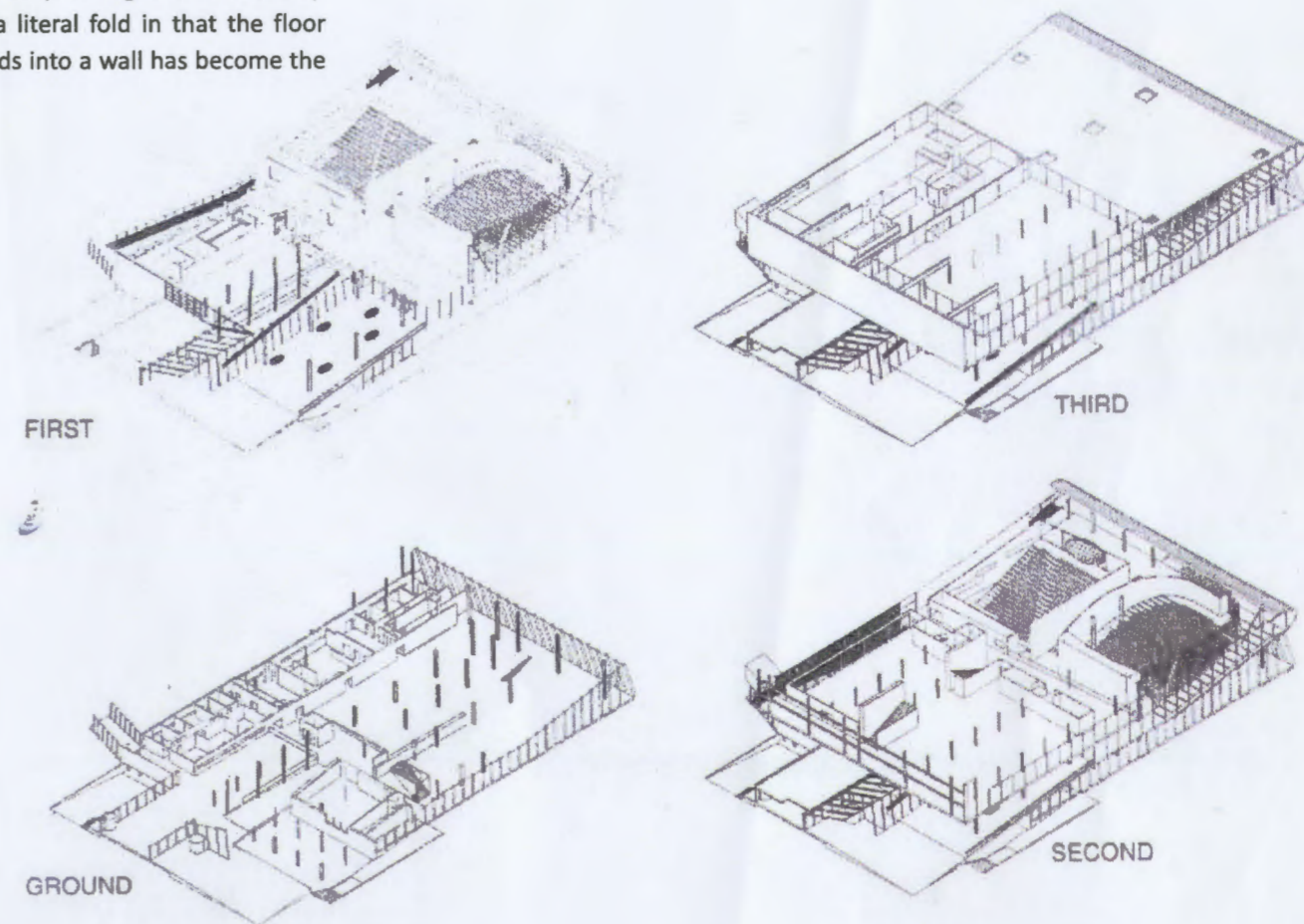
The Educatorium for the University of Utrecht was completed in 1997; it houses a cafeteria, two large lecture theaters, and a cluster of examination rooms. According to the project architect's statement, it was conceived as the hub of a campus servicing fourteen facilities, a "rendezvous and exchange point, creating a new center of gravity, which is to embody the university 'experience': the social encounters of the cafeteria space, the learning and exchange in the auditoria/classrooms, and the individual rites of passage played out in the examination halls".

In this project a deliberate attempt was made to generate diverse forms of social encounter in the building: "seeking potential overlap between the programs and encouraging exchange between the users of its diverse functions, whilst allowing a pragmatic and nearly autonomous use of individual spaces".

Koolhaas appears to adopt Deleuzian ideals of "smooth space" or "folded space" through the folded foyer. A blurring between the inside and the outside is attempted a

tilting of the ground plane and urban plaza that continues as an interior sloping "field" upon which the two auditoria are placed like figures in the landscape.

This rising floor plate, which folds upwards and back to become the wall and then the roof of the building, is described by Koolhaas as a "social magic carpet", an urban landscape of play and social encounter imported into the architecture. This 'fold' has a double reading, since it functions as a spatial device (blurring the relationship between inside and outside) and a formal device, a literal fold in that the floor becomes the wall. Quite effectively this floor that folds into a wall has become the iconic image of the building.



Toyo Ito: folding through phenomenology

Toyo Ito presents an interesting way of challenging the figure | ground relationship. He challenges the figure | ground relationship through an architecture of phenomenology.

"It is not that the architecture is there at the beginning; on the contrary, it is the human act of getting together that exists first. It is only afterwards that architecture comes into being to envelope this action."

Taichung Metropolitan Opera House

Although Toyo Ito never refers to the concept of the fold, his building applies the idea of the fold on a multitude of levels; from the formal, continuous folding, to the idea of event, blurring relationship between figure and ground to relate to social interchange.

The design for the forum defies the conventional shape of a concert hall. It is designed as a cityscape rather than architecture. In past times musicians and performers were acting on city squares or in the streets, enjoying music or playing together with the people interacting as one body, as one entity. The forum is proposed as a space supported by the most advanced technology, where one gets back this freedom and energy to play and listen to music.

The music Forum is located in the middle of the city, without front or back, the building invites people approaching from various directions. It opens up to all sides, turning its spaces into a part of the organic urban fabric, integrated into the network of the city's squares. As people enter from all sides through perforated channels, which become the gates to the organic mechanisms of listening to or uttering sounds, we sense a resemblance to the intricacies of the human mouth and ear.

The spaces of the Music Forum remind of labyrinthine caves, carved out of a continuous system. In fact, they are two separate spaces, each of them both vertically and horizontally continuous, relating not unlike positive and negative to each other.

Space A is the cave of sounds, containing the auditorium, several rehearsal spaces and workshops. Space B is the cave without sounds, a continuous urban landscape of foyers, offices, restaurants and so on.

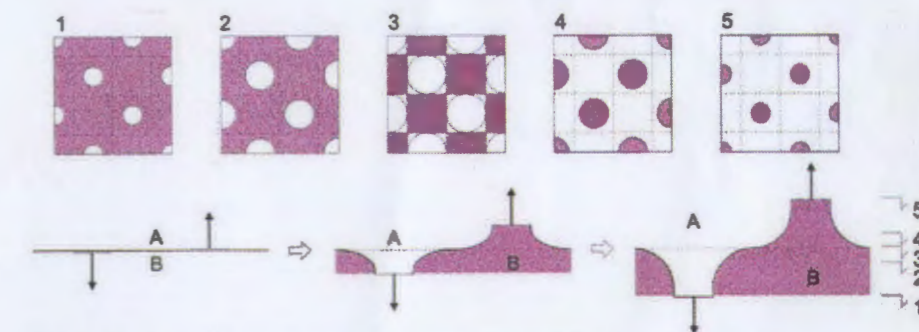
The Taichung Metropolitan Opera House is situated in the park within the New Government Center district. Ito's Opera House is realized in site plan and urban design through his method of "seamless access", which integrates and redirects the mobility and connectivity of the surrounding urban fabric. Ito's proposal reinterprets and displays the complex relations between consumption, fashion, arts and media in the functional organization and structure. The public lobby, arts plaza, grand hall, black box, play house, administrative offices, rooftop garden, exhibition halls, rehearsal areas, circulation and facilities come together to create a multi-layered, complex and dazzling three-dimensional structure, while its porous form allows it to flow naturally and connect with the surrounding environment.

Ito proposes that the concert hall should be conceived as a vivid, informal space that exists as an extension of the cityscape. He wants it to be a place without boundaries between interior and exterior, where people gather to play and to listen to music in an airy and casual atmosphere. He wants an "attracting labyrinth" of sound.

Our proposal not only accommodates an immense diversity of cultural activities but creates continuous dynamic spaces for active exchange and communication. The fluid continuity of the structure creates opportunities for cross-fertilizing exchanges between the concerted and the spontaneous. We are envisioning an open structure which actively engages its surroundings in all directions and creates opportunities for



Concept models made with stockings explore two interwoven spaces (A&U, 2005)



Horizontals and verticals merge to form continuous planes (A&U, 2005)

Summary of architectural interpretations of folding

Formal

_Folded forms represent a unifying figure whereby different segments and planes are joined and merged in continuous lines and volumes.

_The idea of the fold challenges the figure | ground relationship of buildings >> figure-ground conceptualism assumes a reversible and interactive relationship between solid building blocks and the voids between them.

_The folded form challenges the Cartesian method of conceiving an essential form, through interconnected, folded form

Spatial

_folded space is interrelated space

_Folding entails a blurring of inside/outside, solid/void, and space to space thresholds

Programmatic

_Folded space encourages difference within a continuous, yet heterogeneous system

_At the crease of the fold: chance encounter / informality / freedom / open-endedness

_The fold challenges the idea of the building as an object, rather it sees the building as a platform for events

Conclusion

Limits to the fold

Mapping the idea of *the fold* through the history of 20th and 21st century architecture taught me that although the concept of *the fold* has been evident in architectural discourse, the translation of the idea of *folding* into actual architecture has more often than not been misinterpreted as merely formal folded figures.

Of course the idea of the fold is not the only way to achieve this complexity through a careful consideration of spatial connections. The formal manipulations of folding are however capable of incorporating manifold external forces and elements within form, yet *Le Pi* undoubtedly risks being translated into architecture as merely folded figures.

This might be in part since a philosophy, such as *the fold* put forth by the philosopher Gilles Deleuze, has limits when it comes to the project of making a physical building. It is my personal opinion that architects such as Greg Lynn and Peter Eisenman relied too much on the theory when making architecture. Although the philosophy is a valuable tool for thinking about space, architects should not forget that they too, hopefully even more so, have valuable input to bring to the project of architecture.

In other words, a philosophy of space should be seen for what it is: a philosophy, a viewpoint, a way to stimulate thinking. Philosophy, just like art, sculpture or structure has the ability to inspire architecture, but it can never solely become architecture.

Possibilities of the fold

Through the analysis of the chosen case studies I have learned that the idea of the fold does actually provide a valuable contribution to contemporary architectural discourse, in that the careful articulation of connections (through folding or blurring) could definitely result in a more dynamic and complex experience of architecture.

Greg Lynn, although his architecture does not reflect it, effectively suggests that we should therefore produce not a style, but a practice of folding in architecture.

The strategies employed by Koolhaas (spatial arrangements) and Ito (phenomenology) hint at a practice of folding in architecture. Their architecture searches for ways in which architecture could encourage constant dialogue with its urban context, but also with and between its users.

It is a particularly interesting realization to me that through a blurring of boundaries, as the fold suggests, unexpected and unanticipated relationships are encouraged between previously disjointed entities. Through studying the philosophy and architectural interpretations of the fold, I have sensed a tendency towards a more informal way of designing. Architects are perhaps realizing that design does not mean control, but rather encouraging unanticipated possibilities for social interactions.

2] folding in the South African context

Introduction: South African architecture

Although the issue is not unique to South Africa, Contemporary South African architecture has often been criticized for its tendency to separate spaces and buildings through the building of boundaries. These boundaries are often articulated through high walls that separate and demarcate, thereby creating introverted spaces which lead to an impermeable morphology of large, single-use zones in South African cities.

The developer-driven architecture in South African is often qualified by a radical privatization of the public realm. Iain Low claims that this is due to a superficial understanding of transformation and the prospect of rebuilding the city in a post-colonial context.¹

Julian Cooke explains that the gated village is the current architectural concept employed to deal with the vulnerability people feel. The gated village takes the problem to an urban scale. With the surplus of office parks, industrial parks, shopping malls and high-density residential developments at both ends of the income scale, gated villages construct an impermeable morphology of large, single-use zones in which it is a nightmare to provide security.²

It could be that in our current dual society of rich and poor, included and excluded, educated and uneducated, native citizen and illegal immigrant, architecture responds to the fear of the other by building introverted, exclusive and mono-functional zones. Peter Buchanan describes this tendency as the '*capsularisation*' of the city and society. In the city these '*capsules*' include such developments as gated residential and business estates, and the privatized, artificial public realm of the mall, all under CCTV surveillance, isolated and adrift from the context, only to be linked by the safety of the mobile '*capsule*' of the car.³

A familiar characteristic of this privatized architecture is that it often rejects its urban context. Iain Low argues another result of this introverted architecture is that the more phenomenological and experimental dimensions of architecture and its urban context become consumed in the security of familiar forms.⁴

Of course this tendency is not exclusive to South African architecture. Buchanan recognizes that this tendency in architecture is exactly exemplified in Modernism's reduction of the psychologically pregnant notion of dwelling to mere function, and in extreme caricature in the Athens Charter, with its zones of mono-functional buildings freestanding in a void of fluid space and connected only by vehicular roads.

The result of this type of space-making is that the sense of place and belonging in our cities are lost leading to alienation, loneliness and social exclusion, and so to violence and fear.

In the May/June issue of *Architecture SA* (2007), editor Julian Cooke made the following plea to South African architects:

“ Make South African cities into variegated, integrated places with a lively, visible public life. This will not solve the complex problem of crime, but will provide a much better spatial framework to manage it. To open up rather than shut out may seem unrealistic in these paranoid days, but if some experimentation does not begin to happen soon, the opportunity of maturing our post-apartheid cities into what they should become will be lost in the divisive and punishing spatial structure which belongs to jails and military camps, not our homes. “

1 Low, I, Space and Transformation: Architecture and Identity, Digest of South African Architecture, 2002, p.34
2 Cooke, J, To Separate or to Connect, Architecture SA, May/June 2007
3 Buchanan, P, From doing to being, Architecture SA, Jan/Feb 2007
4 Low, I, Space and Transformation: Architecture and Identity, Digest of South African Architecture, 2002, p.34

Speculative design thinking

The idea of *folding* could propose a challenge to this spatial structure familiar to South African cities, where the tendency is to create boundaries or separations instead of connections between buildings and the urban context.

An argument has been raised in South Africa for a conception of humanity that establishes the condition within which the conflict of difference may coexist.^s The idea of *'The fold' or 'folded' space* proposes an architecture that interlinks distinct entities (programs / spaces / differences), through a folding of boundaries.

As mentioned in the first chapter, a folding across lines could create uncertainty between boundaries, instead of defined boundaries of separation. Several folds could create a blurring of inside/outside, solid/void, and space to space thresholds. This new reading might reveal other conditions which may have always been immanent or repressed in the urban fabric of South African cities. The possibilities for the programmatic, spatial and formal folding in the South African context will now be discussed.

5 Low, I, Space and Transformation: Architecture and Identity, Digest of South African Architecture, 2002, p.34

The programmatic fold

As previously mentioned, architecture when faced with the fear of 'the other' often responds by creating private, introverted and exclusive spaces or buildings. The idea of the fold proposes that by respecting the identity of different programs, while connecting them in thoughtful ways, interesting and unpredictable relationships may arise in between the different programs. These spaces of interrelation could result in new organizations of social interchange. For example the Nelson Mandela Museum in the Eastern Cape:

The museum was conceptualized as 'cultural infrastructure'. Located in three interrelated sites, it intervenes in a traditional rural setting and intersects the landscape to establish unique connections between previously disparate sites, thus *folding together* previously disparate sites.

The imaginative intersection has arisen from the thoughtful *folding* of memorialisation and service provision. The cross-programming of basic infrastructure with museology and memorialization lays productive grounds for chance encounters between tourists and traditional rural inhabitants and thereby permits meaning-full exchanges between people who might not have encountered each other (see diagram below: author's interpretation of the project).

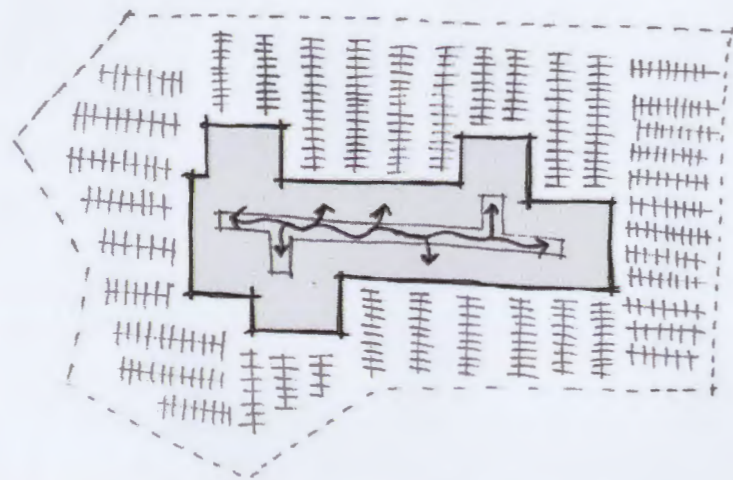
Architecture, therefore, becomes an instrument of mediation, as opposed to an independent institution. The architecture encourages open interpretation and social interchange and therefore possibly participates in the work of nation-building.



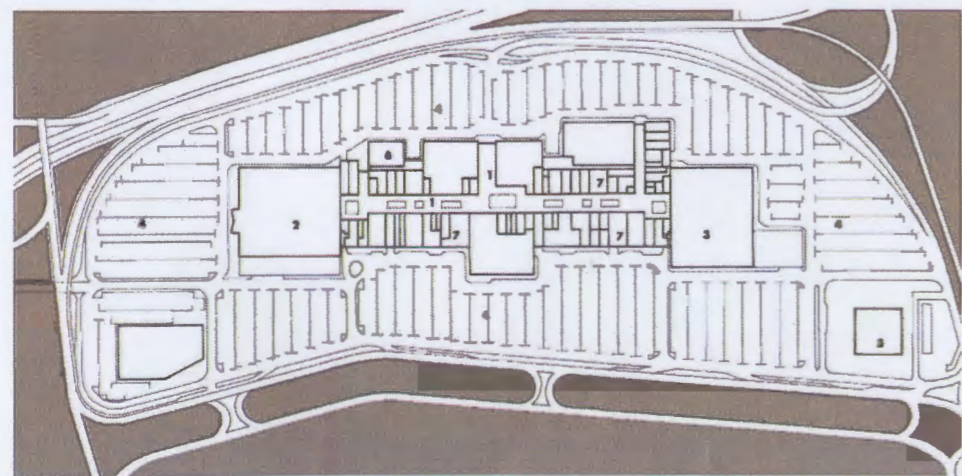
The spatial fold

The idea of *folded space* could challenge the building of defined boundaries, so familiar to South African architecture, through conceiving boundaries as folds that both separates and connects. This in turn would lead to the blurring of inside/outside, solid/void, and space to space thresholds (see speculative diagrams by author below).

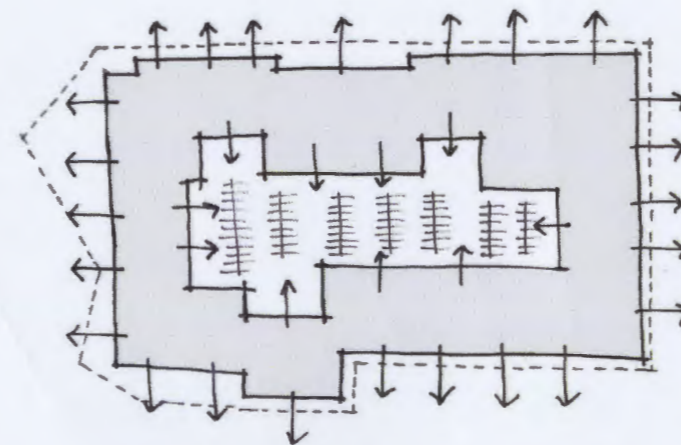
The idea of the fold also proposes that there exist an opportunity for freedom of interpretation in the space in between the interrelated programs. This implies that the space in between should be made such a way that it would stimulate the client or community to utilize the spaces in different ways, discover new uses and interact with the architecture in unpredictable and spontaneous ways.



typical shopping mall surrounded by parking



Typical shopping mall isolated from its urban context through roads and parking



Possibility of folding building into its urban context through reestablishing relationship with the street



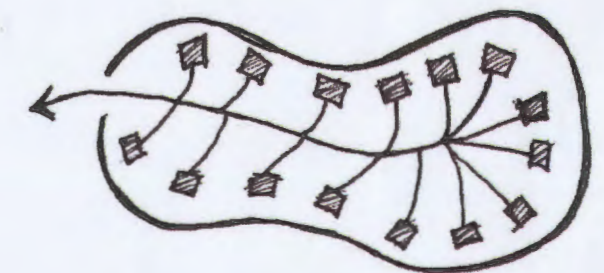
The Werdmuller Shopping Center: an attempt to fold the urban context into the building

The formal fold

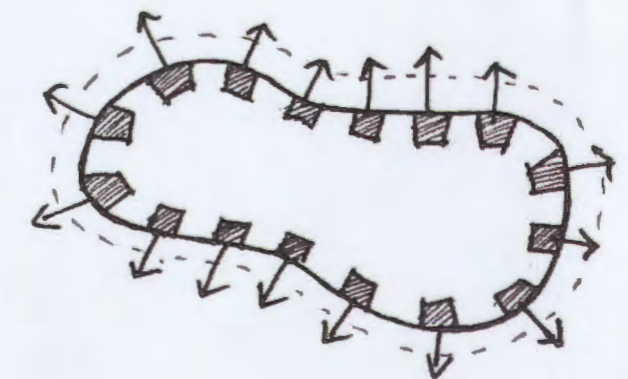
The formal reading of the fold represents a unifying figure whereby different segments and planes are joined and merged in continuous lines and volumes. It has however been discussed in the conclusion of the third chapter that the actual form of a blurring between boundaries does not necessarily have to represent a physical / formal fold.

As mentioned above the result of the introverted architecture of boundaries, familiar to South African cities, is that the more phenomenological and experimental dimensions of architecture and its urban context are reduced to the security of familiar forms.

The idea of the fold could challenge these familiar forms. The formal articulation of the fold in the South African context could entail a blurring of boundaries, through for example conceiving walls as habitable boundaries (see speculative diagrams by author below).



Spatial structure of a typical gated housing enclave



Unfolding the gated housing enclave, through conceiving walls as habitable boundaries

The work of Urban Solutions in the informal trade and transport sector depict the value of the programmatic fold the idea that by respecting the identity of different programs, while connecting them in thoughtful ways, interesting and unpredictable relationships may arise in between the different programs.

For the greater part of ten years, Urban Solutions has been involved with the challenge of integrating marginalized communities, and more specifically street traders and taxi operators into the public realm, attempting to provide them with representative architecture that enables their endeavors (events) and brings a sense of ownership, identity and even pride.⁶

Urban Solution's fists attempt at housing street traders failed;

"The Rocky Street Market, while popular and well occupied, suffered due to lack of bypassing trade. Realizing that street traders could not sustain themselves independent of other city functions and activities, projects were initiated which followed a more integrated approach."⁷

In the Metro Mall Transport Facility and Traders Market development, the link between traders and transport operators was made.

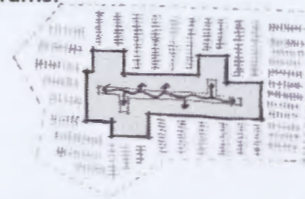
Metro Mall occupies a site of some 2,6 ha in size along Bree Street, one of the busiest streets in the inner city. The development forms part of an ambitious urban renewal programme of a sector of the inner city that, over the past 20 years, has slowly degenerated into urban wasteland. The formalization of the street trading community and the provision of a more permanent home for the large number of taxis in the city were the main drivers for the project.

Formal retail stores are located along Bree Street. Trading facilities are housed along the internal street fronts, used by commuters to access the taxi loading areas.

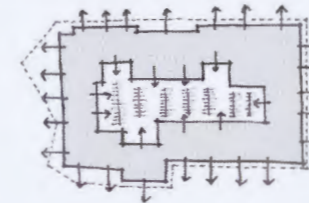
A large variety of trading space cater for different trader needs from small floor-space stalls with concrete counters, to large roller-shutter lock-up cubicles, to fully serviced outlets accommodating hairdressing salons, fast-food services and the like.⁸

6 Decker, T, Contemporary South African architecture in a landscape of transition /, Cape Town : Double Storey Books, 2006
 7 Hansen, L, Integrating marginalised urban users, Architecture SA, Nov/Dec 2008
 8 Hansen, L, Integrating marginalised urban users, Architecture SA, Nov/Dec 2008
 9 Decker, T, Contemporary South African architecture in a landscape of transition /, Cape Town : Double Storey Books, 2006

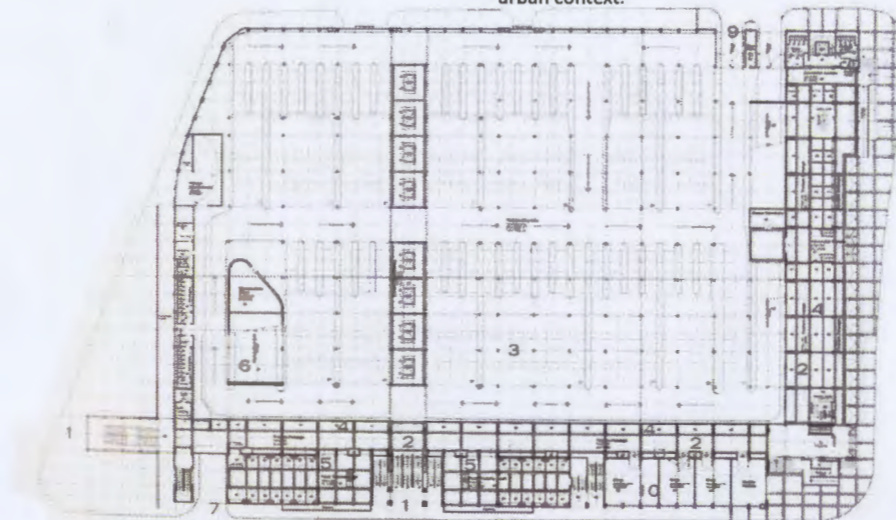
When one compares the spatial layout of the Metro Mall with the layout of a typical shopping mall it becomes obvious why the Metro Mall has such a strong relationship with its urban context and therefore capable of connecting or folding a wide variety of programs.



Typical shopping mall surrounded by vehicles and therefore removed from its urban context



The layout of the Metro Mall with vehicles inside, results in a building with a strong connection to its urban context.



Ground Floor Plan of Metro mall showing vehicles inside, while the edges of the building responds to the urban context



Beyond the specifics of accommodation and the logistics of vehicular and pedestrian movement within the buildings, Metro Mall is primarily designed around the urban principles that informed the original development framework: **making connections with the surrounding city fabric**; completing the street grid to enable continuity of movement; supporting public mobility via various transport modes; **promoting mixed use and urban opportunities**; **blurring street boundaries by the construction of perimeter buildings with active street edges** (so sorely missing in existing buildings); acknowledging the street as a public space; and allowing equal opportunity of access and freedom of movement.⁹

The most commanding features of the building complex are the entrance towers, which act as oversized collection baskets. These dominate the streetscape and have been positioned at the important street intersections and opposite existing movement routes to the commuter halls. They display and speak a language of celebration, an acknowledgement that the complex houses and serves an important public amenity. The towers lead into wide trade passages along which traders can display their goods. Commuters are forced to pass through the colourful trader stands en-route to their transport opportunity. Leading off passages one finds also quiet courtyard spaces filled with benches, water fountains and sculptures, surrounded by cooking stalls all under trees.



Baragwanath Public Interchange and Traders Market

Once again the firm learned from the previous experience. Through an evaluation of the Metro Mall the architects learned that the traders and taxis alike enjoy changing the use of planned functions as and when it pleases them. The plan of this facility has therefore been made less rigid, the trader stalls more flexible, the taxi lanes less structured and the architectural expression less formal.¹⁰

During the class tour we visited the Baragwanath Public Interchange and traders Market. It was an remarkable to expedience the spaces of the building during peak-time traffic.

The photos on the right shows the flexible trading spaces allowing free interpretation of use by the traders. The photo below show the permeable edge of the building. Photos were taken by fellow students.

10 Hansen, L. Integrating marginalised urban users, Architecture SA, Nov/Dec 2008



Roelof Uytenbogaardt: The Werdmuller

For Uytenbogaardt, a hallmark of positive environments is that they are complex. He argues that complexity, however, cannot be designed. It results from freedom of action and from the ingenuity and creativity of many actors seeking to meet their own needs and requirements. For freedom to be meaningful, however, it requires constraint. Spatial structure is the enabling constraint which gives direction, and some predictability, to processes of growth, without necessarily defining their precise forms or outcomes. The great judgment is defining how far design should be taken in relation to any problem.

Spatial structure, therefore, must be seen as the enabling constraint which contributes to life and which gives direction (and thus some predictability) to these processes without defining their precise form or outcomes. In this way, it is possible and necessary to design the preconditions for complexity to occur. There is thus an ongoing judgement as to how far design should be taken. It is the function of structure to generate a rich range of diverse opportunities to which individuals and groups can respond and around which a wide range of human activities can take root. To achieve this, therefore, the structure must be logical and easily readable: it must promote a high degree of predictability of response. It is also one function of structure to generate the unexpected and the idiosyncratic.

The Werdmuller

The Werdmuller is a result of Uytenbogaardt's understanding of freedom and complexity in design.

The building was designed as an alternative to the internally orientated mall, an exploration of light and interconnected [folded] space in which one would always be aware of the building as a whole and the world outside.

The Werdmuller was designed as a suak, a through route, therefore movement organized the plan of the building. The route responds to the pedestrian desire lines from Main Road to Claremont station, while the route along Main Road is picked up from street level and wound up in the form of a ramp that terminates in an upper terrace with a view towards Devils Peak overlooking the road



Photo showing ramp made to draw people into the building



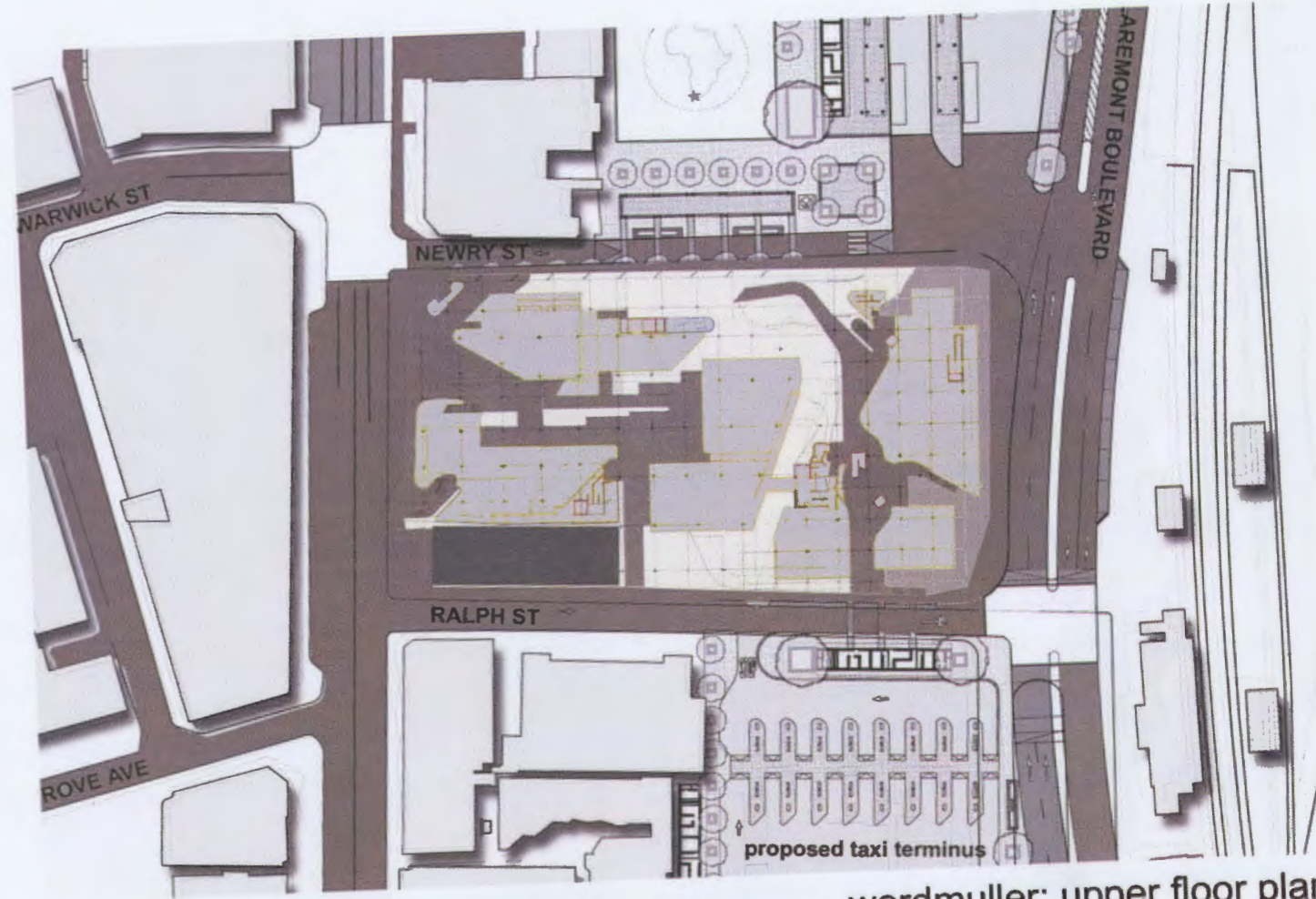
Folding or blurring of boundaries between building and urban context resulted in informal trading





werdmuller: lower floor plan

Lower Ground Floor Plan showing how the urban context is drawn into the building (author's own rendering)



werdmuller: upper floor plan

Upper Ground Floor Plan showing how the urban context is drawn into the building (author's own rendering)

Conclusion

Through studying the relevance of *folding* South African architecture I have come to the realization that the philosophy of the idea of *folding* could propose a challenge to the tendency of South African architecture to create boundaries instead of connections to its urban context.

The idea of the fold to connect previously disjointed entities through a folding or a blurring of boundaries could result in unpredictable and spontaneous relationships between different programs. These spaces of interrelation could result in new organizations of social interchange, much needed in South Africa's conception of humanity that establishes the condition within which the conflict of difference may coexist.¹¹

*"The idea of the fold could lead to a more informal way of designing, anticipating new and unexpected things to happen in between the folded programs, sites and users of the space. For example the relationship buildings have with people and the surrounding environment could through the blurring of boundaries encourage a constant dialogue."*¹²

Although the Werdmuller did not succeed, it is a good example of an architectural attempt to fold or blur boundaries between different programs (retail and commercial) and the building and its urban context (the building was designed as a through route).

As mentioned in the conclusion of the first chapter, through studying the philosophy and architectural interpretations of *the fold*, I have sensed a tendency towards a more informal way of designing. Architects are perhaps realizing that design does not mean control, but rather encouraging unanticipated possibilities for social interactions.

The local case studies emphasized this informal way of designing that allows the building's inhabitants to use them imaginatively and unexpectedly. Urban Solutions learned this through a lengthy process of refining the design of taxi trader and transport facilities.

Through an evaluation of the Metro Mall the architects learned that the traders and taxis alike enjoy changing the use of planned functions as and when it pleases them. The plan of the Baragwanath Public Interchange and Traders Market facility was therefore designed in a "less rigid" (informal) way, the trader stalls more flexible, the taxi lanes less structured and the architectural expression less formal.

The idea of allowing a more informal space between programs can serve to stimulate the client or community to utilize spaces in different ways, discover new uses and interact with the architecture in unpredictable and spontaneous ways.

11 Low, I, *Space and Transformation: Architecture and Identity*, Digest of South African Architecture, 2002, p.34
12 Conclusion of the Philosophical origins of 'the fold'.



Introduction

The theory investigation concluded that the relevance of the fold in the South African context is the realization that through the folding or blurring of the relationship between previously unrelated programs, previously separated spaces and the building and its urban context, new and interesting social interactions might arise.

Station square, specifically the site on the corner of Strand and Adderley Street proved to be an appropriate site on which to test this theory of the fold on both a social and a spatial level. Although the site is situated on one of the most accessible sites in the city, or even in the whole of Cape Town it is known for its clear separations and barriers. The three levels in the heart of Cape Town city, the underground, the ground and the above ground / station roof are separated both spatially and socially on this specific site.

social and spatial context



[+1]

[0]

[-1]

[+1] above ground: Cape Town City's major taxi interchange is situated on the roof of the city's railway station. Enormous amounts of people, who live on the outskirts of Cape Town's city center, make use of public transport (taxis) to arrive on the site, in the center of Cape Town, on a daily basis. The taxi interchange therefore plays an important role in the lives of these people, which is obvious in the amount of informal traders that have set-up stalls on the roof of the station building. In order for this enormous amount of people who arrive on the roof of the station to enter into the city, they have to walk over a 1.5 m foot-bridge that runs over Strand Street and into the Golden Acre Shopping Centre before they can reach the ground plane of the city. The taxi-interchange on the roof has no direct connection with the ground plane of the city.



[0] on ground: In order to ensure that pedestrians make use of the underground pedestrian mall as a daily through route into the city, the ground plane of the site has been designed in such a way so as to make it impossible for pedestrians to walk on the ground or street level. True to the spirit of Modernism (the underground malls were designed during the 1970's) the ground plane was designed solely for the convenience of the motor car, while the working class pedestrians are forced underground. The Strand and Adderley Street intersection does not even comprise of sidewalks. The result is that the buildings around the intersection do not open up to the street; in fact the buildings have turned their backs on the site and the intersection by building 4 to 5 storey high walls without street entrances, openings or even glass.



[-1] below ground: The working class pedestrian, who live on the outskirts of Cape Town's city center, make use of public transport (the train or taxis) to arrive on the site in the center of Cape Town on a daily basis. These working class pedestrians arrive on the site either on the ground (via train) or on the roof of the station building (via taxi). In order for these people to move from the station site (**ground or roof**) into the city, they are forced (**underground**) through the Golden Acre Shopping Mall and (or) through the dark and ill ventilated Strand Street Concourse underneath the city, while the more affluent who can afford a motor car move on the ground plane of the city.

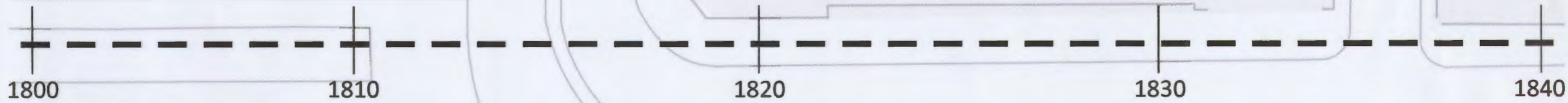


Jay-walking through Adderley Street

Historical context

The site is situated on the railway station corner of the Strand and Adderley Street intersection. The site is of historical significance since Strand Street indicates the edge of the old city, in other words where the land originally met the sea. Today the all the land north from Strand Street is reclaimed land developed during the 1950's as part of the foreshore plan to provide a gateway to Cape Town and the whole South Africa. Sadly Strand Street developed as a through fare cutting the center of Cape Town in two, serving as a barrier between the old city and the new city (the foreshore).

Adderley Street, the main road of Cape Town has a rich social and architectural history that will be explored in through a timeline below.



During the 1830's two piers were built at the bottom of Adderley and Bree street (Cape Times)

Jay-walking: walk in or across a road without regard for approaching traffic.



1820 view of Adderley street showing the flower sellers, who now occupy their own arcade of the main street. Jay-walking, it appears, has always been a feature of Cape Town's streets.

(Cape Archives AG 6408)



1832 view of the Heerengracht (Adderley street) For many years the Heerengracht was the focus of live in the colony. A feature of Cape Town streets during this period was the 'Malay' fruit and vegetable vendors who carried their wares in laden trays suspended from a bamboo pole across their shoulders.

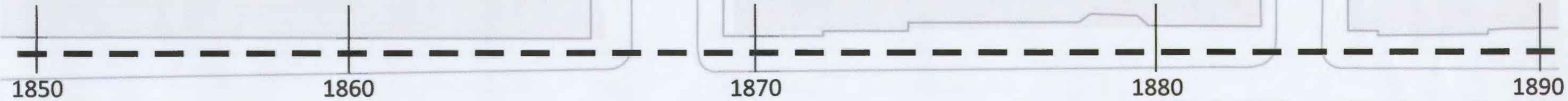
(D'Oyly, Cape Archives D8.aa3)



1863 Amidst public jubilation, the first length of railway line was opened. Linking Cape Town and Wellington. With the laying of a railway goods line across the seaward end of Adderley Street, an important process was begun: the isolation from the city if the sea.



Late 1880's The Original Cape Town Station had a strong relationship with Adderley Street
(Cape Archive AG 1865)



1860 The first substantial harbour works began with the construction of the Alfred docks, later to be extended when the Victoria Basin was added.



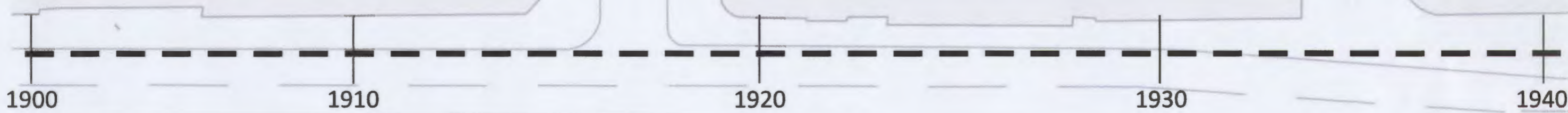
1866 Adderley Street (the Heerengracht or Gentleman's walk) was renamed after Charles Adderley in gratitude for his efforts in redirecting British convicts, scheduled for deportation to the Cape, to Botany Bay. On the left of the image is the Groote Kerk and the Slave Loge, both of which still exist today.

Cape Archives M591



1918 Up until the mid 19th century Adderley Street was the bustling main road of Cape Town city, filled with pedestrians, trams and horse carts.

Many festivals, parades and events took place in Adderley Street since it was the main road and the only road that had a direct connection between the sea and the land.



Adderley Street

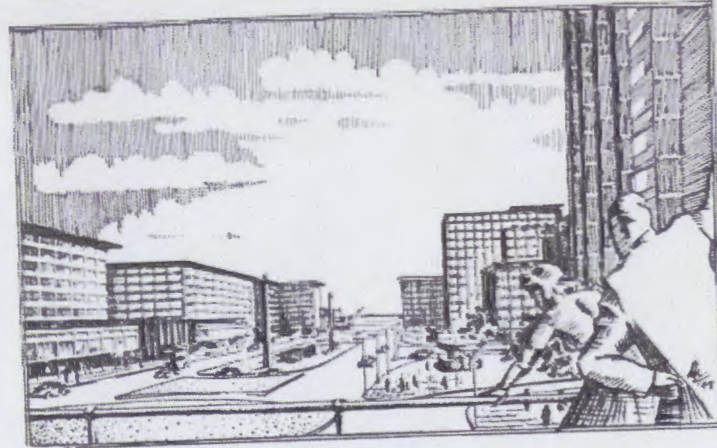


1894 a description of Adderley Street.... "Named after Sir Charles Adderley, who in his time was Governor of the Cape, Adderley Street may be considered, both architectually and commercially, the leading thoroughfare of Cape Town. At present it is the only thoroughfare that continues directly to the sea, there being at its base a central jetty.

Adderley also contains the station of the Cape Government Railways, the head office of the Standard Bank, the Supreme Court buildings, the chief Dutch Reformed Church, and the offices of the Castle and Union Steamship Companies, whilst at its top are the entrance to the Government Avenue and the Houses of Parliament."

Frank de Jong, Cape Town and its surroundings, p4.





1951 City Council produced its comments on the plan in a document entitled *Metropolis of Tomorrow*. Although the report highlighted the importance of the Foreshore area in relation to the Cape Town setting, the failure of the Foreshore is clearly that it ignored the two basic dynamics of any city its people and its environment.

Although never mentioned in the 1947 Foreshore report nor in the subsequent 1951 report of the city engineer, the 'wind tunnels' on the foreshore are one of the biggest single disincentives to pedestrian activity in the city.

1945

1950



1963 Heerengracht Street, the extension of Adderley Street, measures over 100m from building to building, and was planned largely to accommodate traffic circles and a dual carriageway system and is, as a result difficult to cross and lacking in human scale and is therefore a discouragement to pedestrian activity.

Floyd notes that although the floor space ratio per site on the foreshore is high, the overall density of building related to the whole area, including public open spaces and roads, is very low. "it appears that the enormous areas between buildings are rather an embarrassment to the authorities", he says.

1955

1960

1965

1947 the Foreshore Report: with the aim and objective, "to give tangible form to the Prime Minister's wish that the Foreshore Plan should provide a dignified gateway, not only to Cape Town, but to the whole of South Africa. Sadly these ambitions were never realised.

(Cape Town City Council)

An aspect of the Foreshore report that has had an abiding effect in the form of the city related to the siting of the railway station, scheduled to replace its Victorian Predecessor on the site of what is now the Golden Acre. It was the wish of the railway authorities that the station should be built at the foot of Adderley street at the junction between the old city and the foreshore. Despite opposition from the city council, the railways won their point and the railway station, together with the widening of Strand Street thoroughfare, have since proved a serious impediment to the merging of the Foreshore with the old city. The exigencies of apartheid, too, demanded that the two separate concourses be built, substantially increasing the frontage along Strand Street.

In terms of layout, the large blocks and wide roads of the Foreshore have resulted in a bleakness and environmental poverty.



1972 up until the early 1970's jay-walking was still possible in Adderley Street, as shown on these images; pedestrians and motorcars move across the road and occupy the ground plane of the city.

Unfortunately this ended with the construction of the Strand Street concourse and the golden acre shopping center - from then on pedestrians were forced underneath the city. The ground plane of the city at the Strand and Adderley Street intersection was given to the convenience of the motorcar.



1970

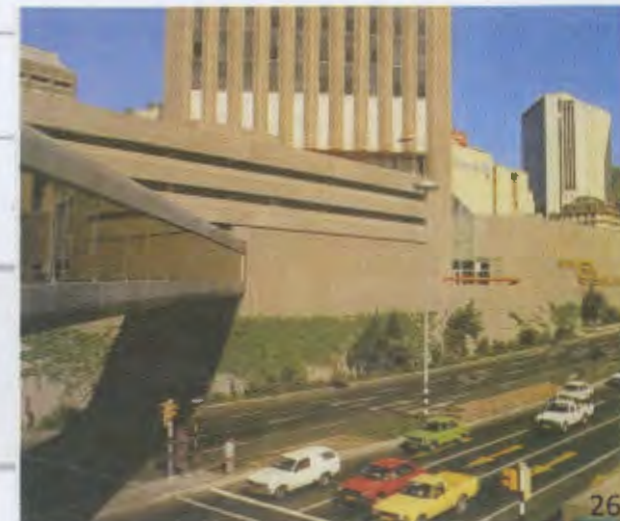
1975

1980

1985

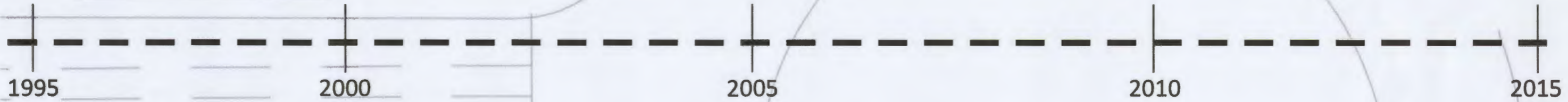
1990

Adderley Street





2010 BRT routes are planned to run down Adderley Street by 2010.

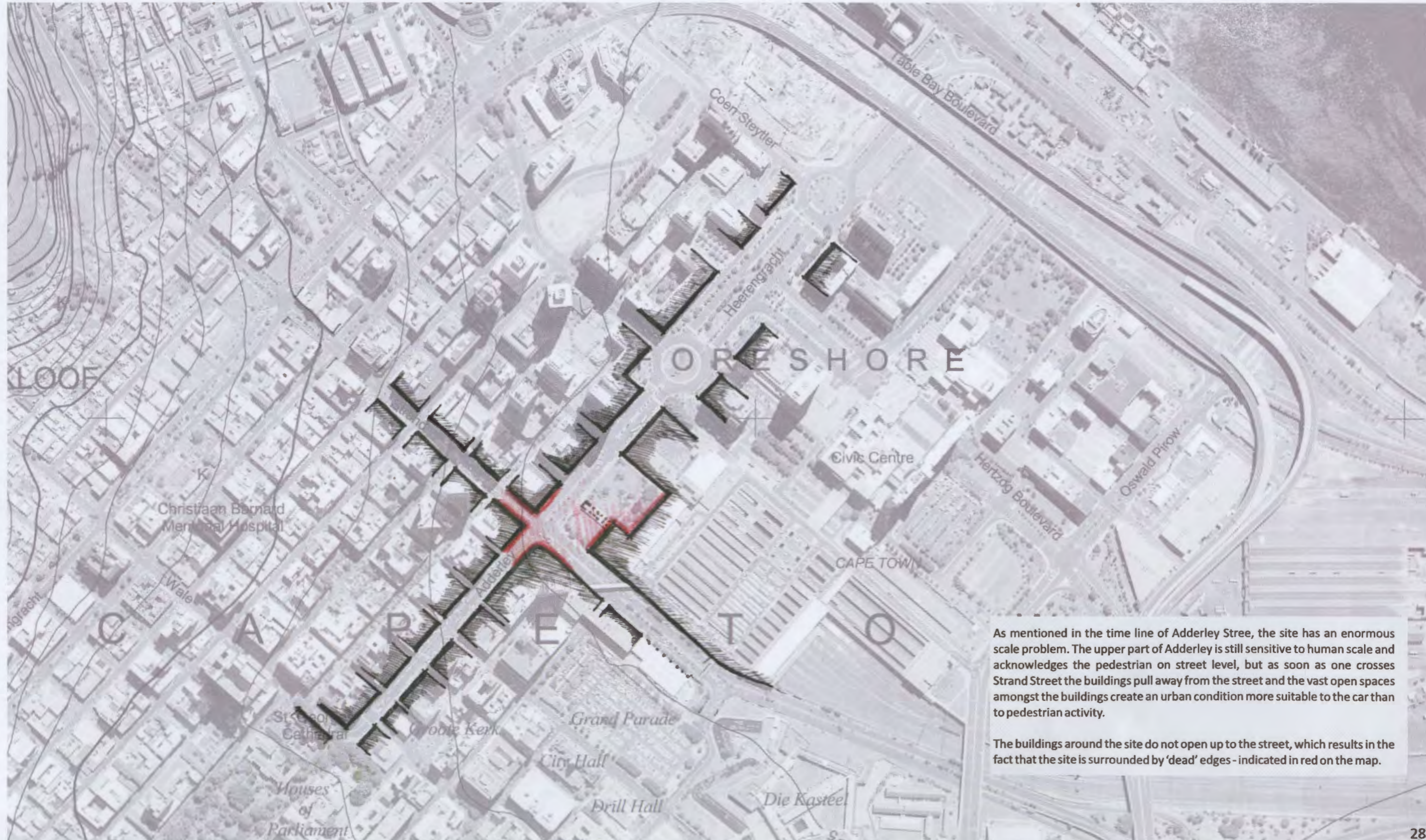


The flower sellers are one of the few customs that survived along Adderley Street. The first photograph of the flower sellers on Adderley Street was taken in the 1820's, the business has been passed on from generation to generation and today the flower sellers occupy their own arcade just off Adderley Street.



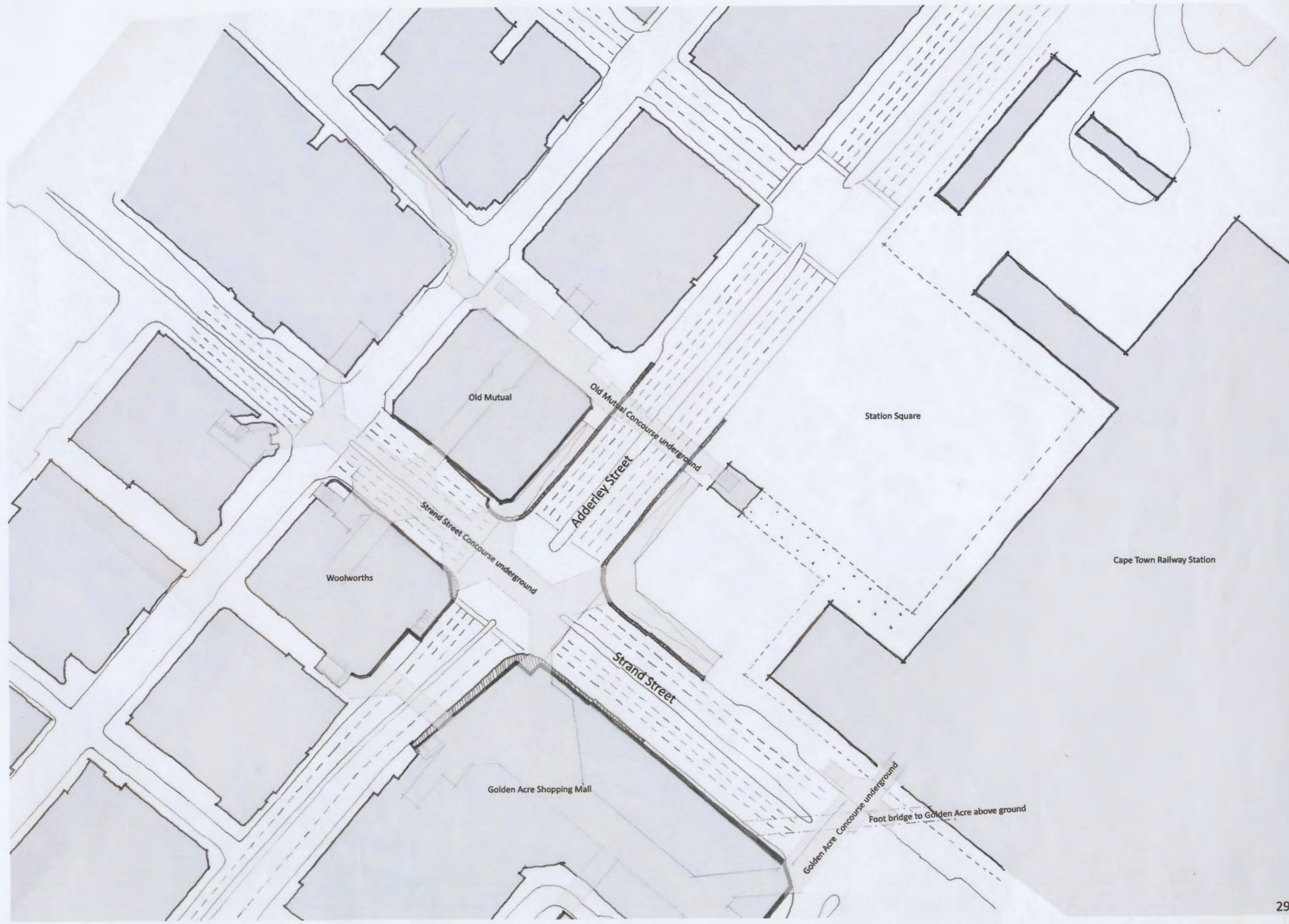
2009 from newspaper clipping: 'The City of Cape Town is gearing up to create the best ever light display for the festive season in Adderley Street, Cape Town. In addition to the traditional elements of previous displays, this year's display boasts 12 brand new light installations and a 2010 theme. The switch-on event on Sunday, 30 November promises to be the best in its 42 year history. At 20:00, over 50 000 spectators will watch as Executive Mayor Helen Zille performs the official switch-on with South Africa's 2010 mascot Zakumi and other soccer icons.'

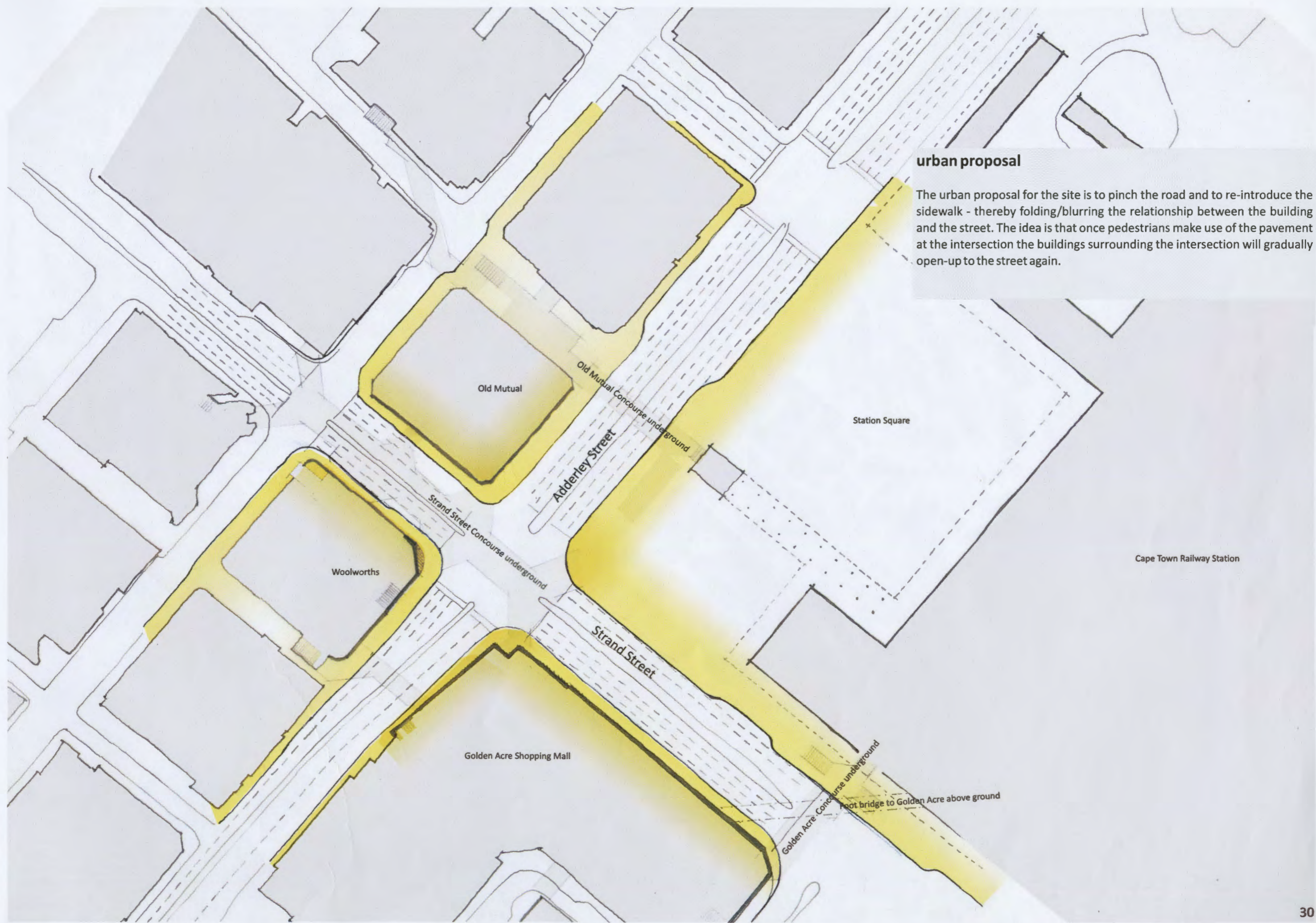
urban analyses



As mentioned in the time line of Adderley Stree, the site has an enormous scale problem. The upper part of Adderley is still sensitive to human scale and acknowledges the pedestrian on street level, but as soon as one crosses Strand Street the buildings pull away from the street and the vast open spaces amongst the buildings create an urban condition more suitable to the car than to pedestrian activity.

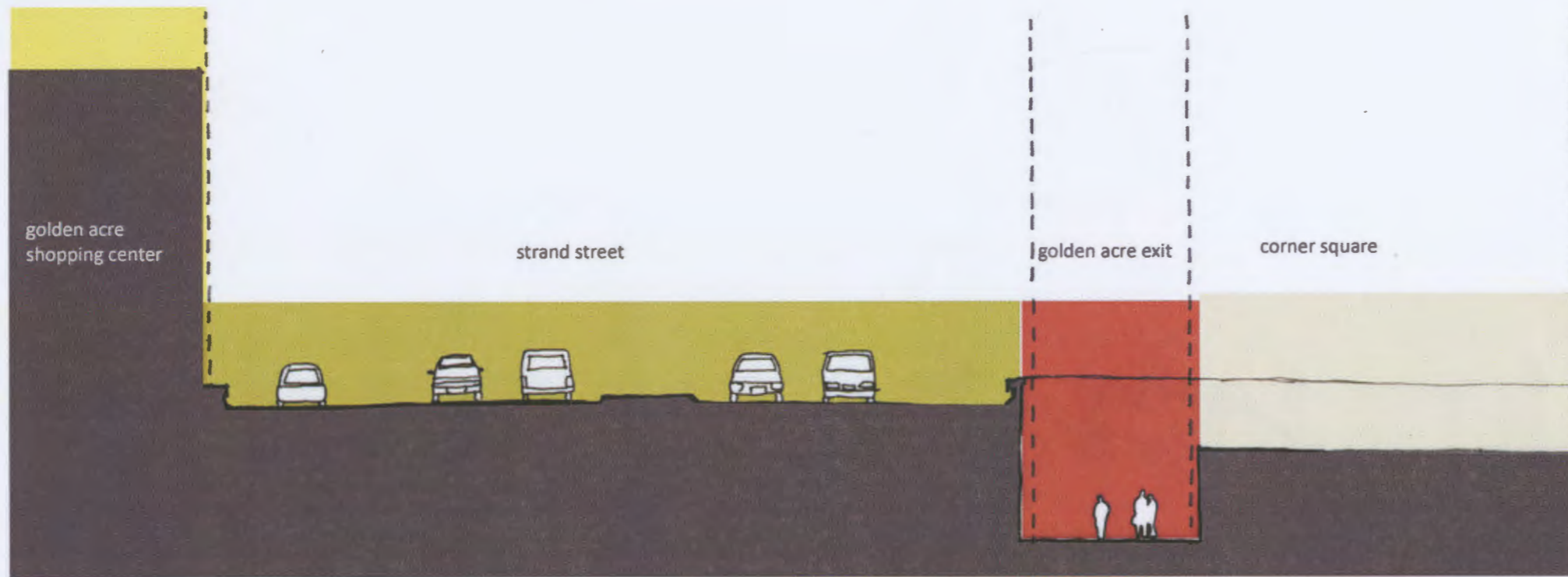
The buildings around the site do not open up to the street, which results in the fact that the site is surrounded by 'dead' edges - indicated in red on the map.



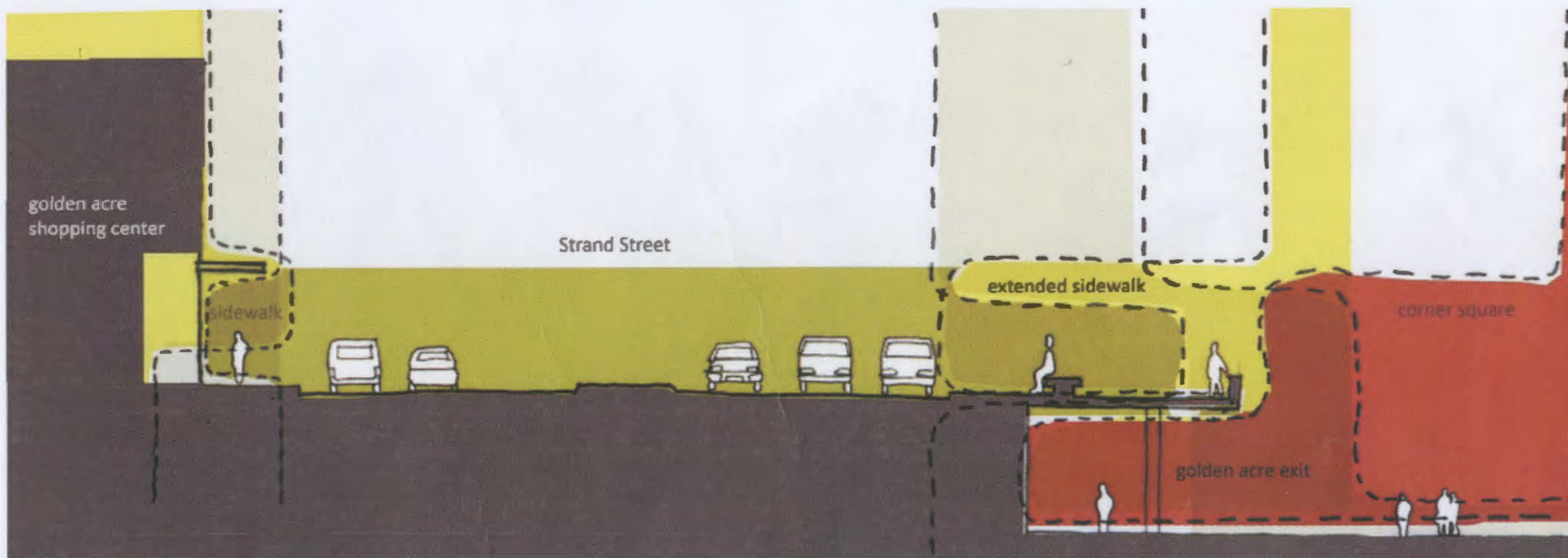


urban proposal

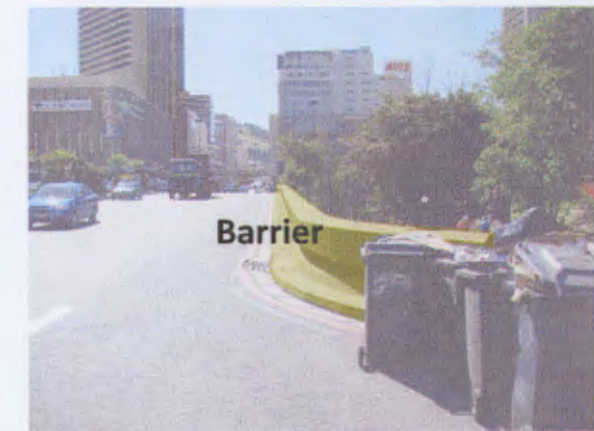
The urban proposal for the site is to pinch the road and to re-introduce the sidewalk - thereby folding/blurring the relationship between the building and the street. The idea is that once pedestrians make use of the pavement at the intersection the buildings surrounding the intersection will gradually open-up to the street again.



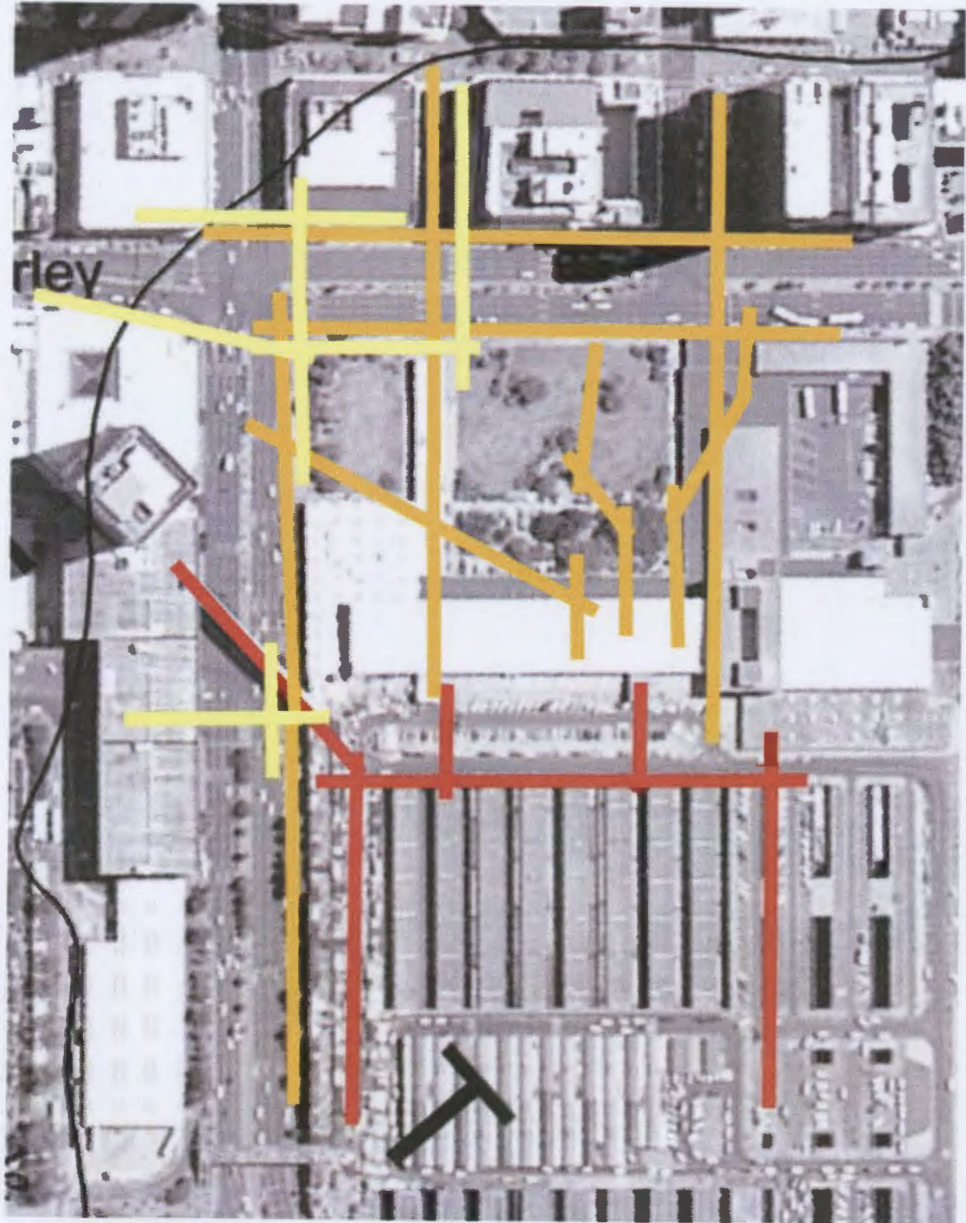
Section through Strand Street showing existing situation:
No pavements and spaces are separated by barriers



Section through Strand Street showing urban proposal:
introduce pavements, fold spaces into each other.

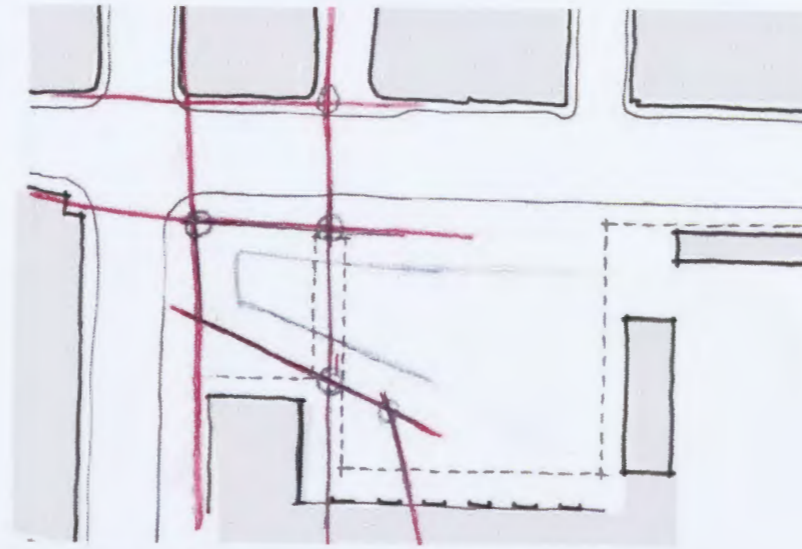


Pedestrian movement on the site

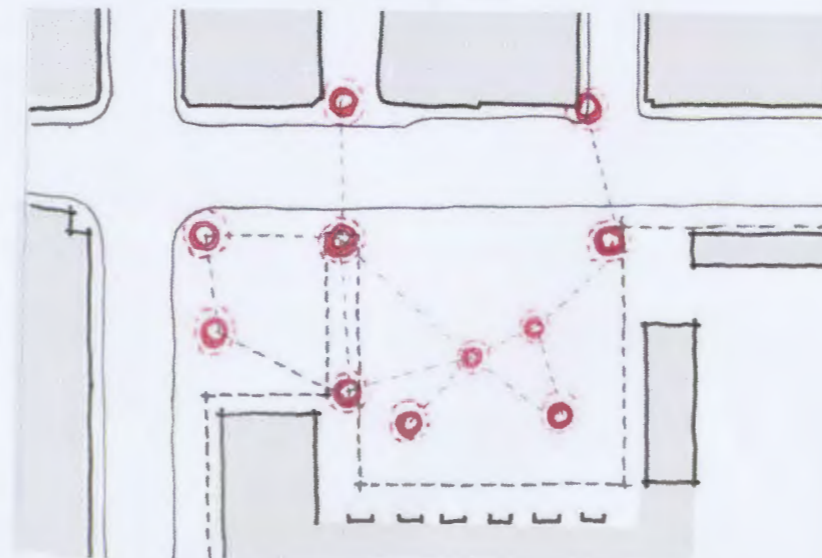


- Predominant pedestrian routes above ground
- Predominant pedestrian routes on ground
- Pedestrian routes below ground

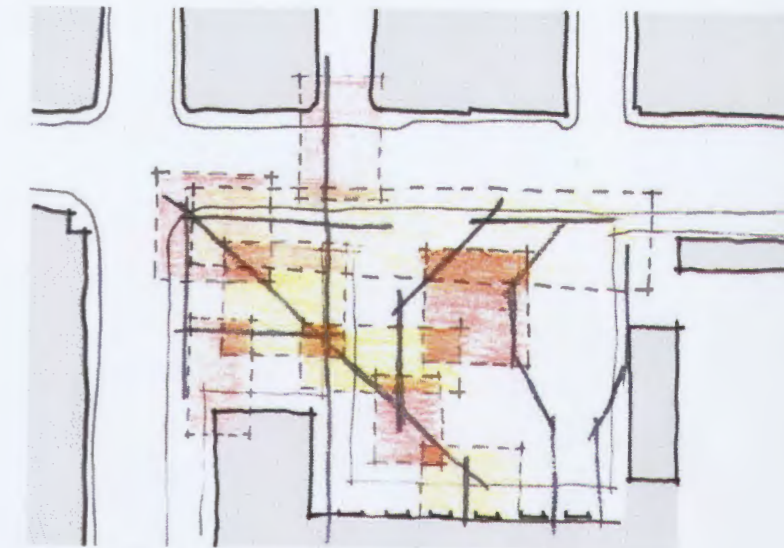
mapping



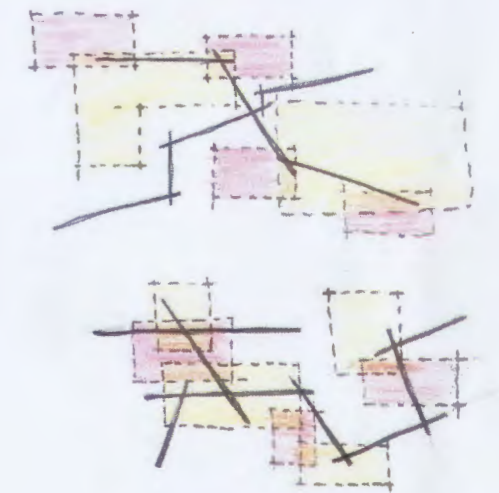
The building as a route along a series of nodes



A series of nodes connected through routes



Many possible routes through a series of connected spaces

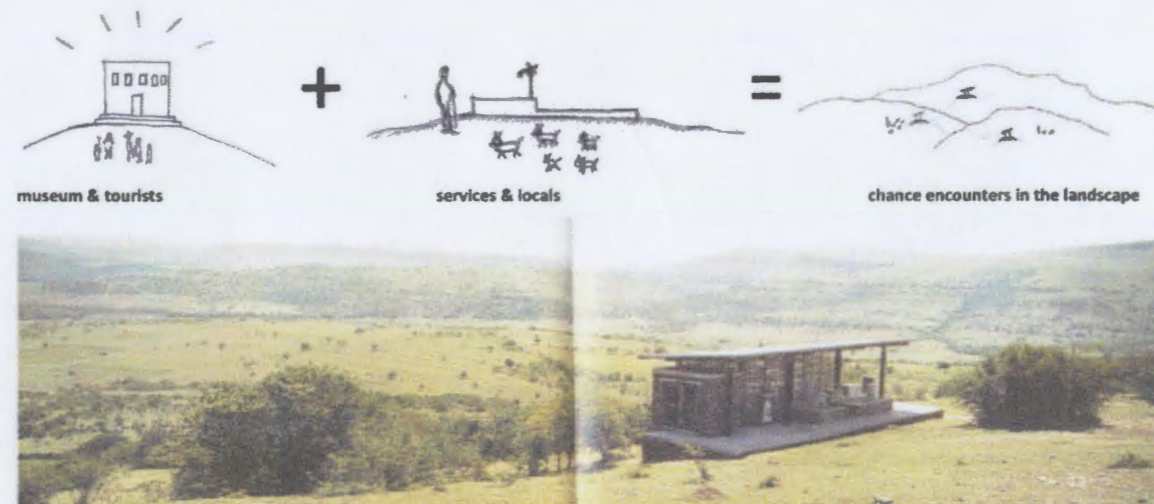


4]

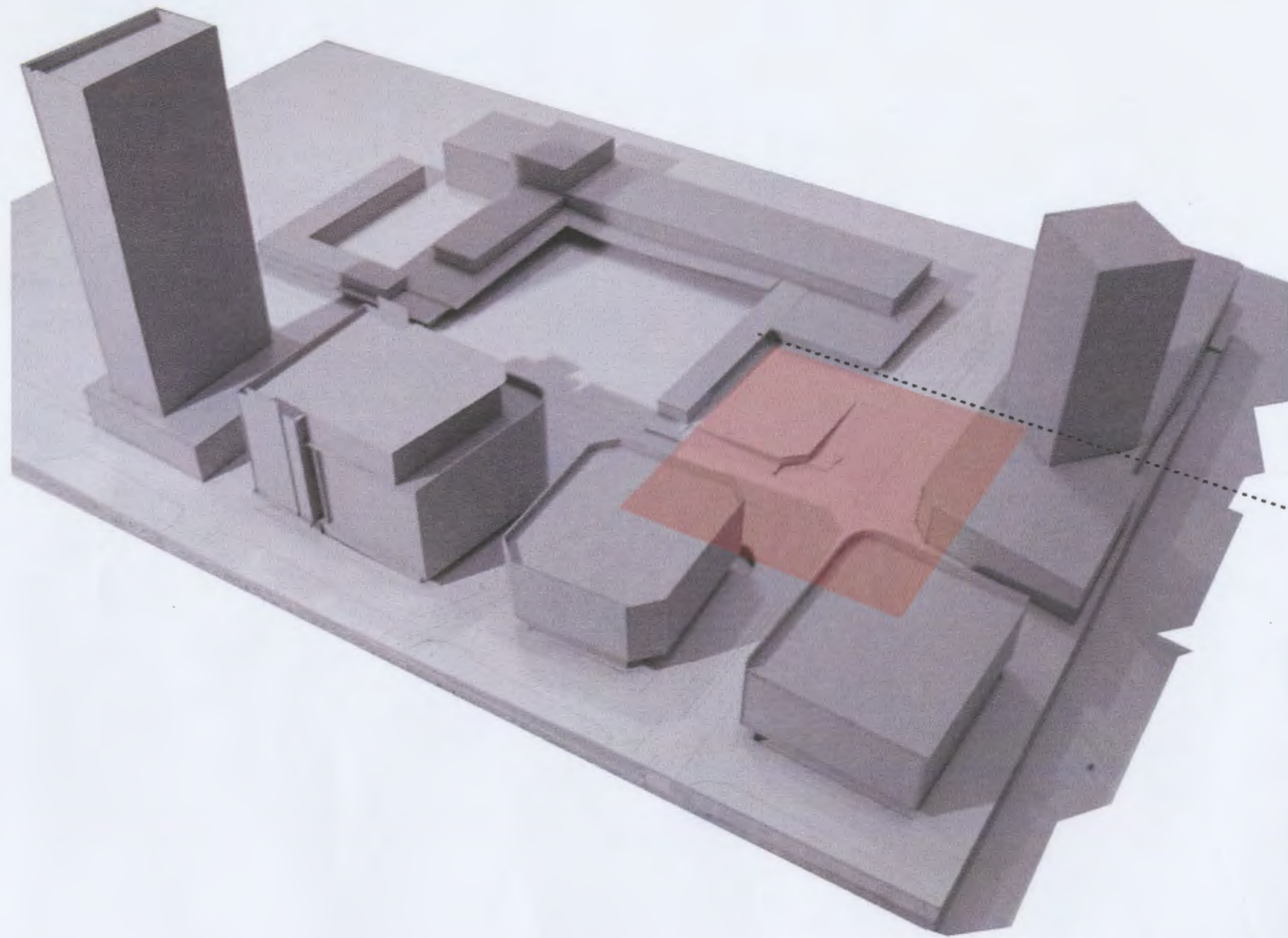
concept



How can architecture formulate a continuous mixture which still allows for variety and complexity?



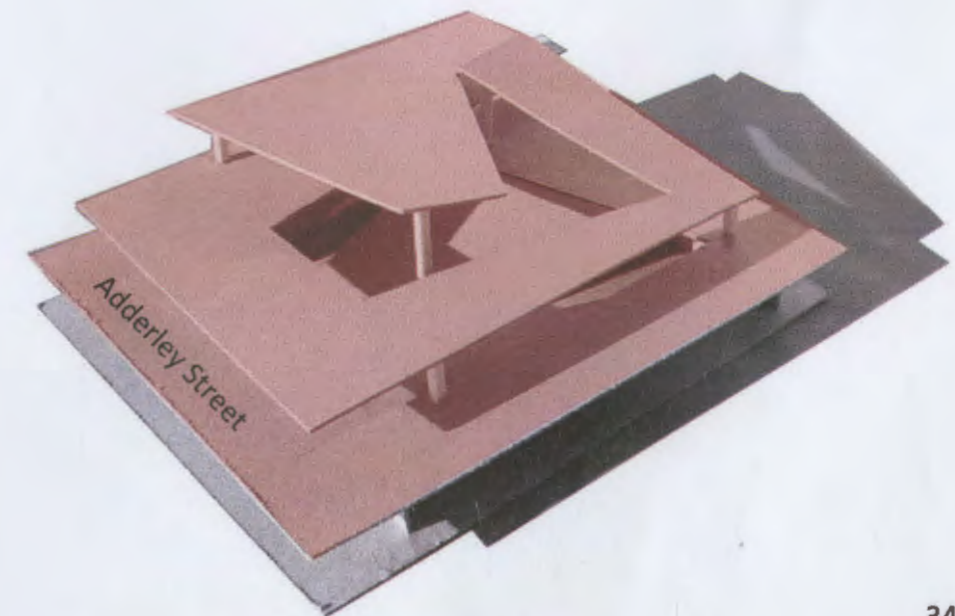
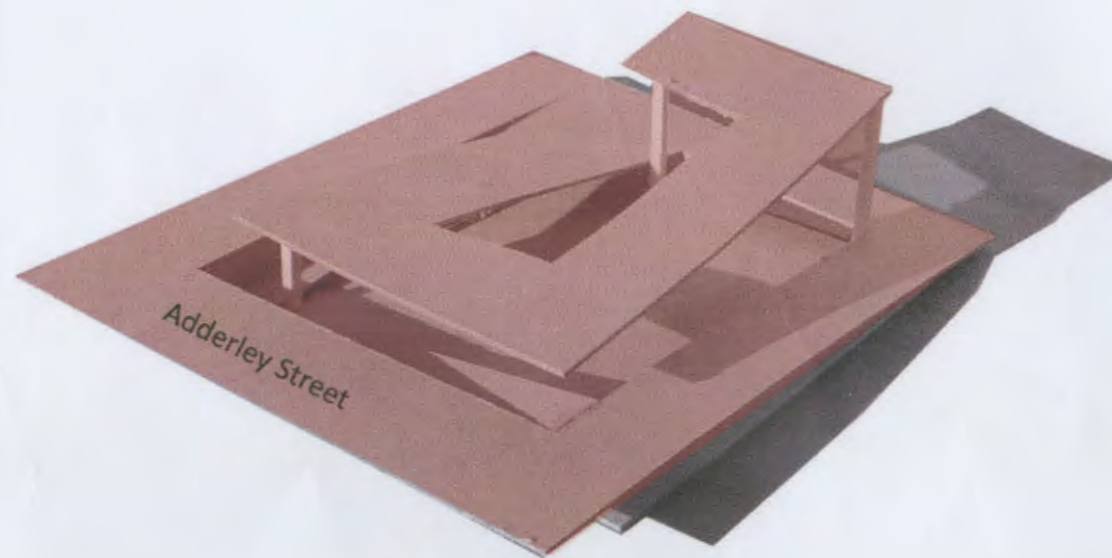
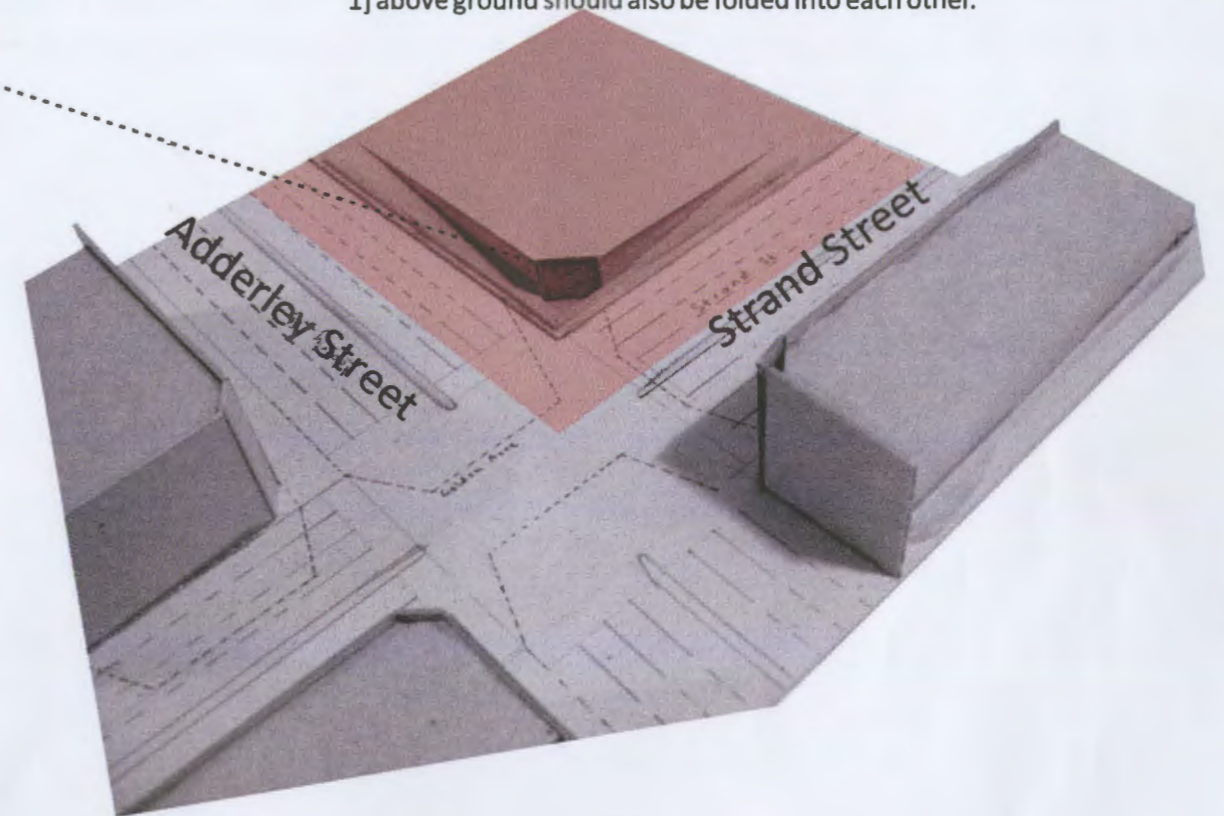
Could folding of the boundaries between previously separated programs and spaces encourage social interactions?

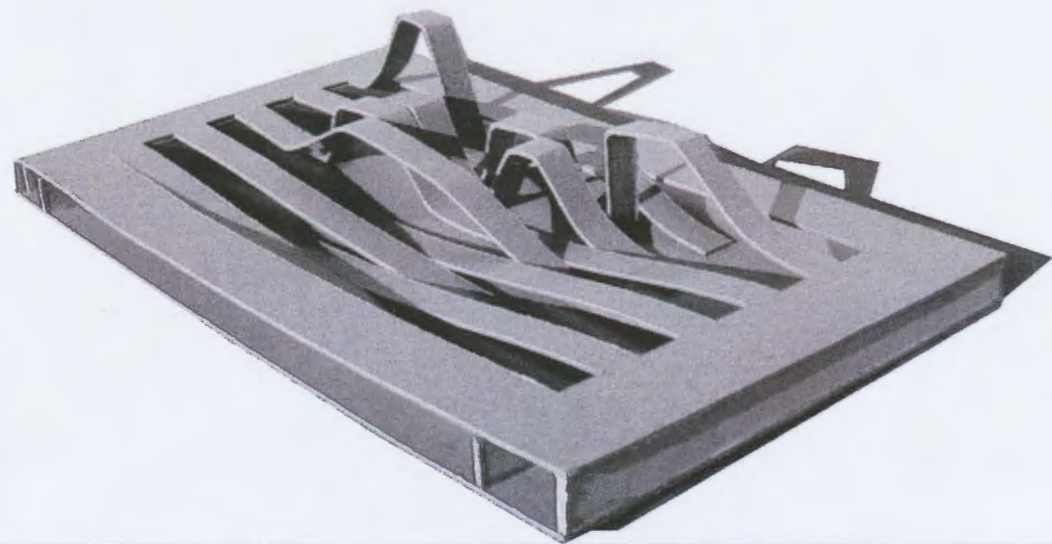


Spatial folding:

Experimenting with folding the building or site into its urban context

The site and the building should be folded or connected to its urban context, specifically Adderley street, Strand street, the edge of the knuckle building and the station square. The three levels of the site [-1] Below ground, [0] ground, [-1] above ground should also be folded into each other.

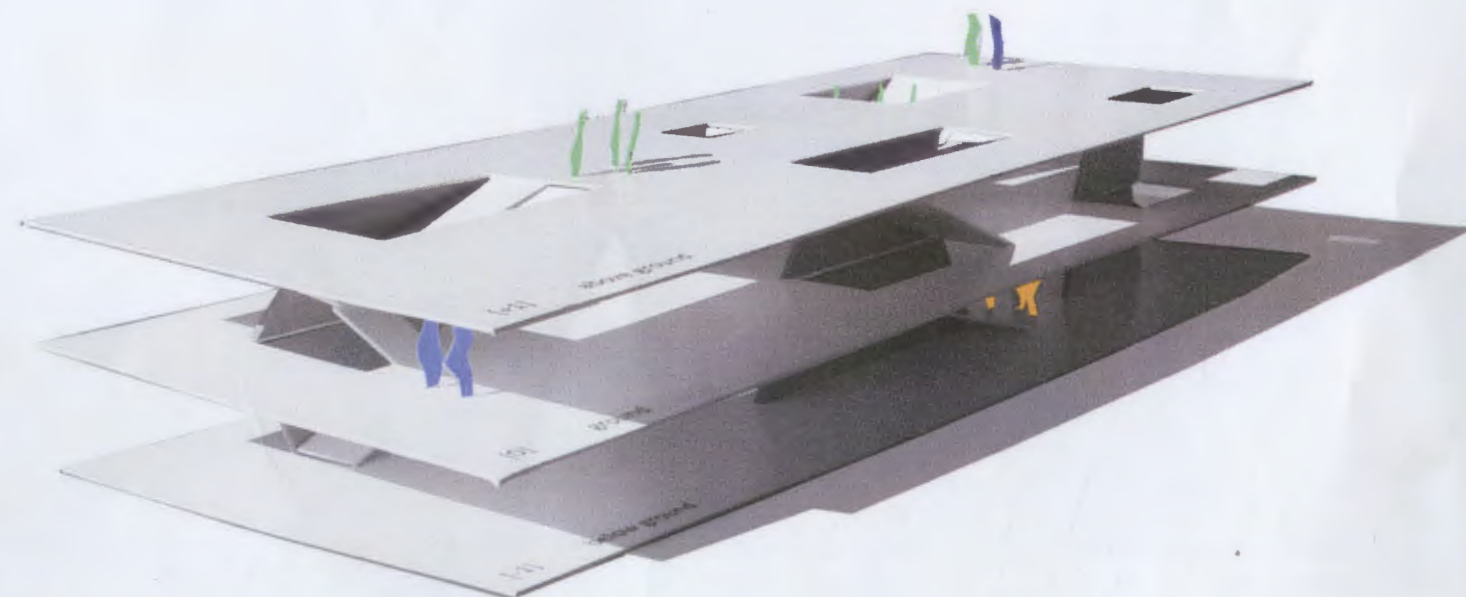
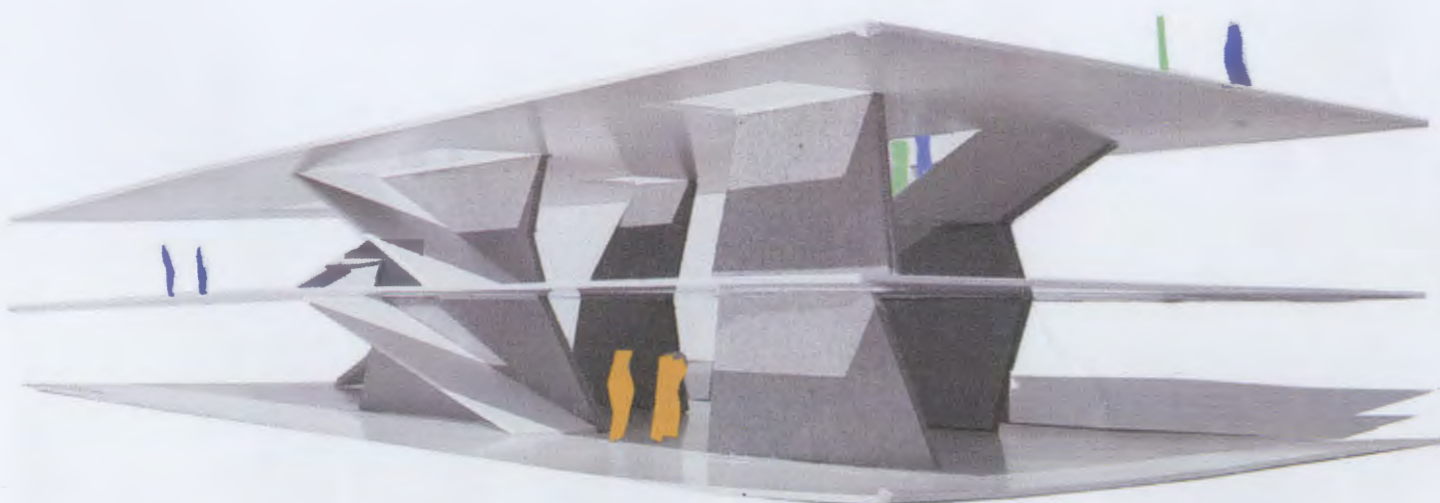
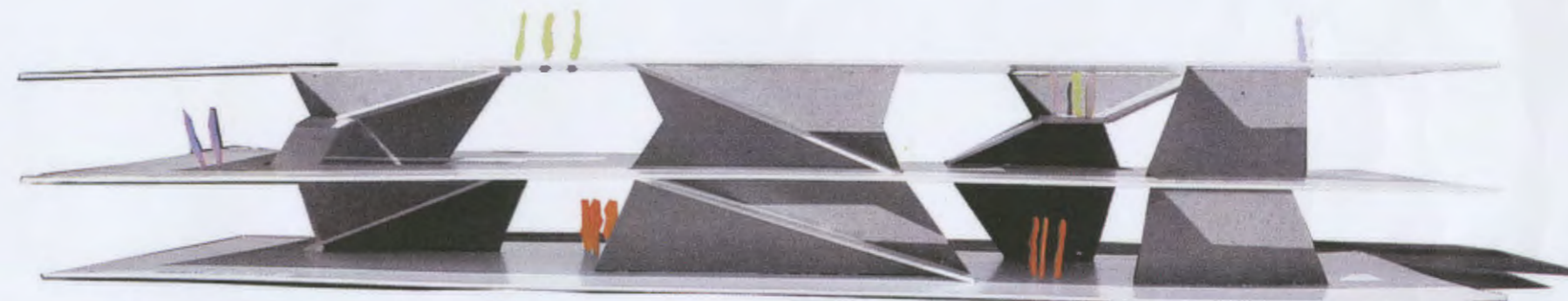
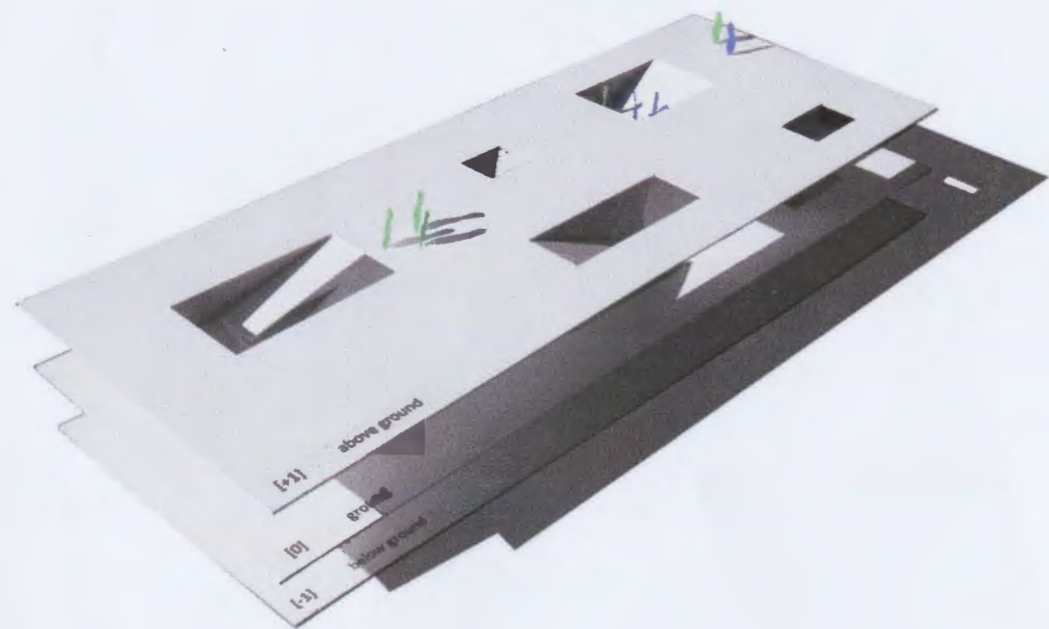
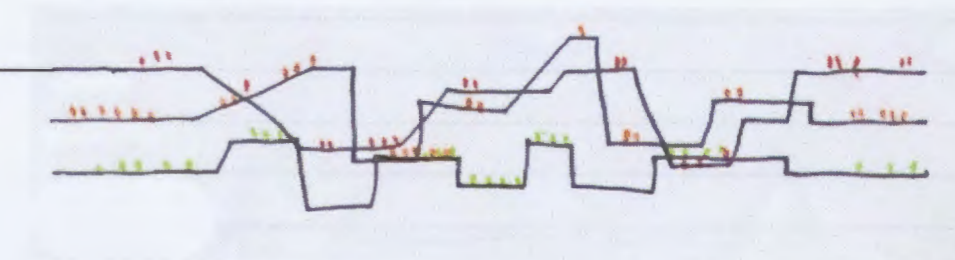


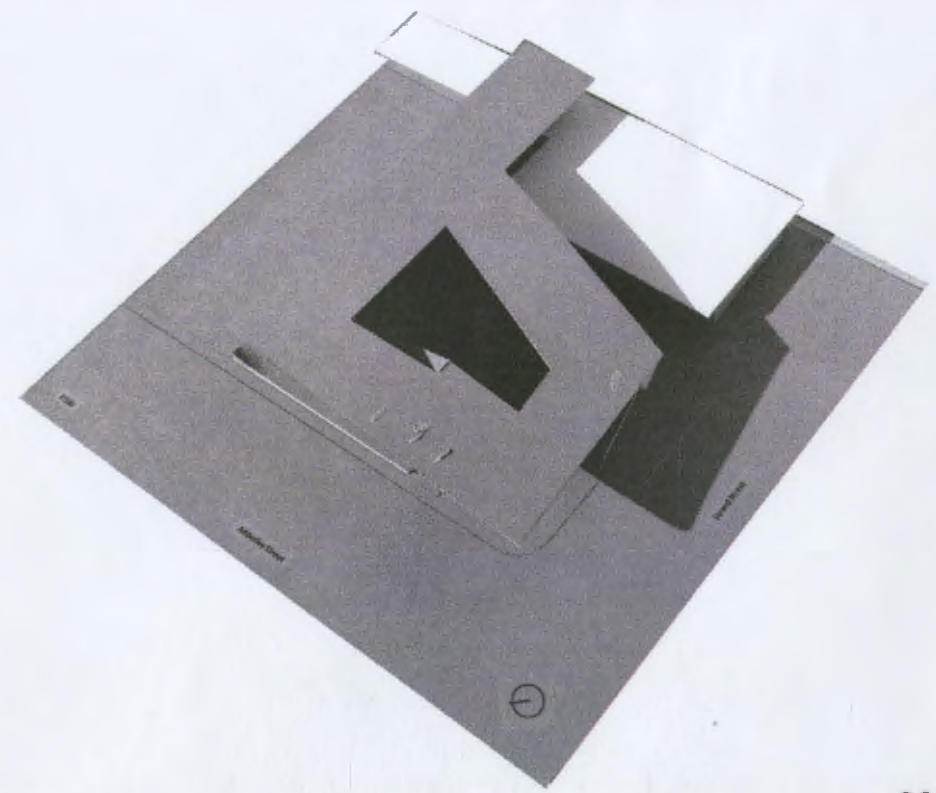
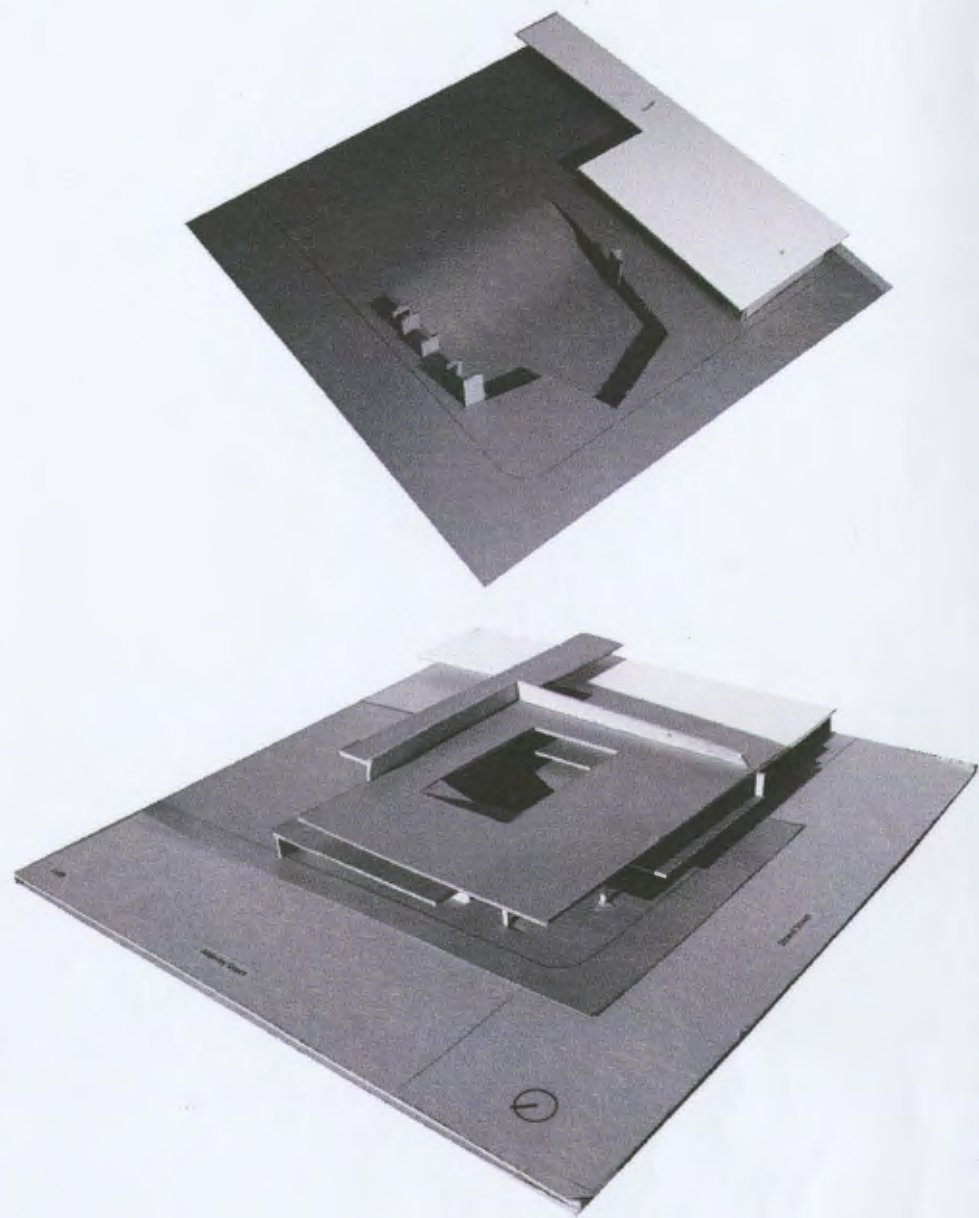
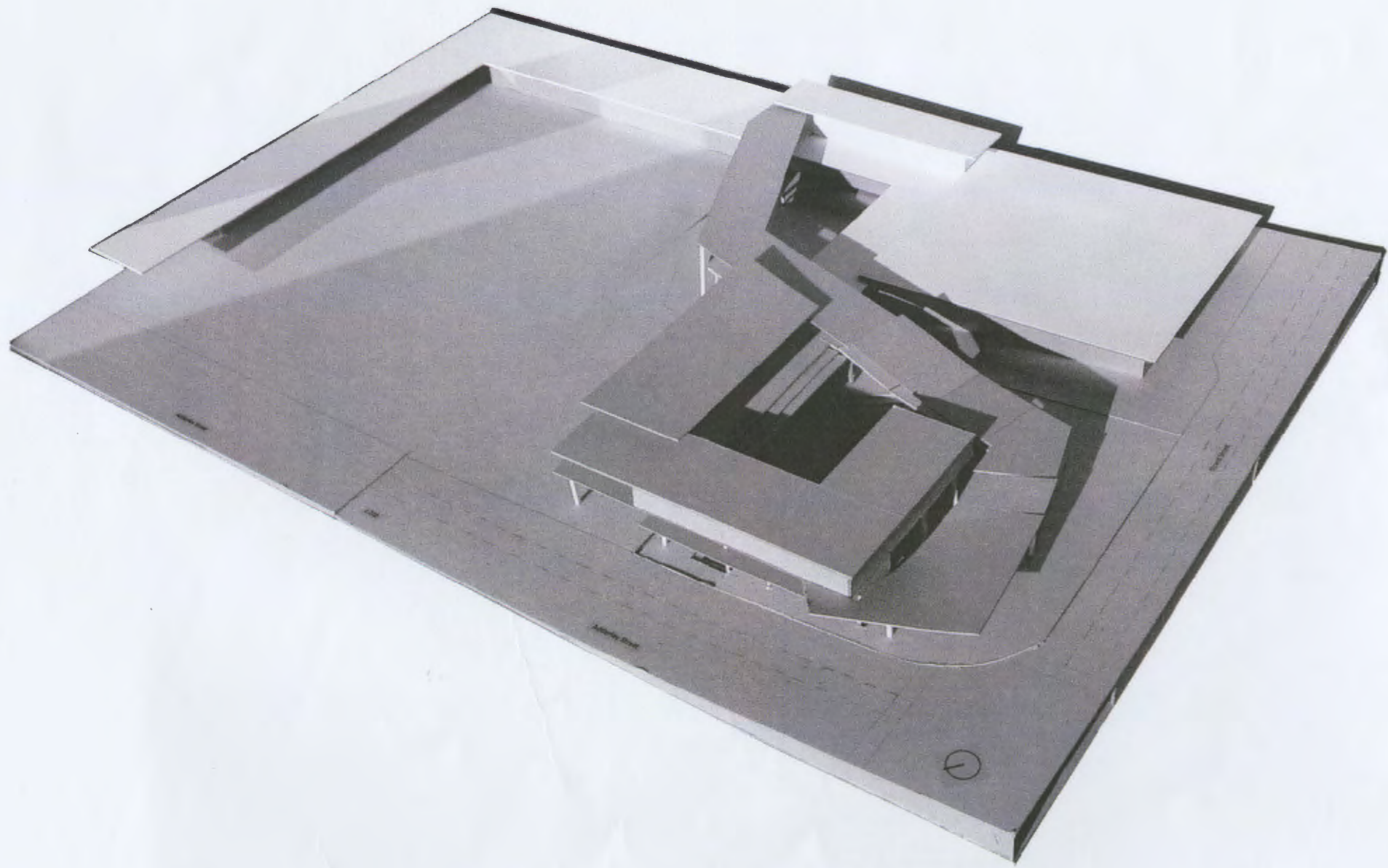


Spatial folding:

Experimenting with folding the three levels on the site:
 [-1] underground / strand street concourse,
 [0] ground and
 [+1] above ground / station roof

How to create permeability between the three levels?

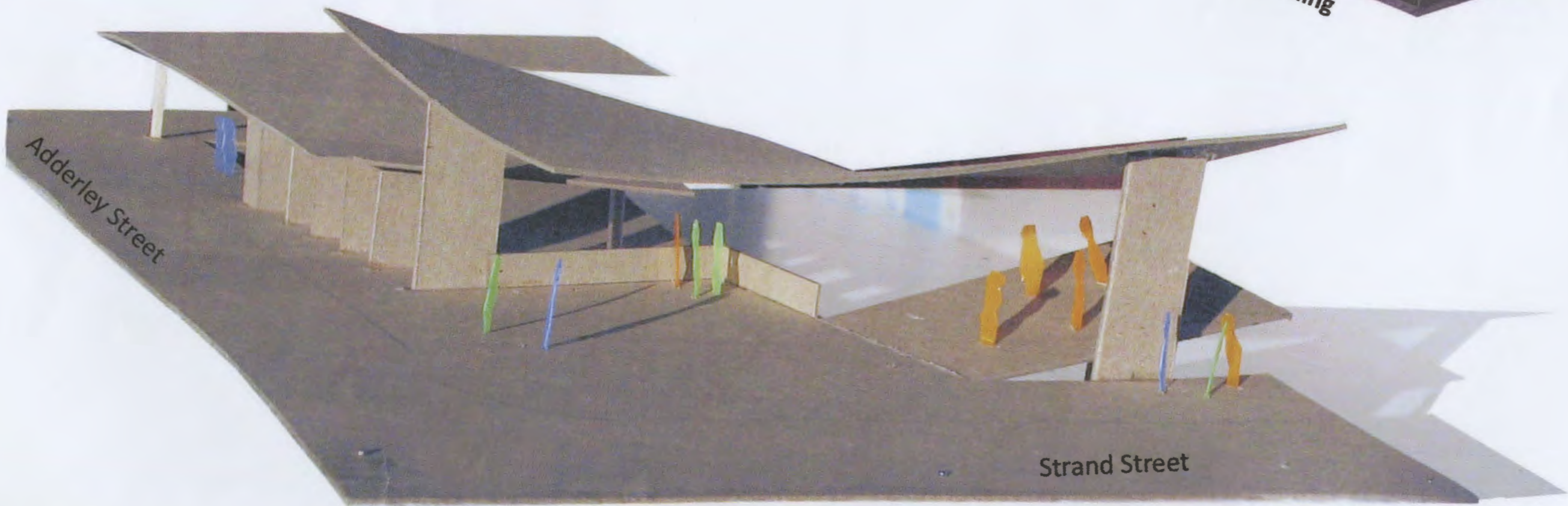




Strand Street

Adderley Street

Folding the station square into the building



Adderley Street

Strand Street

Folding the pavement into the building



Informal trading

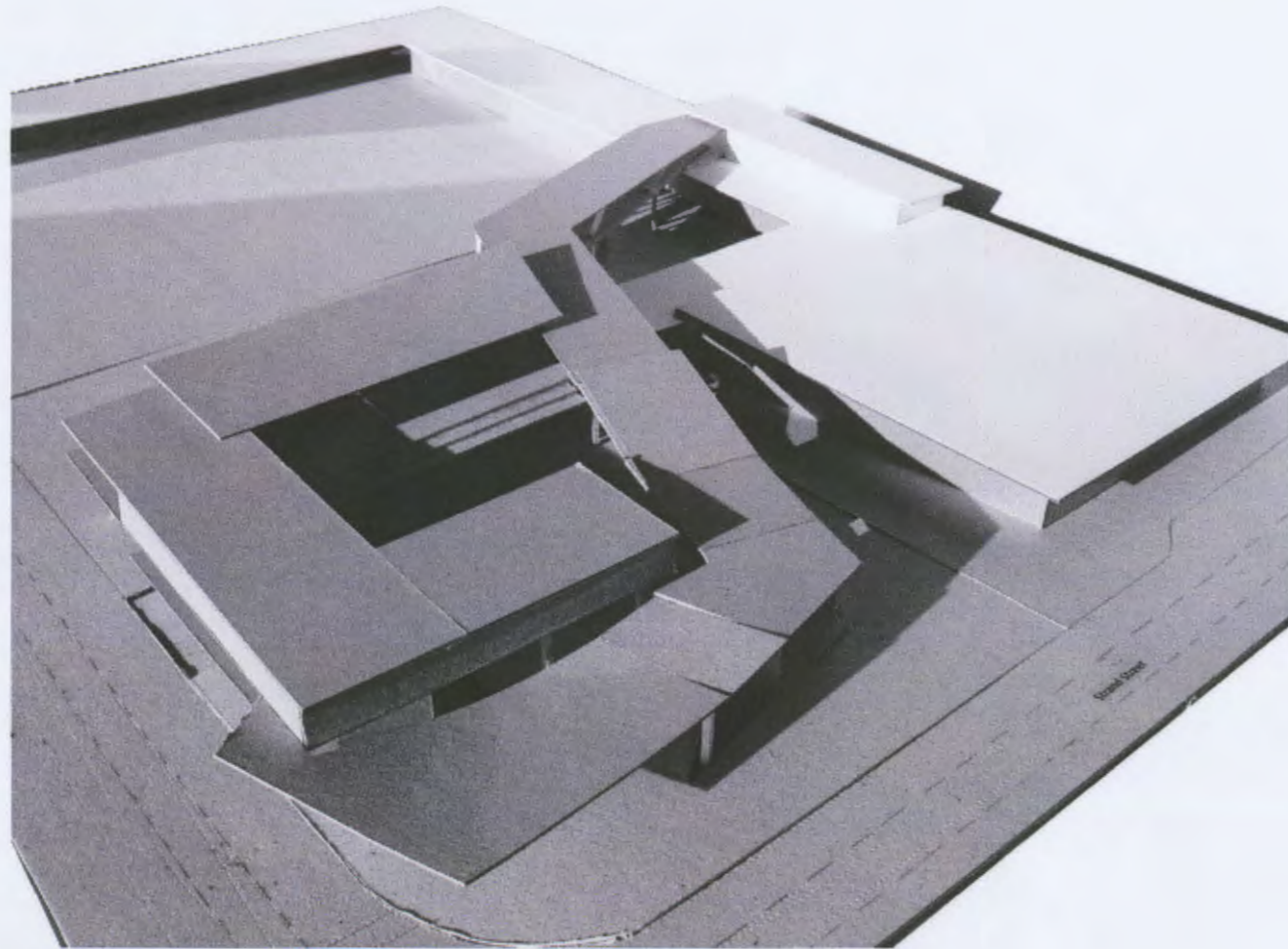
The screenshot shows the Metro FM website layout. At the top, there's a navigation bar with 'Radio Stations' and 'LISTEN TO METRO FM ON THE INTERNET FROM ANYWHERE IN THE WORLD'. Below that, a main banner for 'GLEN & UNATHI THE AVENUE / 03:00PM-06:00PM' features a 'LISTEN LIVE' button. The middle section is a news and sports update from '56.7 CAPETALK' with a 'COMING UP TODAY' section for 'THE WORLD AT SIX'. A 'QUICKNAV' sidebar is on the left, and a 'VACANCIES' section is on the right. The bottom part of the page includes 'NOW PLAYING' with 'TREVOR NOAH', 'PROMOTIONS' for 'WE ROCKED BLOEM', 'MUSIC' for 'KREESHA TURVER / LADYKILLER', and 'EVENTS' and 'COMPETITIONS' sections.

Programmatic folding

The aim of the programmatic folding is to provide opportunities for spontaneous reactions amongst the folded programs. The site and the building should be able to facilitate the informal, temporary and everyday life events, but also provide opportunities for formal, permanent programs and special events. The specific programs chosen to explore this idea are informal trading - which occurs on the site in a haphazard fashion- and radio broadcasting. In order to fold these diverse programs a communal 'event' space was introduced that both programs would have an interest in.

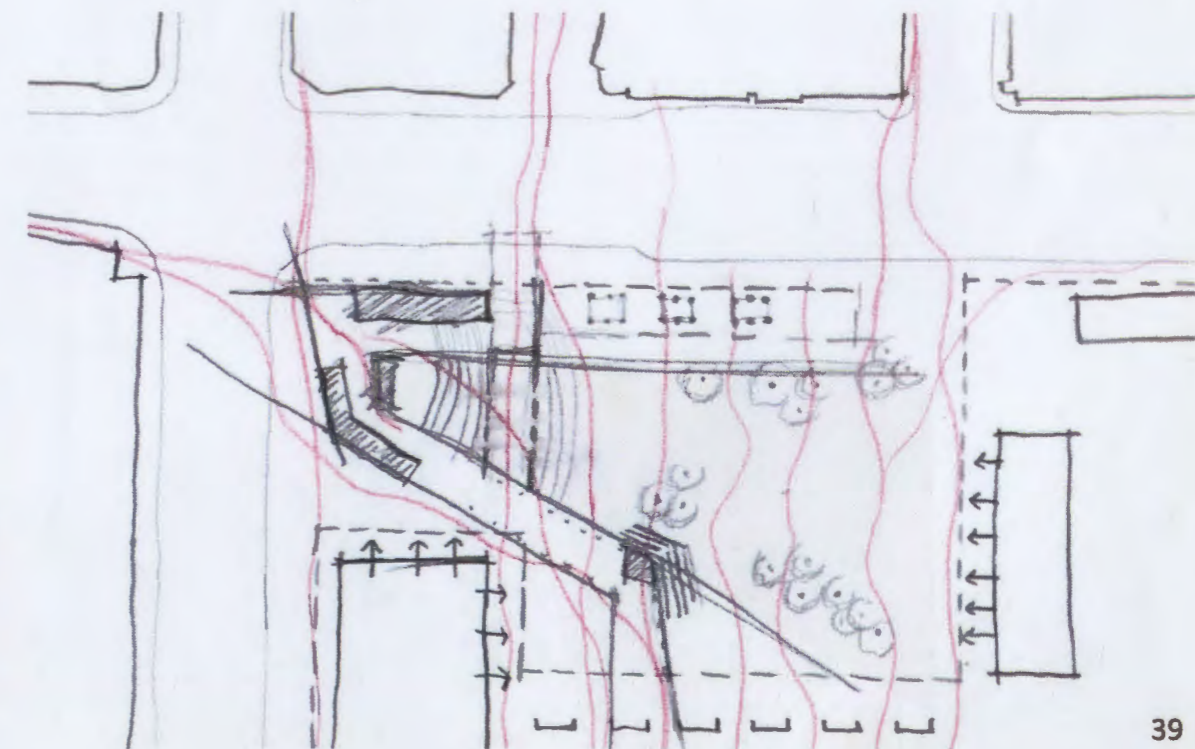
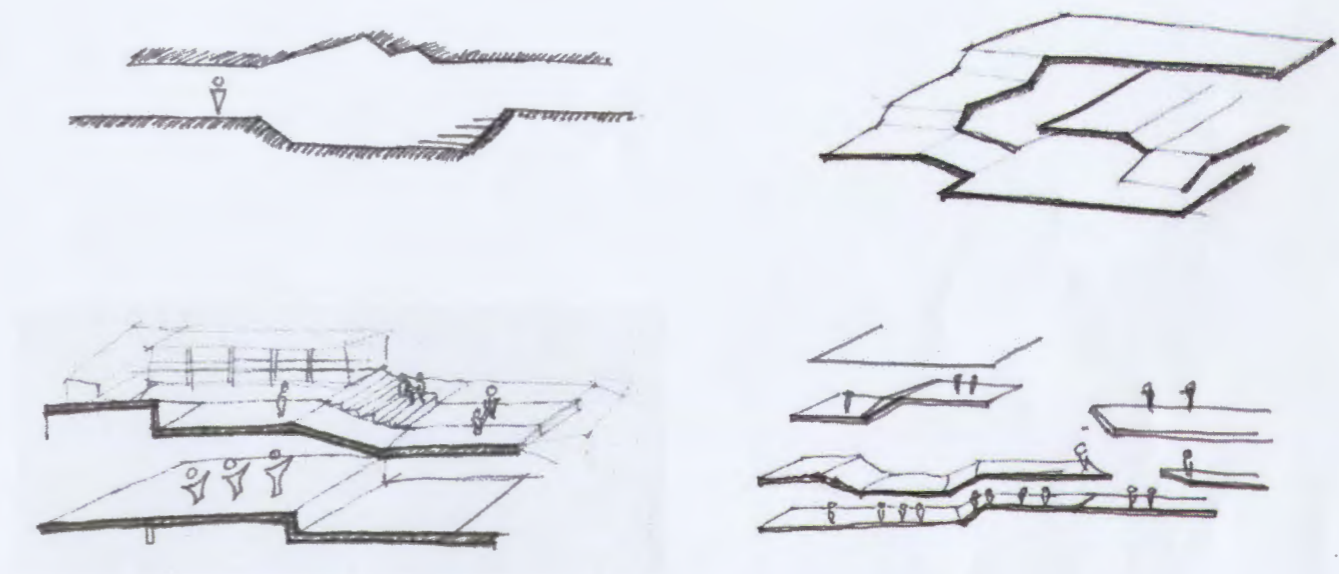
The 'event space' or urban amphitheater could be used by the radio to have loud broadcastings from or to host special events, when these events occur there will obviously be more bypassing feet, which is beneficial to the informal traders. When the radio is not using the amphitheater informal traders, by passers or informal musicians wanting to be noted could use the space.



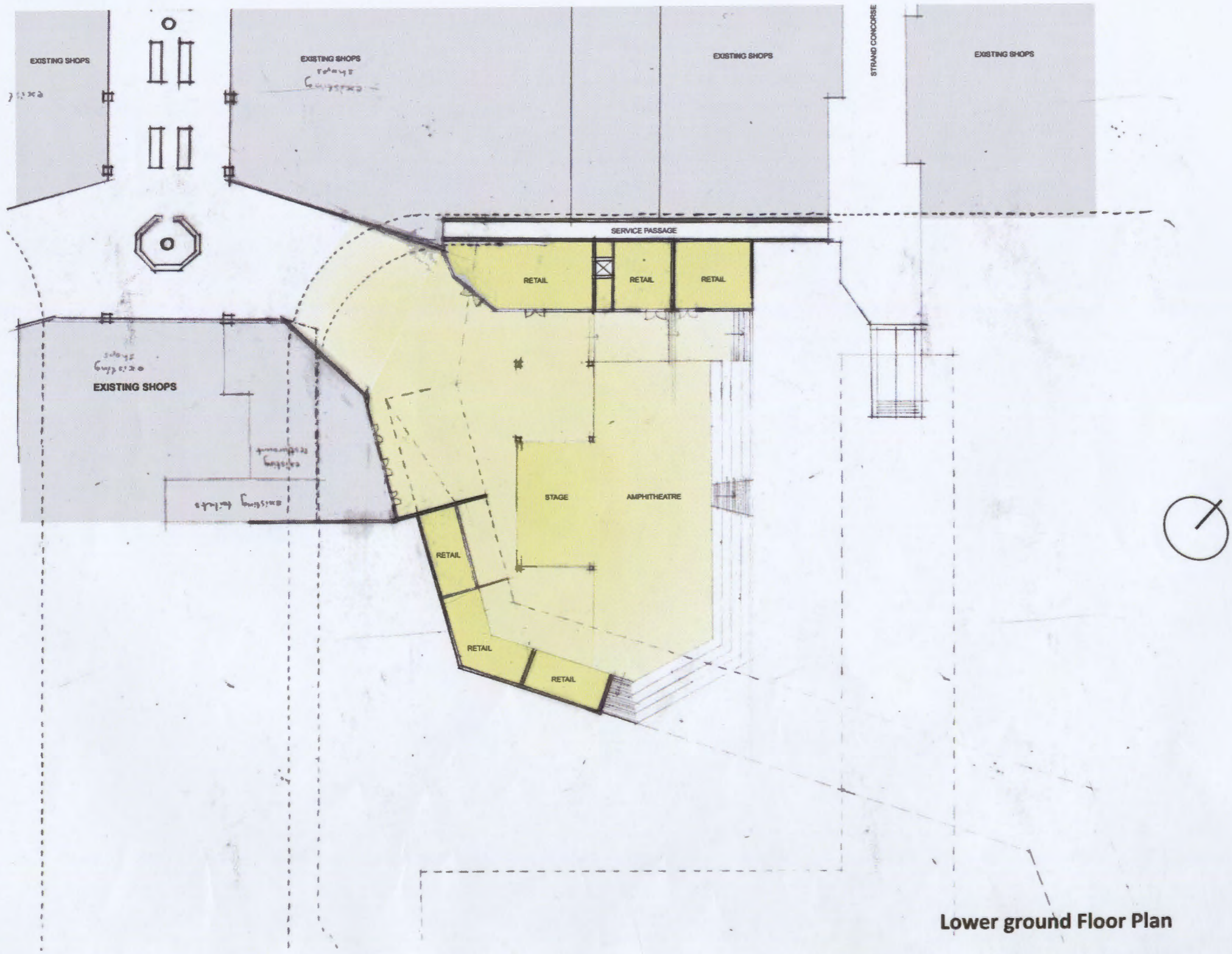


Formal folding

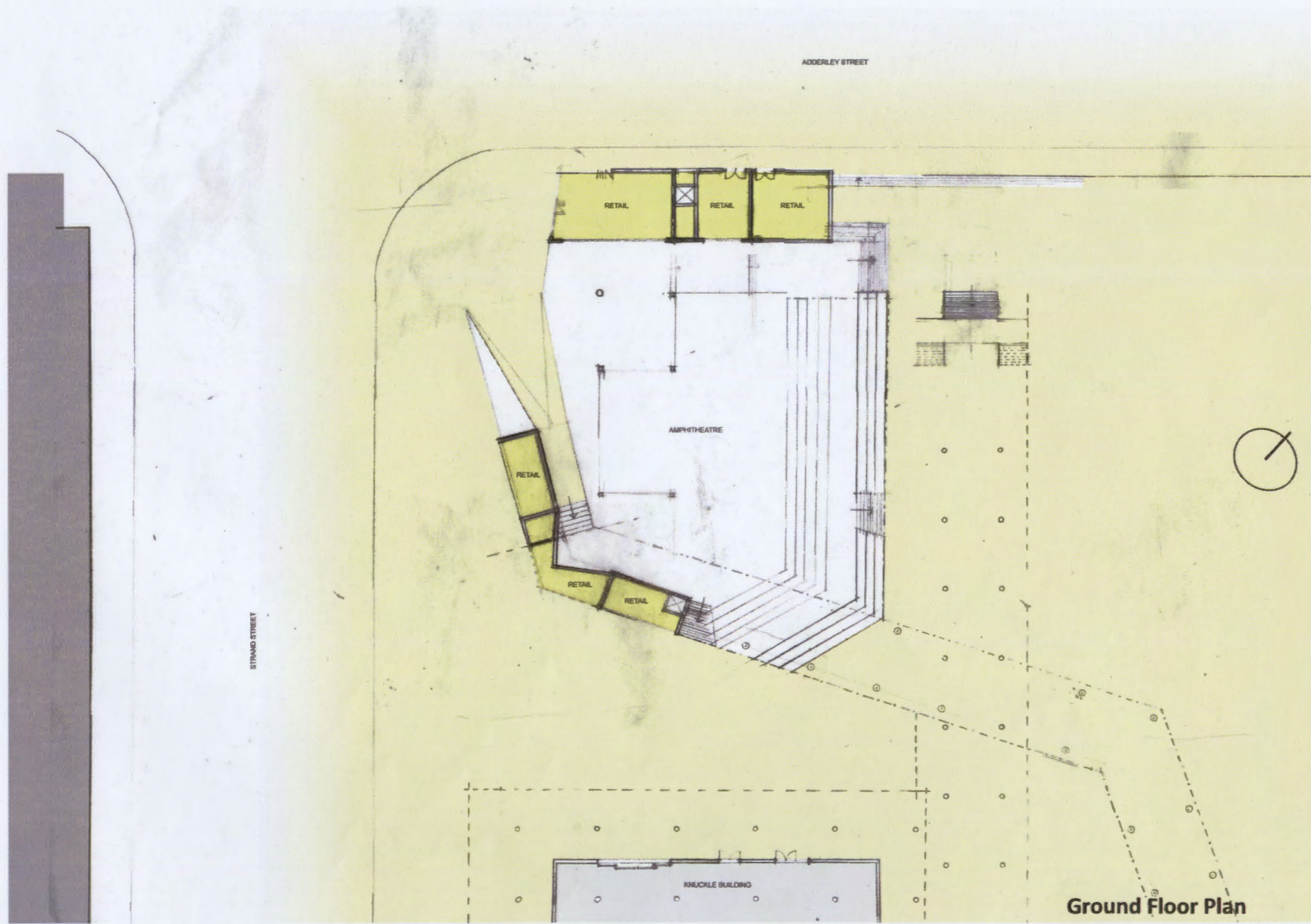
In the formal articulation of the building geometries where used to open-up, channel and close spaces; to direct pedestrian flow, and to draw people into the spaces. The form of the building was generated by the pedestrian movement across the site.



Rough sketch plans



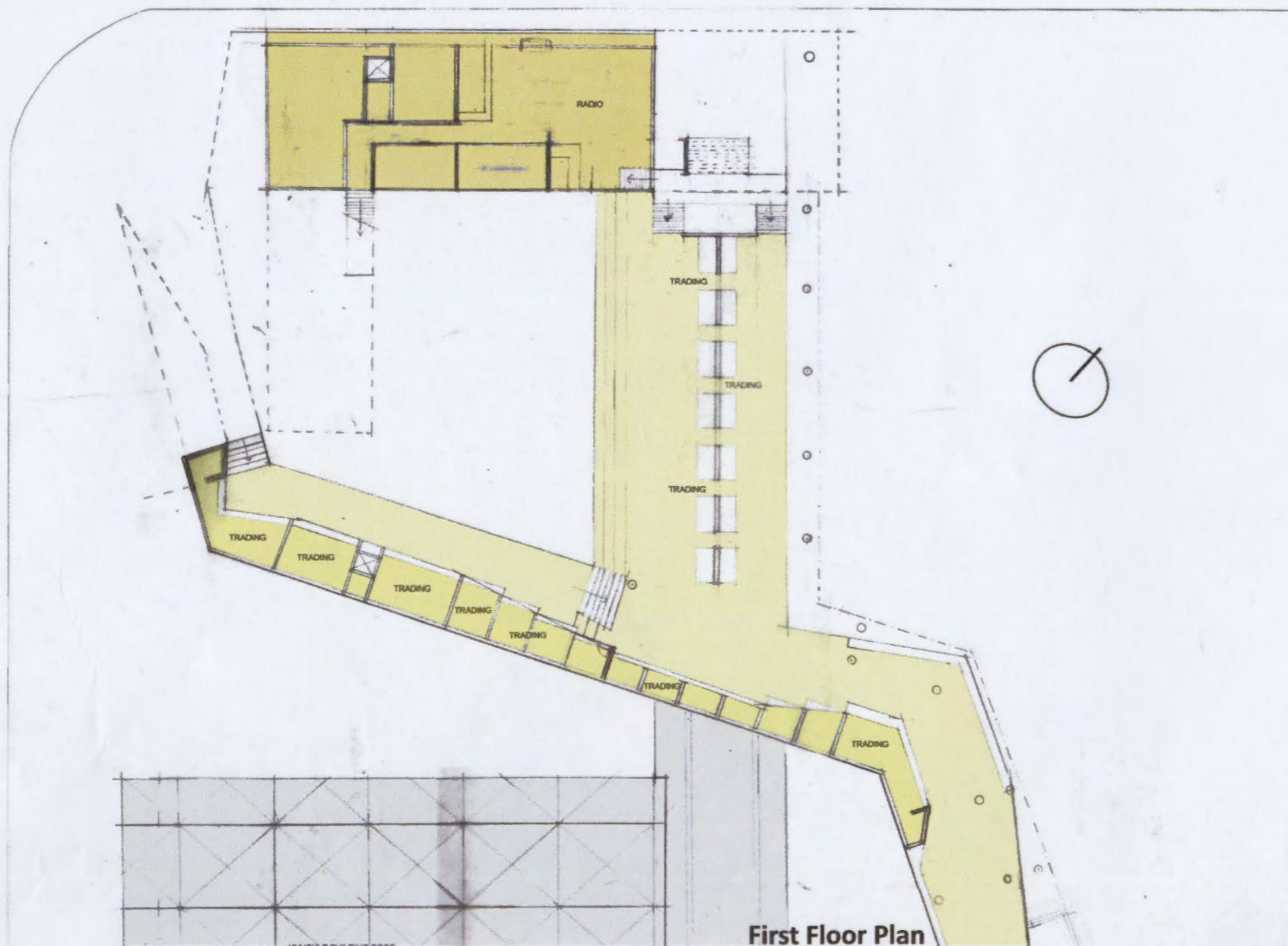
Lower ground Floor Plan



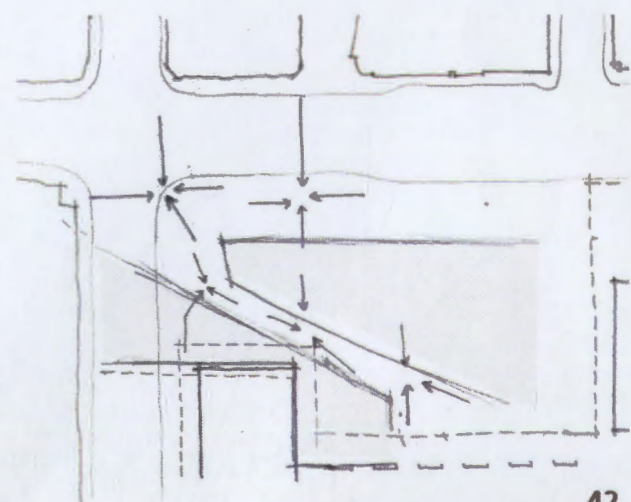
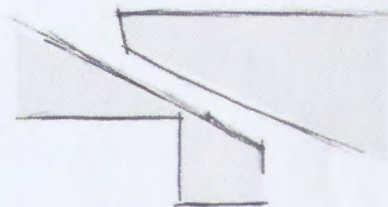
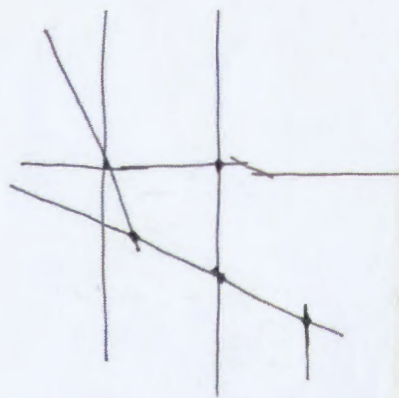


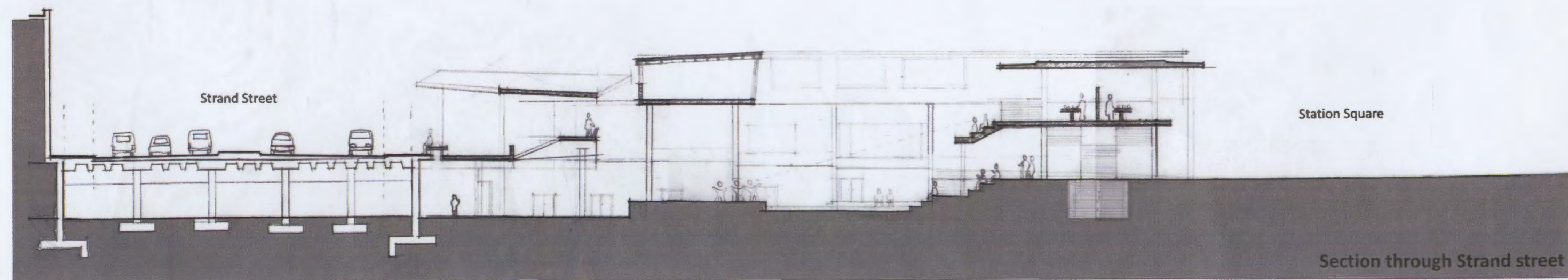
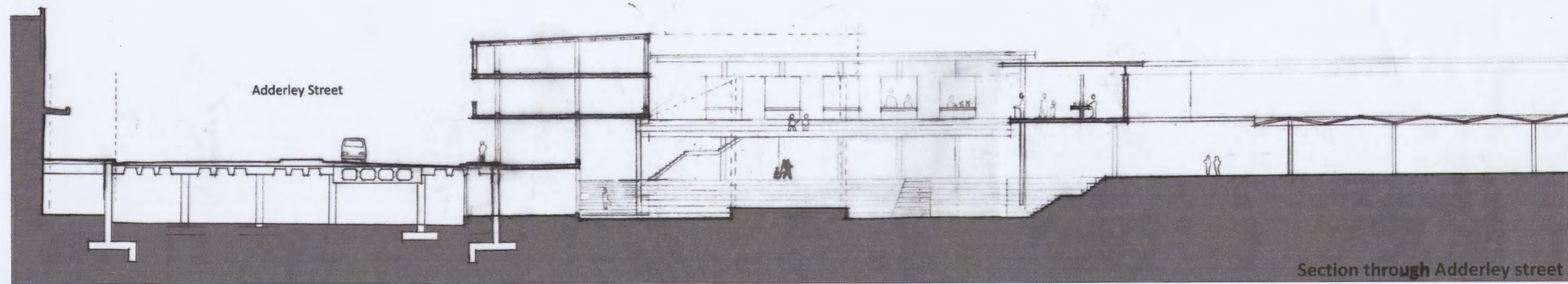
STRAND STREET

ADDERLEY STREET



First Floor Plan





Structural explorations

Introduction

The formal interpretation of 'the fold', as discussed in the Theory Project, challenges the Cartesian method of representing a pure form, through suggesting a multiple form - a unifying figure whereby different segments and planes are joined and merged in continuous lines and volumes.

This section of the document taken from the original Technology Project, completed in the first semester: *Unfolding Form: exploring structures that challenge the Cartesian Rationality*, will aim to discover whether this formal interpretation of the fold could indeed propose a challenge to the Cartesian rationality or more specifically Cartesian derived structure and space. The relationship between the structure, the form and the spatial experience of buildings that challenges the Cartesian method will be explored through the thoughts and work of the structural engineer, Cecil Balmond.

Cecil Balmond

Cecil Balmond, a structural engineer originally from Sri Lanka, challenges the tradition of Cartesian stability by designing structures that engage the uncertainty and fluidity of the current moment. He names these structures, resulting from a non-linear process of design: *informal*. He explains it as follows:

"...the informal steps in easily, a sudden twist or turn, a branching, and the unexpected happens the edge of chance shows its face."¹

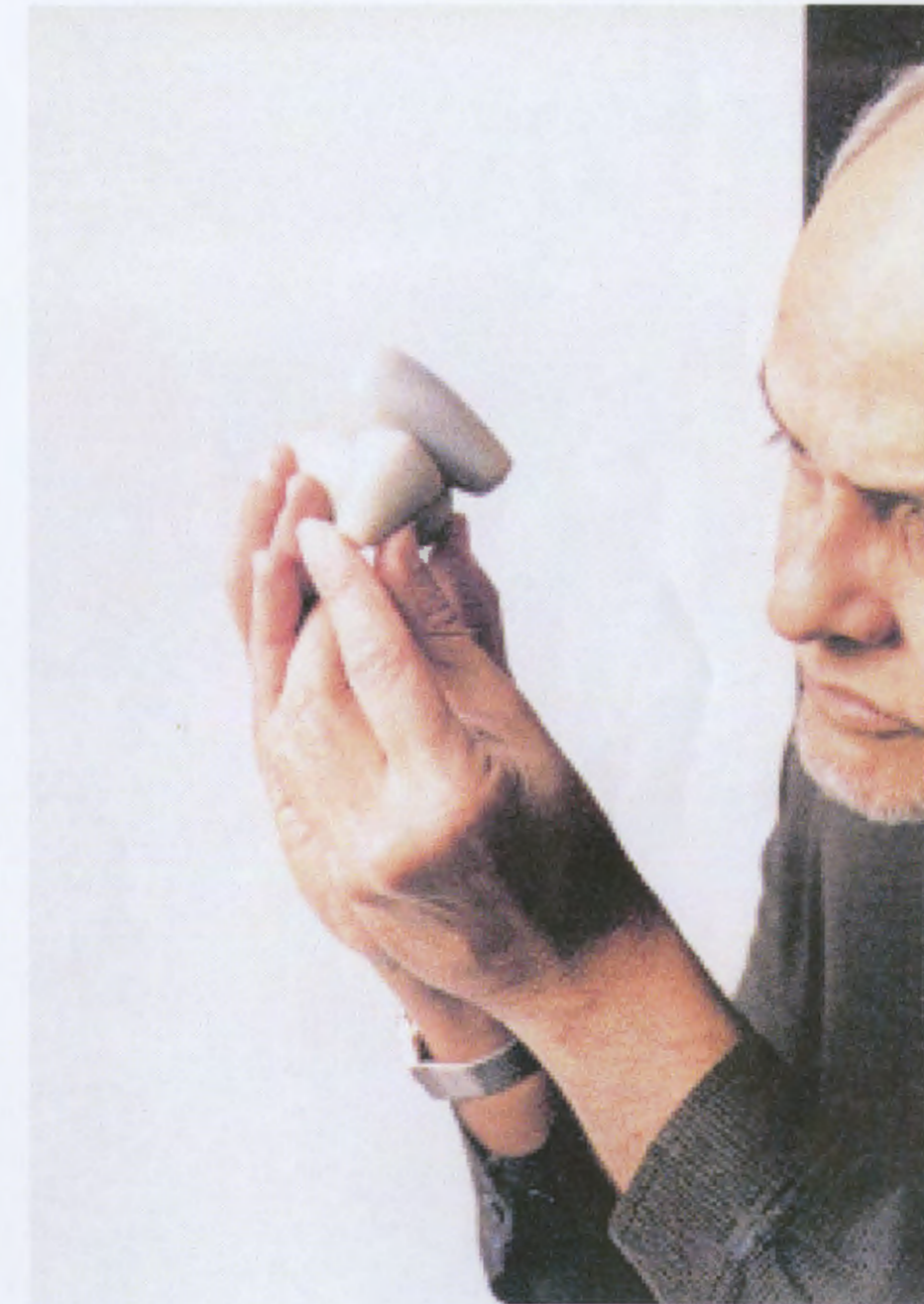
Cecil Balmond has been working has been working with the international firm of consulting engineers, Ove Arup and partners for the past thirty years, on a variety of prestigious and award-winning architectural projects. According to architect, Rem Koolhaas,

"He [Cecil Balmond] is involved in the most intimate moments of the architectural processes and has spawned a generation of hybrids of engineering and architecture, where previously separate identities have merged."²

Rem Koolhaas even goes as far as to say that he wouldn't even start a project until Balmond "has weighed in". Koolhaas their collaboration as follows, *"Cecil has changed my outlook on structure and enabled me to rethink architecture."³*

What makes Cecil Balmond's theories interesting and especially relevant to me is the fact that although he is arguing for space to be freed from the Cartesian rationality, he does not approve of form-finding that is software dependant, like so many other designers that follow the same line of thought. Rather, he is searching for new types of structural innovation, which could lead to unexpected surprises in form and design.

¹ Balmond, C. & Jannuzzi Smith, *Informal*, Prestel, London, 2002
² Ibid, p.9
³ Kabat, J, *The Informalist*, Wired, April, 2001



Cecil Balmond with a wax study of a proposed ten story mixed-use building in central London (Wired, 2001)

Challenging the Cartesian rationality

Cecil Balmond introduces an article that he wrote for the Italian journal, *Lotus* in 1998, by making the following statements, quite provocative coming from a structural engineer,

"We make cages out of our structures. We want our buildings to have frameworks, but out of Cartesian compulsion we compartmentalize space into strict horizontals and verticals. Our designs reinvent the topographies of rigid skeleton. Locked in right angles, the assumption is of order as a rigorous delineation and within that the building as object."⁴

Balmond continues to explain that through this method the external boundary is set, and by grid and sub-grid a method of exact sub divisions begins; a diminution into regular, repetitive fixings of space.

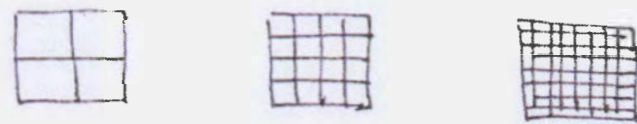


Diagram by Cecil Balmond explaining the reductive nature of the grid and the sub grid.

The result of this kind of space-making, according to Balmond is that a lot of creativity in the design process is lost, *'imagination is immobilized and movement is trapped'*. What Balmond is perhaps hinting at is the fact that architects, when conceptualizing the structure of their designs, often start off with a fixed and rigid grid which ends up limiting the freedom or complexity of the design.

It is obvious that Balmond's statements can be read as a critique of modernism,

"In the static perfection of the modernist cube, with its minimalist palette of glass and transparency we see right into the emptiness of the container. Structure seems to have no response but to stand mute."⁵

Balmond seems to be making a very literal and reductionist statement here, linking conventional, modernist Cartesian structure to unimaginative design, when a large part of the Modern Movement was actually concerned with the concept of the *free plan* - whereby the structural grid frees up the plan and spatial nature of the building.

The difference between the Modernist *free plan* and Cecil Balmond's argument to challenge the structural grid or Cartesian rationality could be explained through his search for new types of structural innovation, which is inextricably linked to the form and design of buildings.

⁴ Balmond, C, & Jannuzzi Smith, *Informal*, Prestel, London, 2002
⁵ Ibid, p.9

Balmond extends his critique to the 'high-tech' movement in architecture as well, he claims that in high-tech elaborations one sees only an extension of the modern, mechanistic tradition; steel mast and cable, structure as machine. Balmond goes on to state that, *"In terms of space and configuration, inspiration seems to have given way to an overpowering technology."⁶*

In order to regain some creativity in the design of structure and architecture, Balmond suggests that one should engage in a more intuitive way with the possibilities of geometry and structure, more on instinct than on the assumption of space being neutered, capable only of containerization.

In the projects Balmond is involved with he often starts the design process through this intuitive search for innovative structure, trying and testing different structural solutions through concept diagrams and quick, paper concept models. Through this search Balmond aims to uncover the 'hidden order' in the nature of the structure.

Balmond explains that in the irregular rhythms and diversity we see all around us, the real is highly complex and very rich in its entanglements. He suggests that one should look for characteristics that 'seed' the complex and give starting points to an inner logic which could lead outwards to the idea of ensemble and coherence.

"Now that the world is being accepted as not simple, the complex and oblique and the intertwining of logic strands gain favour. Reason itself is finally being understood as nascent structure, non-linear and dependent on feedback procedures. Beauty may lie in the actual processes of engagement and be more abstract than the aesthetic of objecthood."⁷

The above mentioned positions lead Cecil Balmond to formulate a set of ideas regarding an 'informal' way of thinking about the design of structures and buildings.

⁶ Balmond C, *New Structure and the Informal* Lotus international, 1998, n.98, p.[70]-83.

⁷ Balmond, C, & Jannuzzi Smith, *Informal*, Prestel, London, 2002

The informal

Cecil Balmond argues that creative play with structure and geometry could lead to innovative architectural designs where the sense of working from a theoretical base of form towards a configuration of structure strengthens the overall design idea.

He explains that there is a lot more to structure than strict post and beam compositions, "Slabs may fold and act as lines of vertical strength, beams may bifurcate and change shape, columns can serve as beams".

He argues that the structural ingredients are all there to evolve form in fascinating ways and that the challenge is to make structure the new discipline in a re-examination of space.

Balmond explains that architecture is in a time when anything goes and there is no basis for a manifesto post modernism has come to, ultimately, no meaning. With little understanding of the motivation of form, modernism runs into minimalist dead ends and by continuing to look to the outside the seduction with objecthood and architecture as art is perpetuated.

Of course the computer also fundamentally changed the way architects conceive form and space in the 21st century. In this current time software programs provide unparalleled freedom to explore and the result is a mind blowing free-for-all where anything goes. But Balmond warns that cool new shapes and blobs are nothing more than mere façade if they are propped up by standard post and beam constructions. Balmond explains,

*"Geometry is not invoked; no one peers within and asks questions about the archetypes of form. These are forgotten. Instead, instant realizations are sought from computers with form-finding that is software dependent."*⁸

He argues that in order to create integrity in the establishing of a free shape a new method is needed for configuration with flexible starting points, "Instead of line surface; instead of equi-support scatter; instead of fixed center a moving locus; and instead of points zones." Balmond calls this set of ideas, 'the informal'.⁹

The informal is however not random or arbitrary, as one would generally accept, rather it relies on overlap to bring forward a series of shifting certainties its logic is contingent upon initial conditions. Chaos is seen as a succession of several orders, quite different, Balmond argues, to the idea we have of trapping the arbitrary and calling it order.¹⁰

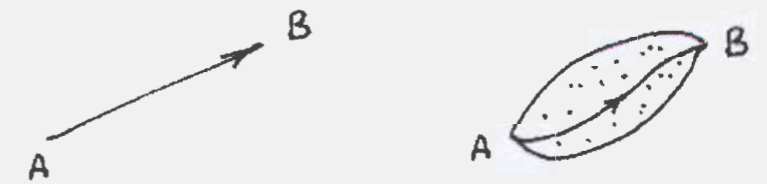
But in a building form that is static, where are the dynamics, what is the non-linearity?

Balmond claims the answer lies deep in configuration. As we are made of patterns, both random and regular, both physical and emotional, probing the archetypes of pattern is important in its recognition and resonance we may find an element of beauty. In the past beauty was conditioned by aspects of purity, fixed symmetries and pared minimalist structure being accepted as norms. Balmond states that, as our long as our brain keep to tramlines of reasoning the model will persist.

Balmond introduces the chapter, *Informal*, of his book, *Informal: Cecil Balmond* (2002) with the following explanation:

*"The twisting-turning inside out of a moebius strip belongs to the informal. A roof that turns to wall, a floor that moves into column, a skin that is structure, where boundary is not border, is part of it. Columns out of step, of different shape or material, side by side, also belong."*¹¹

He goes on to explain that the difference between the informal and the formal may be compared in the description of force. Newton offered the classical definition: force as action at a distance in a straight line. Balmond explains that Determinism pictured force as an arrow, straight and true, thereby bridging the void with unwavering objective linearity the rigid link of an absolute logic chain.¹²



But Balmond clarifies that the modern description of force is different. The modern view is that between A and B there is a field of potential and a minimum path will be sought. Depending on local conditions that path may vary. Subjective and relative, the informal view is based on instants of mutual cooperation, side by side differences charting the least resistance.

When reading Cecil Balmond it is important to remember that although structural innovation is one way in which to achieve original forms of architecture it is by far not the only way.

What makes Balmond's theory especially relevant is the fact that he is proposing an approach towards structural design which enables integrity in the establishing of free shapes at a time when architecture is disillusioned by the dishonesty of free shapes resulting from form-finding software.

8 Balmond, C, & Jannuzzi Smith, *Informal*, Prestel, London, 2002

9 Balmond C, *New Structure and the Informal*, *Architectural Design*, Vol. 67, no 9/10 Sept-Oct, 1997

10 Balmond C, *New Structure and the Informal*, *Architectural Design*, Vol. 67, no 9/10 Sept-Oct, 1997

11 Balmond, C, & Jannuzzi Smith, *Informal*, Prestel, London, 2002

12 Balmond, C, & Jannuzzi Smith, *Informal*, Prestel, London, 2002

Structural explorations

This section consists of a series of structural explorations, which will aim to explore and analyze the relationship between the design idea or concept, the structure and the spatial experience of a range of buildings, which are a result of Cecil Balmond's 'informal' approach to designing structure.

The chapter is divided into three sections as inspired by Cecil Balmond's informal approach to structural design: *Challenging the grid*, *Continuous planes* and *Structural skins*.

Challenging the grid

- Project 1: Serpentine Gallery Pavilion by Alvaro Siza
- Project 2: Taichung Metropolitan Opera House by Toyo Ito

Continuous planes

- Project 1: Arnhem Interchange by UN Studio
- Project 2: The Jussieu University Library by Rem Koolhaas

Structural skins

- Project 1: Victoria & Alfred Museum Boiler house Extension by Daniel Libeskind
- Project 2: The Seattle Public Library by Rem Koolhaas

Challenging the grid

"laying down a grid should be a mapping of the possible, not restraining order. A grid is a necklace, folded in a certain way, which at any instant can be pulled apart and shifted dramatically a moveable feast, not necessarily serious, fixed one moment, vanishing and refigured in the other. Each point on the grid is allowed a charm live." Cecil Balmond ¹³

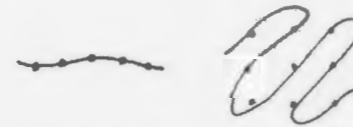


Diagram by Cecil Balmond explaining the concept of a grid as a necklace (Balmond, 2002)

project 1: Serpentine Gallery Pavilion, 2005

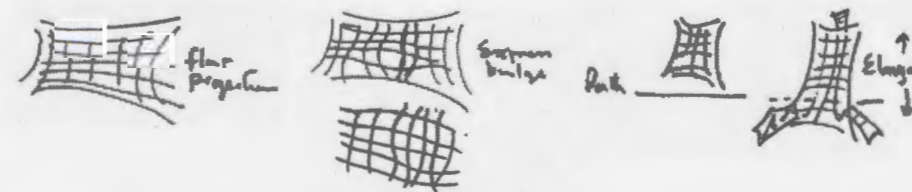
architect: Alvaro Siza

structural engineer: Cecil Balmond

design/conceptual idea:

The Serpentine Gallery Pavilion is a temporary structure. Alvaro Siza conceived the pavilion as a "crouching animal".

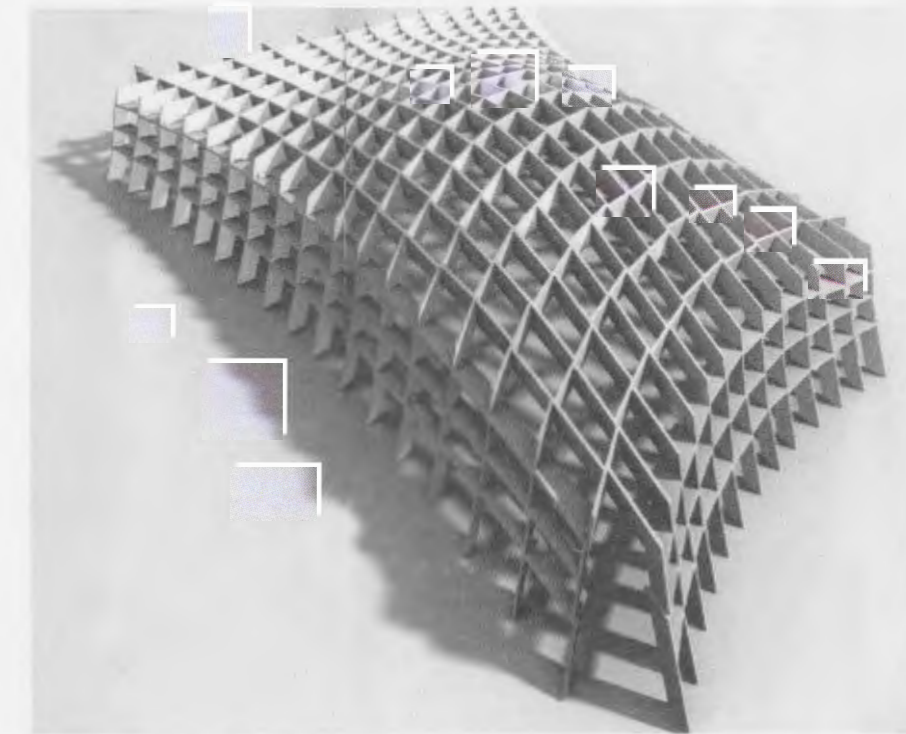
The starting point to the design was idea of a deformed grid. Since a grid has the possibility to provide the armature for sculpting space, while simultaneously controlling the structure. Siza saw timber as the material and a grid as its framing vessel. Cecil Balmond saw the grid as a "template for action" a mechanism to be deformed, tuned through Siza's spatial sensitivity, to the context of the site.¹⁴



Diagrams by Cecil Balmond exploring the possibilities of deforming the grid. (Balmond, 2002)

¹³ Grid, Lotus International, Issue 127, 2005

¹⁴ Meredith, M & Sasaki, M, From control to design: Parametric / algorithmic Architecture, Actar, 2008, p.46



Computer rendering of the structure of the Serpentine Gallery Pavilion. (Meredith, 2008)

Structural idea:

Cecil Balmond and the AGU¹⁵ took the grid, the intent of the project, and explored the potential. They raised the following questions: How does one allow the grid to deform but maintain some pattern? How can the grid be allowed to articulate its geometry, but with subtlety?

Since the pavilion is a temporary structure it had to be made in a way that allows it to be easily assembled and disassembled. Demount ability favours man-handle-able components and simple connections would speed the assembly process. Therefore an interlocking structure that self-stabilises through the assembly process was thought of as the ultimate solution.

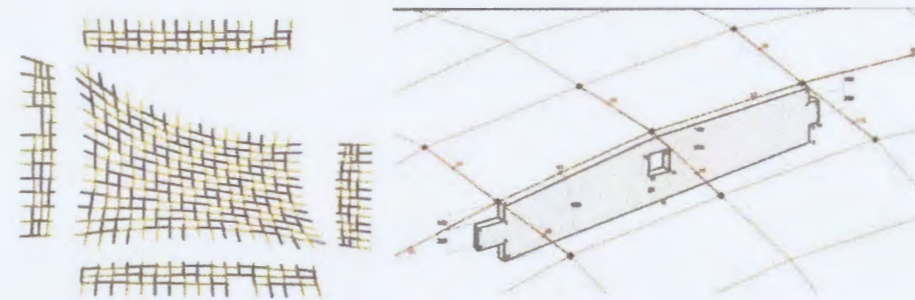
Cecil Balmond and the AGU unit explain that a simple set of rules defines each component in the interlocking structure. All elements are the same in dept; mortice and tenon dimensions are fixed; the bottom edge is straight; the top edge kinked; and so on.¹⁶

By mathematically relating each of these rules to the surrounding nodes of the grid (see figure top right), the standard component (and hence all components) can be described. Coding these vector relationships into a script, the volumetric geometry of every point (427 in total, all different) could be produced automatically from an input geometry the nodal definition of the underlying grid. Each component's geometry was directly sent to the five-axis CNC router, making drawings redundant.

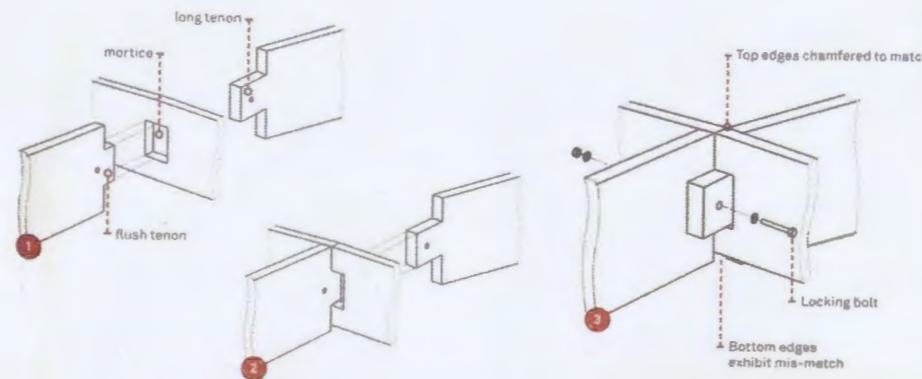
The reciprocal grid provided the solution. Each discrete element is two grid-bays long, (see figures top right), Individual elements support each other by locking their ends into neighbouring elements.

Balmond explains that there is no clear load-path and no structural hierarchy: forces loop, pinwheel-style, through the structure until perimeter support is reached. The structural diagram, of discrete elements with pin-ended connections, allows simple mortice and tenon connections (bending forces do not need to be transferred). The ends of elements meet, in a rectangular hole at mid-point of a third (see figure bottom right).¹⁷

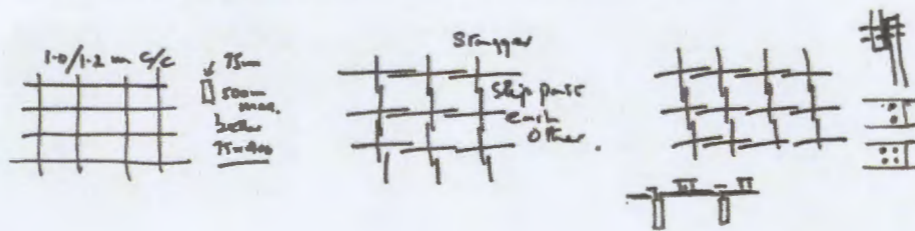
The alternative offset of the elements (a logical consequence of the double mortice and tenon joints) creates shuffles and slips in the grid. The static grillage becomes a dynamic network, the pieces tumbling in their eccentric positions each displaced from the underlying grid. The subtleties of the generative rules dictate the slips. As the elements accommodate greater deformations of the grid, the deliberate deformations are amplified.



The reciprocal grid showing interconnected elements, each two structural bays long. (Meredith, 2008)



Simple mortice and tenon joints overlap to create a dynamic grid. (Meredith, 2008)



Diagrams by Cecil Balmond showing offset or slips in the grid. (Balmond, 2002)



assembly process showing steel shoes and over lapping joints.

15 Cecil Balmond founded the AGU, (Advanced Geometry Unit) in 2000 as Arup's think tank; It is a multidisciplinary group of architects, engineers and scientists dedicated to researching complex structural geometry in support of new architectural visions and solutions.
 16 Meredith, M & Sasaki, M, From control to design: Parametric / algorithmic Architecture, Actar, 2008, p.46
 17 Meredith, M & Sasaki, M, From control to design: Parametric / algorithmic Architecture, Actar, 2008, p.466



Exterior view of the Serpentine Gallery Pavilion (Kronenburg, 2007)



Interior view of the Serpentine Gallery Pavilion (Kronenburg, 2007)

spatial experience:

The slips in the connections of the construction elements lead to an ornamental quality to the Pavilion. The authors of the Serpentine Gallery Pavilion claim that this was an intentional result of the assembly logic, the mismatches could have been easily eliminated by a tweak to the script, but they chose to articulate the construction method of the Pavilion.

The overall result of the Pavilion is that of a contemporary vernacular. The key is the connection detail, precisely fabricated yet crudely assembled; its medieval simplicity is what unlocks the life of the whole grid.¹⁸

project 2: Taichung Metropolitan Opera House, Taiwan,
 Winning Competition Entry 2004, estimated completion **2009**

Architects: Toyo Ito & Andrea Branzi **Structural engineer:** Masato Araya

design/conceptual idea:

*The Opera House is designed to be a cityscape rather than a building, the reference image for the building being a mouth or an ear the organs for sound emission and reception.*¹⁹

The Taichung Metropolitan Opera House is situated in the park within the New Government Center district. Ito's winning design for the Opera House is articulated through his method of "seamless access", which integrates and redirects the mobility and connectivity of the surrounding urban fabric.

Ito's proposal reinterprets and displays the complex relations between consumption, fashion, arts and media in the functional organization and structure of the Taichung Metropolitan Opera House.

The public lobby, arts plaza, grand hall, black box, play house, administrative offices, rooftop garden, exhibition halls, rehearsal areas, circulation and facilities all come together to create a multi-layered, complex three-dimensional structure, while its porous form allows it to flow naturally and connect with the surrounding environment.²⁰

structural idea:

The structure for the Opera House was conceived as a thin, three-dimensionally continuous, curved shell structure that follows a system of structural optimization based on simple geometrical transformations.

The structure started off with the manipulation a grid:

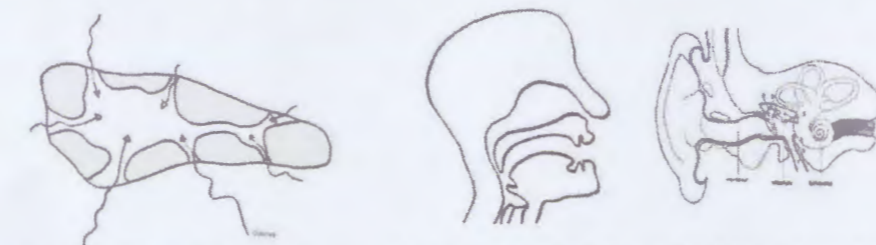
The architects explored ways in which the grid could be manipulated to create a continuous structure and spaces. *"When the junction between walls and floors is eliminated, the two elements merge into one and the distinctions between them and the limits they impose are reduced to zero. We have now moved beyond Euclidean geometry, creating twisting shapes without any reference to an orthogonal system."*²¹



The building designed as a porous cityscape (El Croquis, 2005)



The porous form allows the building it to connect with the surrounding environment. (El Croquis, 2005)



the reference image for the building: a mouth or an ear – the organs for sound emission and reception (El Croquis, 2005)

Concept models were made of stockings to explore interwoven spaces (see image on the right). The spaces of the Music Forum remind of labyrinthine caves, carved out of a continuous system. A thin, three dimensionally curved structure of two interwoven spaces vertically and horizontally continuous, relates like positive and negative to each other.

Space A is the cave of sounds, containing the auditorium, several rehearsal spaces and workshops. Space B is the cave without sounds, a continuous urban landscape of foyers, offices, and restaurants (see image below).²²

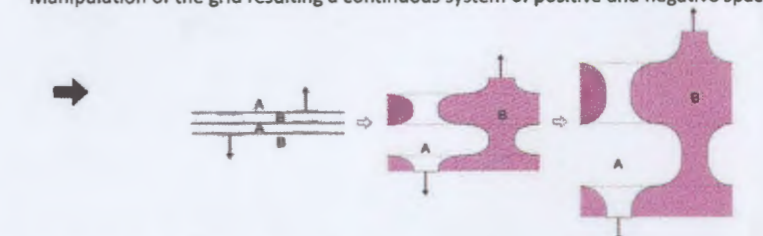
But how does one build such a complicated structure?



Concept models made with stockings explore two interwoven spaces (A&U,



Manipulation of the grid resulting a continuous system of positive and negative spaces



Horizontals and verticals merge to form continuous planes (A&U, 2005)

19 El Croquis: Toyo Ito 2001-2005, no 1123
 20 Tseng, D, Result of Taichung Metropolitan Opera House International Competition, A & U, Vol. 427, 2006, p.14-19
 21 Cellarius, C, Twisting Vibrancies Flowing through a Stimulating Atmosphere, A & U, Vol. 417, June, 2005, p 84

22 Cellarius, C, Twisting Vibrancies Flowing through a Stimulating Atmosphere, A & U, Vol. 417, June, 2005

In order for the structure to be built a structural model of the complex geometry was required. At this stage Cecil Balmond and the AGU unit from Arup became involved.²³ To realize the ambitious design the AGU developed a series of specific geometry and structural model generating tools.

The AGU unit explained that in order to generate a structural model the software used to analyse the structure only requires the edge curve of a doubly-curved surface to execute an inbuilt meshing algorithm²⁴ that approximates the area with a so called Coons path. A wire frame of edge curves and their corner point is sufficient to describe the whole structure (see image on the right).

The advantage of the computerized structural model is that the minimum data set that needs to be communicated with the architect is reduced to the crude mesh information. The developed tools enable the creation of a structural model in an optimized process and an almost instant response to design changes. In reverse, structural optimized versions of the mesh geometry can be proposed and communicated to the architect in the same way.

At competition stage, a double-layered composite steel structure using sprayed concrete was proposed. A grillage of curved steel beams were proposed to form the geometry. Expanded metal sheets would then be attached to the beams since it would be flexible enough to follow the curvature and act as the formwork for the spray-on concrete. This option was not developed further as sprayed concrete technology is relatively uncommon in Asia and only used for nonstructural purposes.²⁵

Keeping the steel structure combined with conventional shuttering did not seem to be sensible as in addition to the complex steel structure an equivalently complex shuttering system for example CNC milled Styrofoam would be required.²⁶

Therefore a concrete only option was developed as the best option for the construction of the complex structure.

The concrete structure was designed with internal void formers to reduce the self weight (see photos on the right). Instead of using mild profile steel a series of parallel Warren trusses made of reinforcement steel are defining the geometry. Each sub panel of the catenoids defined by the crude mesh geometry - is cut parallel at various spacing. The so received planar curves deliver the geometry of the two chords of the respective trusses.

Void formers are placed in between and additional structural reinforcement is attached on both sides. Three layers of expanded metal sheets provide the formwork for the in situ self-compacting concrete. Finally, a manually rendered finish is applied on the rough surface (refer to diagram below).

The AGU unit at Arup explained that only with the help of tools specifically developed for the project was it possible to preserve the challenging architectural concept. By incorporating geometry processing techniques from other disciplines and linking them to structural analysis the boundaries of complex forms in construction are pushed to new limits.²⁷

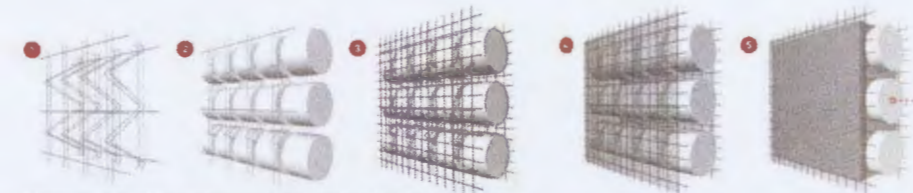


Diagram explaining proposed concrete shell construction



Prototype of the proposed Catenoid structure being assembled in a factory

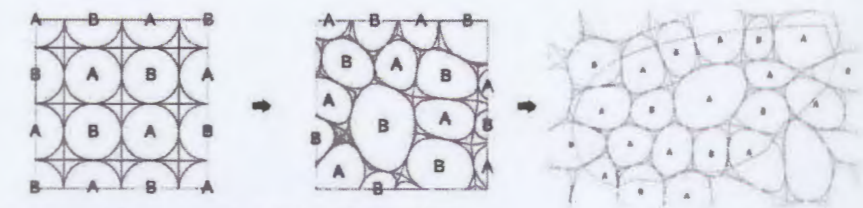
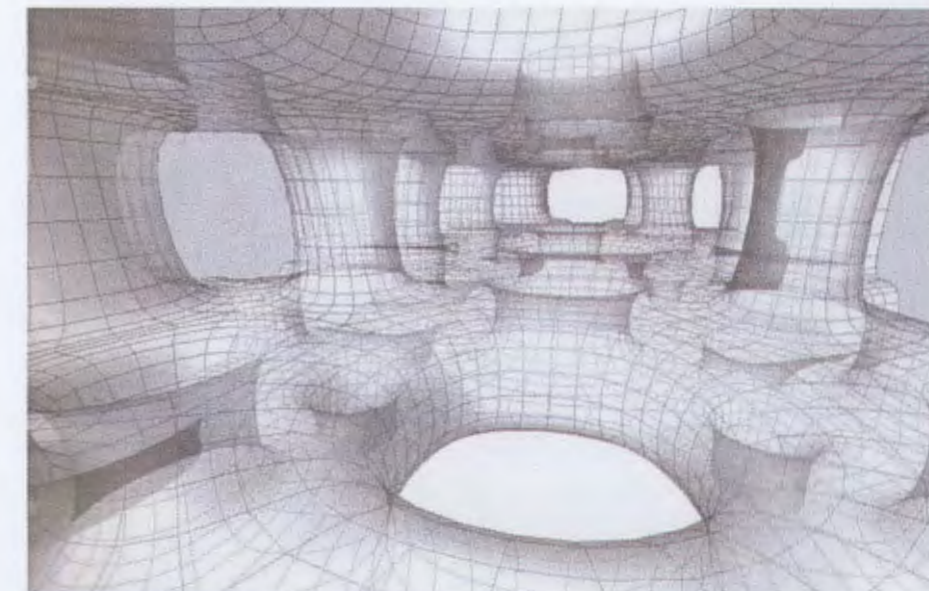


Diagram explaining the morphing of the grid (A&U, 2005)



Computer rendering of the wireframe showing the edge curves



The first rapid prototyping model of the structure

23 Cecil Balmond founded the AGU, (Advanced Geometry Unit) in 2000 as Arup's think tank; it is a multidisciplinary group of architects, engineers and scientists dedicated to researching complex structural geometry in support of new architectural visions and solutions.

24 Algorithm: A geometric or arithmetic rule that is repeated (Balmond, 2002)

25 Meredith, M & Sasaki, M, From control to design: Parametric / algorithmic Architecture, Actar, 2008, p.58

26 Meredith, M & Sasaki, M, From control to design: Parametric / algorithmic Architecture, Actar, 2008, p.58

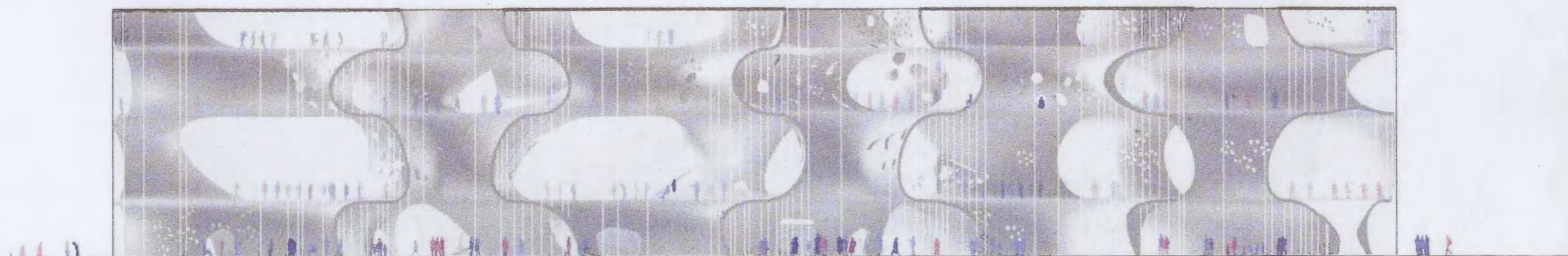
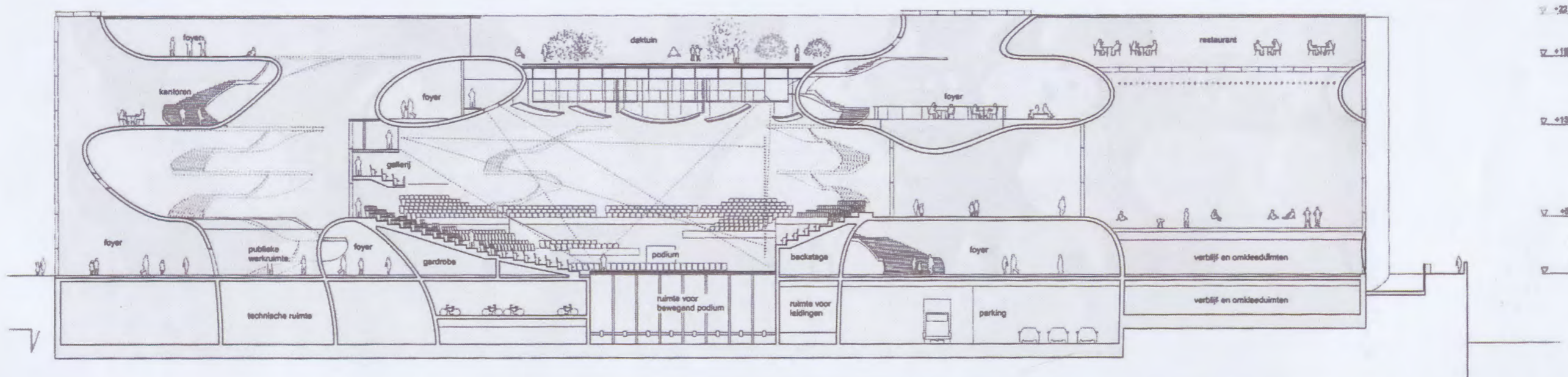
spatial experience:

Although the building is not built yet the spaces rendered through the models and drawings does show a porous building flowing freely into the surrounding urban environment. The building successfully blurs the boundaries of inside and outside, building and urban context, which Ito strove to achieve.

Ito's design for *The Taichung Metropolitan Opera House*, conceived as a "porous cityscape" depicts a building where the integration of the design idea, the structural principle and resultant spatial experience achieved a seamless continuity, where the original grid has completely disappeared.



Models depicting the porous building flowing freely into the surrounding urban context(A&U, 2005)



Continuous planes

"A line or a system that folds develops characteristics of the informal. Hybrid situations and juxtapositions arise propelled by the local, overlapping nature of the algorithm." - Cecil Balmond (p.119)

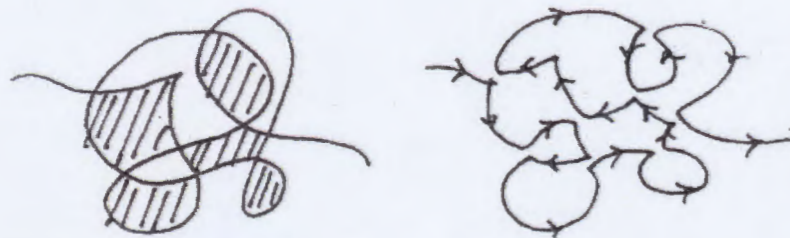


Diagram by Cecil Balmond explaining continuous planes or lines of structure (Balmond, 2002)

project 1: Arnhem Central Interchange, Arnhem, The Netherlands, 1996 2007

Architects: UN Studio

structural engineer: Cecil Balmond

design/conceptual idea:

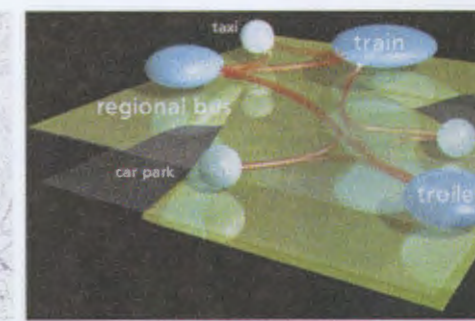
UN studio conceived the design as a seamless connectivity and flow between basement car park, concourse area and commercial offices.

At the *Arnhem Central Interchange* the bus terminus and train station are combined into a new type of complex an integral public transport area. The area is organized as a roofed-over, climate controlled plaza that interconnects and gives access to trains, taxis, buses, bikes, parking, office spaces and the town center.

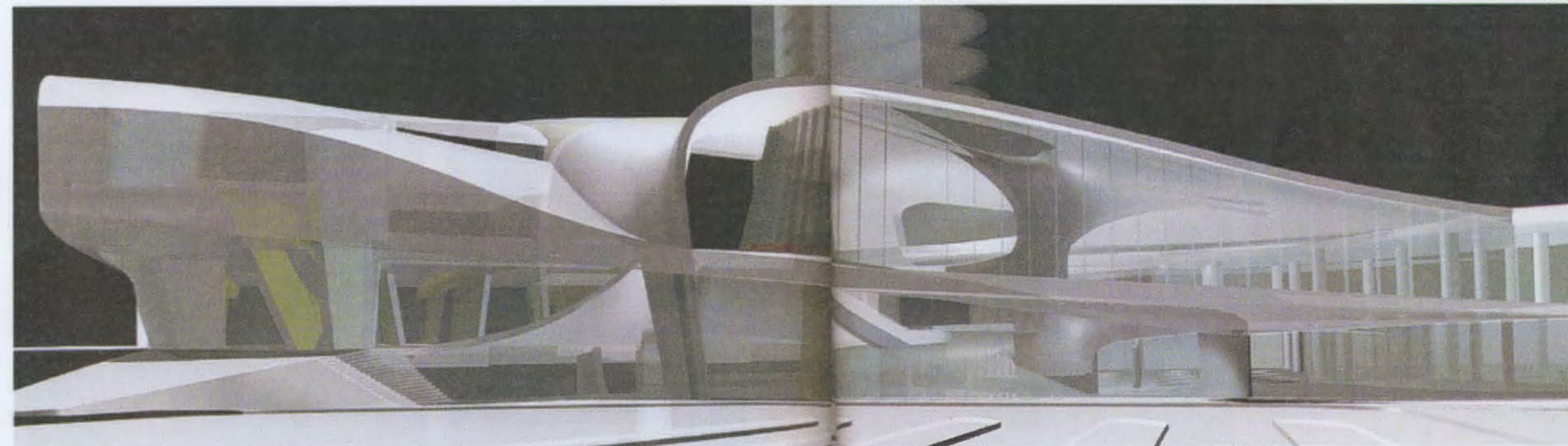
More than 65 000 people pass through the Arnhem Interchange every day; for many visitors the town starts here.



Site plan



integration of different transport modes (A & U, 2004)



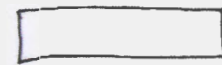
Computer rendering showing the attempted seamless connectivity between the different levels of the Arnhem Interchange (A & U, 2004)

structural idea:

The initial concern between Ben van Berkel, the architect and Cecil Balmond was:

How does one integrate the three separate layers of the program?

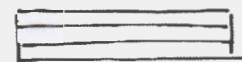
Commercial offices



Concourse area



Basement car park



In each case the demand on the grid was different – for the car park, a 15m grid; for the offices a much smaller grid of 7-9m while a column free area was desired in the concourse area.

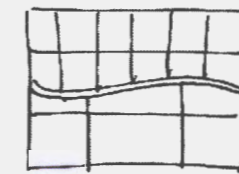
Balmond explained that the typical approach would assume space to be organized in vertical slices with the grids being taken as plumb lines. According to this typical approach the vertical continuity would be taken out through the transfer of forces. The vertical structure of the building would plunge down with load, while the horizontal structure would thicken up to bridge the mismatch.

Cecil Balmond speculated about a number of possibilities:

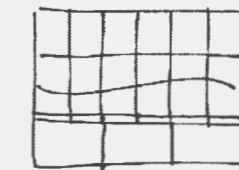
To drive the predetermined car park grid through the concourse level to meet the office grid and have the load transfer at office level.



To let the concourse level take out the clash of grids, but this proved not to be a good strategy, since curvature should not be adopted for transferring point loads.

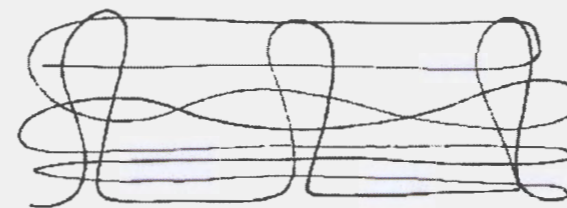


To allow the office grids to ride through producing columns in the concourse area, with major transfer at the car park level.



According to Balmond none of these proposals seemed right. He searched for a way to bring the concept of seamlessness through in a structural diagram.

Balmond explained, "We drew a line that moved up from the foundations to loop and coil over space."²⁹

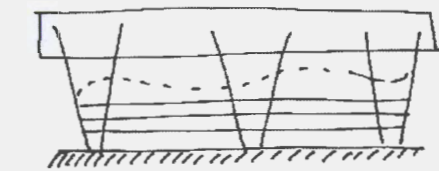
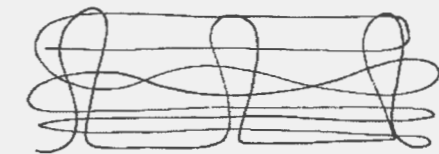


All diagrams drawn by Cecil Balmond (Balmond, 2002)

The final structural concept as put forth by Cecil Balmond proposed that the single row of column points at basement level should widen into zones, or regions, and initiate an upward movement.

He clarifies, that rather than serve as limiting points the lowest contact surface should be the start-up, and not a dead-end. Therefore, instead of an orthogonal framework, he suggested an improvising thread layered and folding over itself to become the concept for structure.

Balmond claims that through conceiving of structure as zones the need for transfer had disappeared.



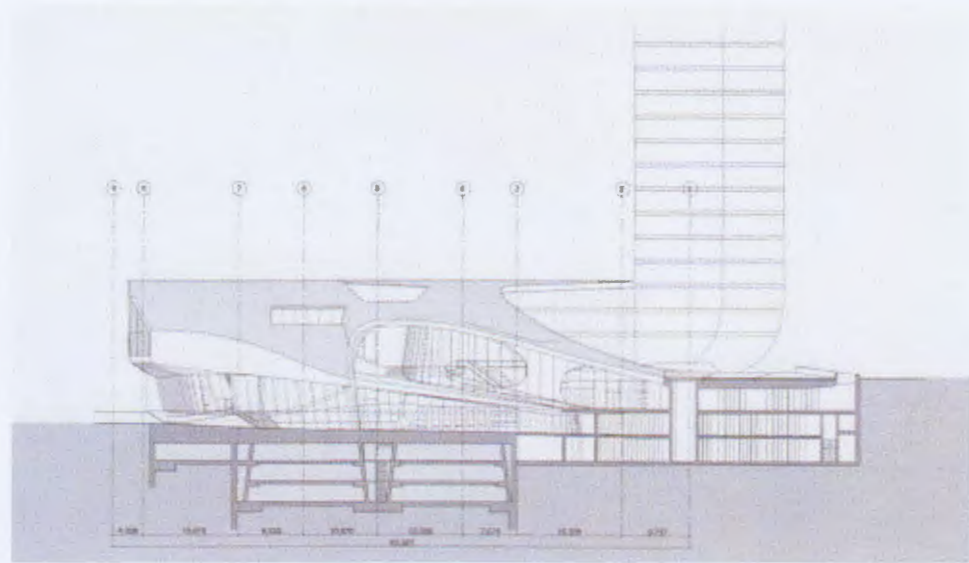
Diagrams explaining structure conceived as a folding thread interpreted as

Van Berkel is known for his ability to turn diagrams into thought provoking architecture. The diagrams were subsequently readily transformed into realization.

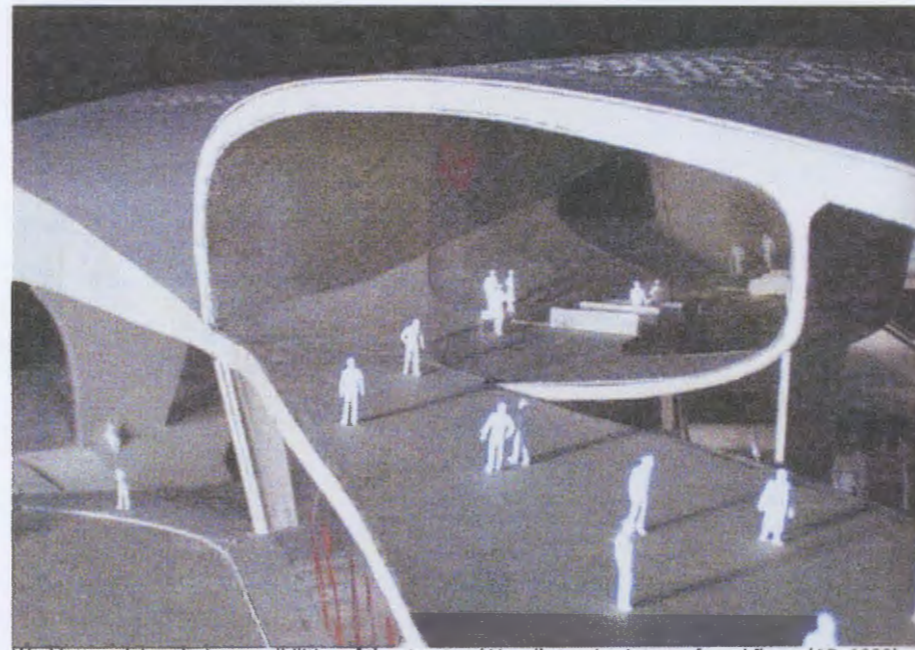
The loops turned into inclined V-walls. In the car park, shelves or corbels off the walls supported floor decks; holes cut out of the Vs gave pedestrians access from one side to the other. Parts of the walls folded over and stretched or merged at concourse level.

Higher up, the Vs were reduced to columns offering spans of around 10 meters for the office levels.

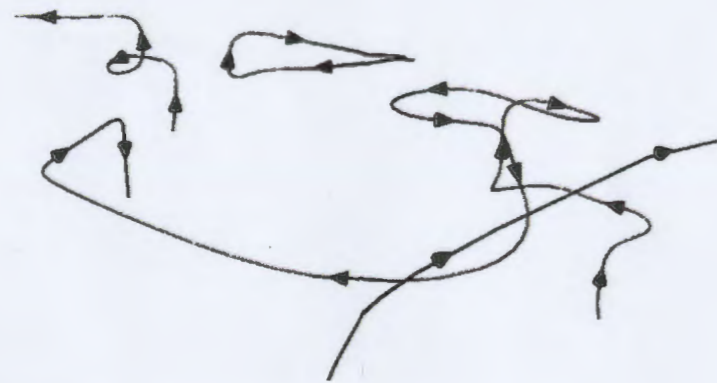
The V's were not only structural, but offered architectural and servicing strategies as well. The V's act as 'people collectors' they conduct light down into the car park offering vertical orientation for visitors. In other word the Vs integrate structure, light, people and technical services. Balmond refers to them as, 'Super Multiple-Organisers'.



Cross section showing inclined V- walls folding into floors and roofs (AD, 1999).



Working model exploring possibilities of the structural V-walls turning into roofs and floors (AD, 1999).



Diagrams exploring ways to generate structure from a folding line.(Balmond, 2002)



Photograph and computer rendering showing how the V's conduct light down into the building (A&U, 2004).

spatial experience:

The Arnhem Central Interchange interconnects and gives access to trains, taxis, buses, bikes, parking, office spaces and the town center. The intersection of different traffic systems is however reduced to a minimum in order to maintain good pedestrian accessibility to all the facilities.

Through the ordering system of the V's (integrating structure, light, people and technical services) pedestrians can find their bearings and choose their destination at a glance. This sense of orientation is enhanced by the penetration of light at essential points, such as the entrance to the station and the offices.

The design of the Arnhem Interchange succeeds in inextricably linking human movement, transport systems, light and structure in a continuous system.



project 2: The Jussieu University Library, Paris, competition, 1993

Architect: Rem Koolhaas **structural engineer:** Cecil Balmond

design/conceptual idea:

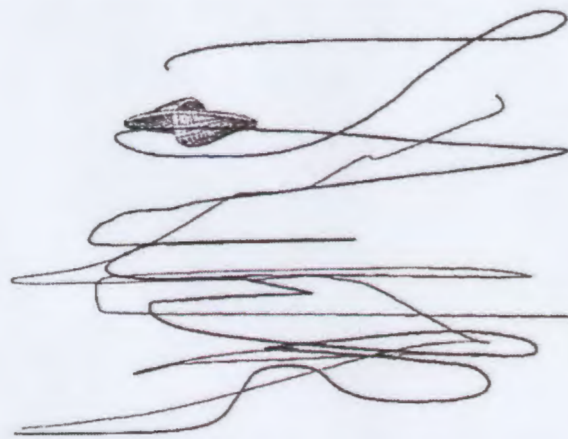
The Jussieu Library is conceived as a three-dimensional network, not a building.

The Jussieu Library challenges the conventional. Instead of a simple stacking of floors, the sections of each level are folded to touch those above and below. The result is that all the planes are connected by a single trajectory, a wrapped interior boulevard that exposes and relates all programmatic elements of the library.

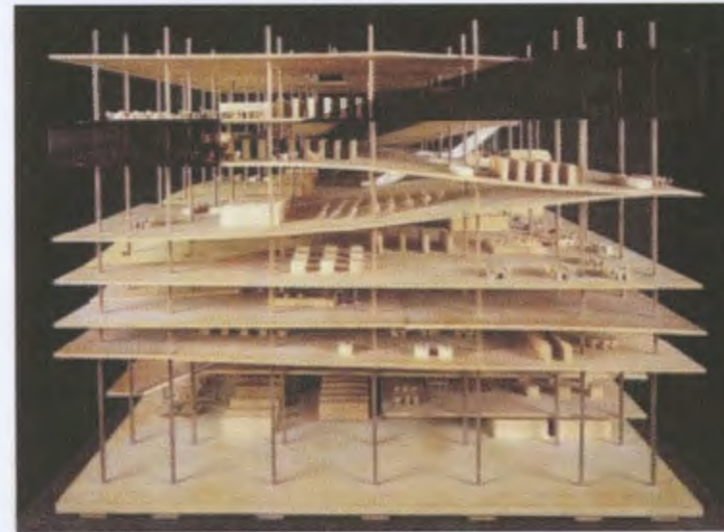


Conceptual paper models exploring a continuous floor plane (AA Files, 1993)

The design was conceived as a social 'magic carpet' which is folded to form a stack of platforms. In this way a single trajectory traverses the entire structure, like a warped boulevard, giving the advantage of visibility and accessibility to all the programmatic elements.



Conceptual diagram by architect Rem Koolhaas (Koolhaas, 2005)

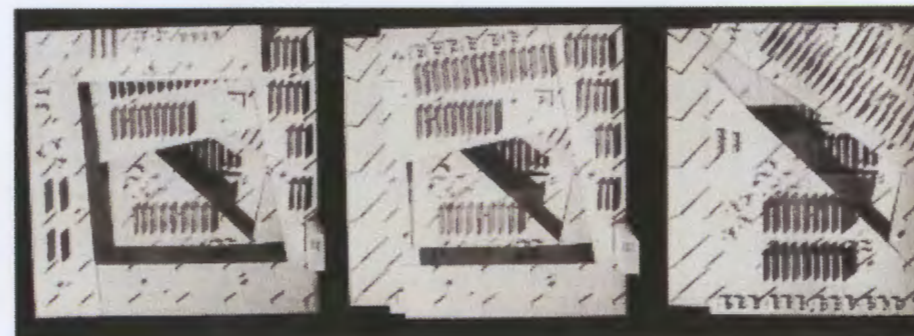


Working model showing connected floor planes (Koolhaas, 2005)

structural idea:

Cecil Balmond explains that in the structure of the library the vertical bracing of the building was released from the traditional lines of concentration and redistributed throughout the cross section as a scatter. This allowed the floors to lift and spiral.

Stability was given by a series of local interventions, coupling various discontinuities back to nodes, incorporating the slanting floor elements themselves as bracing elements.

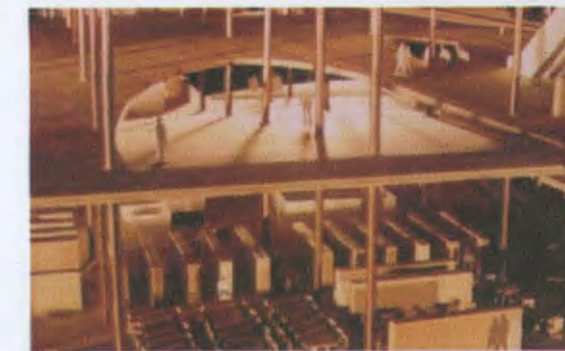


Models depicting continuous floor planes

spatial experience:

Through their scale and variety, the spatial effect of the inhabited planes becomes almost that of a street. Koolhaas explains that this boulevard generates a system of programmatic "urban" elements in the interior: plazas, parks, monumental staircases, cafes, shops.

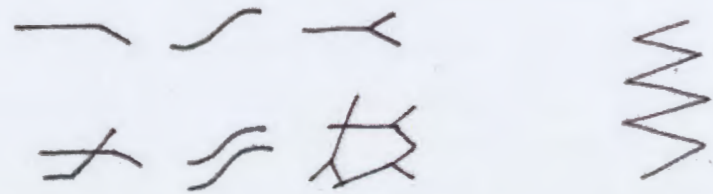
The visitor becomes a *Baudelairean flaneur*, inspecting and being seduced by a world of books and information by the urban scenario.



Model depicting the interior spaces depicted as urban streets (AA Files, 1993)

Structural skins

"The twisting-turning inside out of a moebius strip belongs to the informal. A roof that turns to wall, a floor that moves into column, a skin that is structure, where boundary is not border, is part of it."



Diagrams by Cecil Balmond exploring possibilities of structural skins (Balmond, 2002)

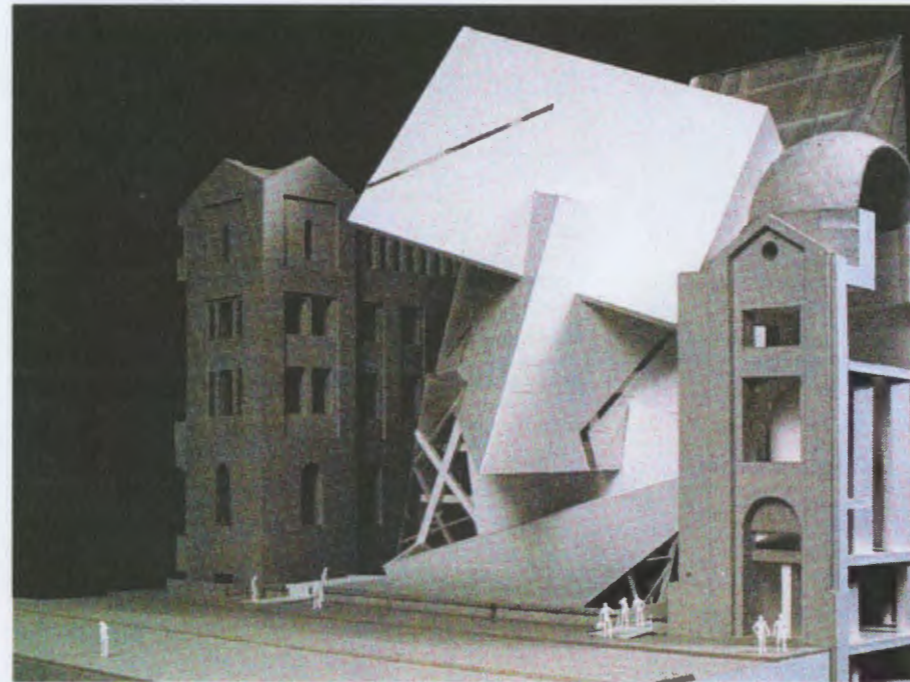
project 1: Victoria & Alfred Museum Boilerhouse Extension, London, 1996-99

architect: Daniel Libeskind

structural engineer: Cecil Balmond

design/conceptual idea:

The design is structured around three main ideas: the spiral movement of art and history; the inter-locking of inside and outside, and the labyrinth of discovery. The design aspires to translate these three dimensions into a coherent ensemble of functionally related spaces.



model of the V & A Extension (AD, 1997)

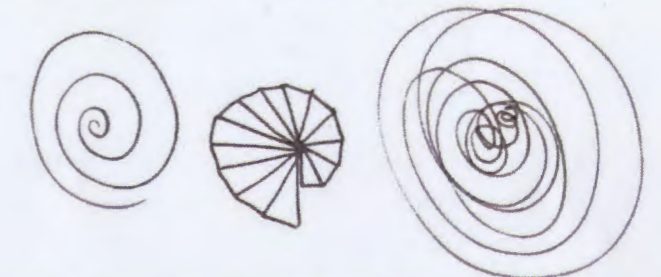


Site plan showing location of V & A Museum Boilerhouse Extension and concept sketch by architect (AD, 1997)

structural idea:

The structural concept for the building, as explained by Cecil Balmond, began with the idea of a 'chaotic spiral' as inspired by Libeskind's idea of the spiral movement of history.

Classical spiral forms revolve around fixed centering; both logarithmic and Archimedean spirals turn in ever widening orbits fixed by a continuous unwrapping of space. There are no discontinuities, no jerks and no jumps.



Diagrams by Cecil Balmond explaining the logarithmic, Archimedean and chaotic spiral (AD, 1997)

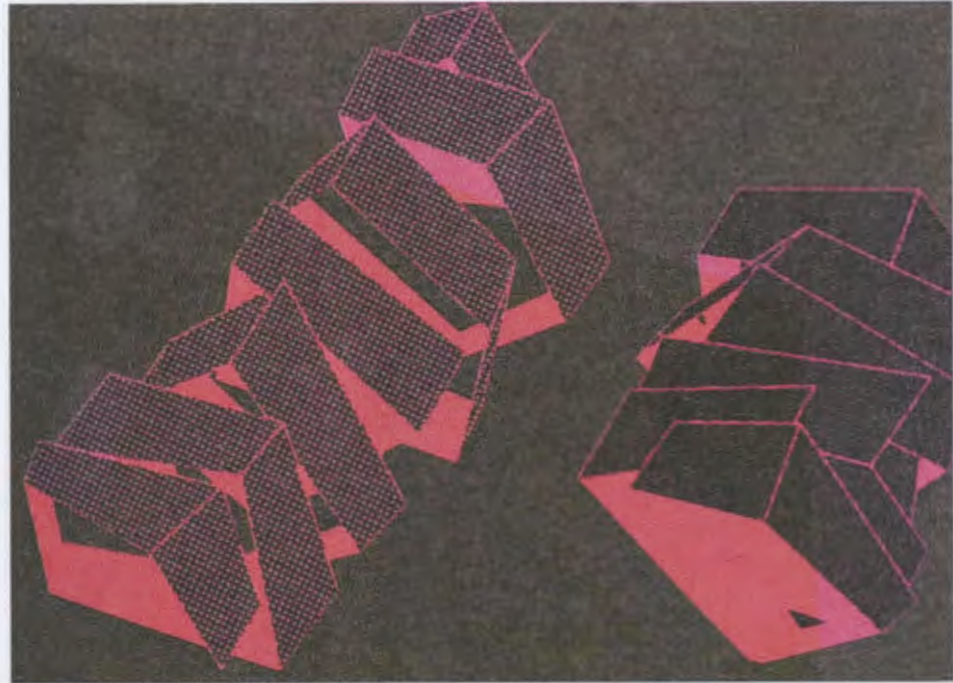
But the spiral of history is different, it is chaotic – its center moves, the orbits jump. The resulting rule is that of interlock and overlap.



Diagrams by Cecil Balmond exploring a pattern of a criss-cross spiral on plan (Balmond, 2002)

The 'chaotic spiral' was conceived as an evolving trajectory, crisscrossing space, continuous and open ended, spiraling upwards. The overlap of the lines became the cross-over points giving necessary bearing to the walls, which take their strength from the interlock.

The structure as it was 'builds' on itself, standing free; needing no internal core or extra braces. Floors act as diaphragms and columns do not penetrate the volumes, giving to the interior spaces a serene quality.



Computer renderings exploring the spiraling skin (Balmond, 2002)

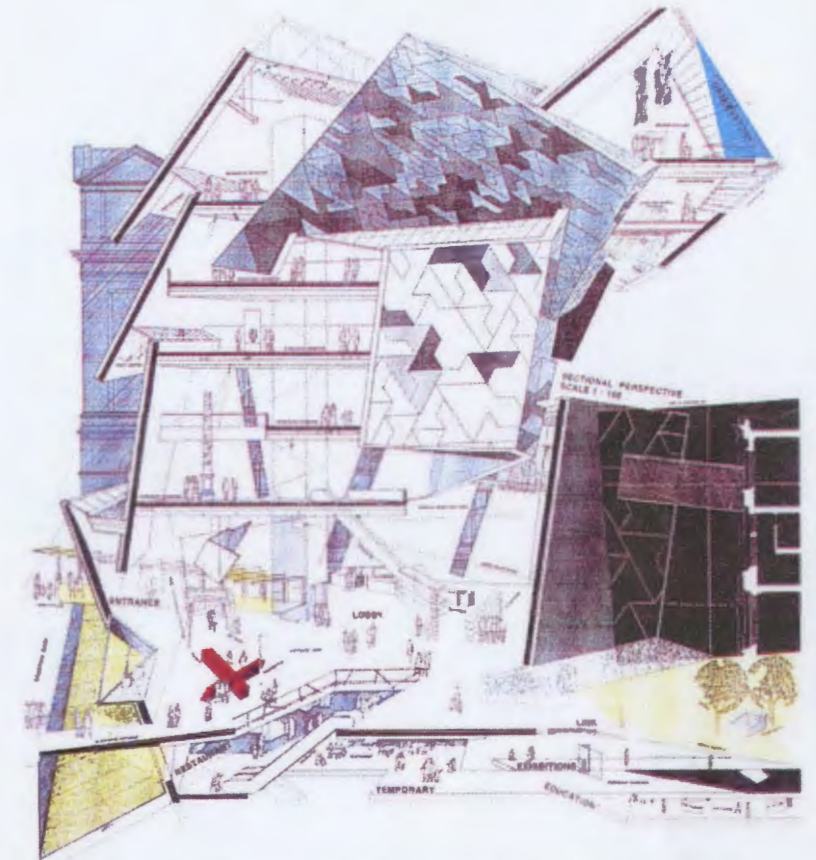


Model showing the concrete structure turning into glass at the top to let light in (AD, 1997)

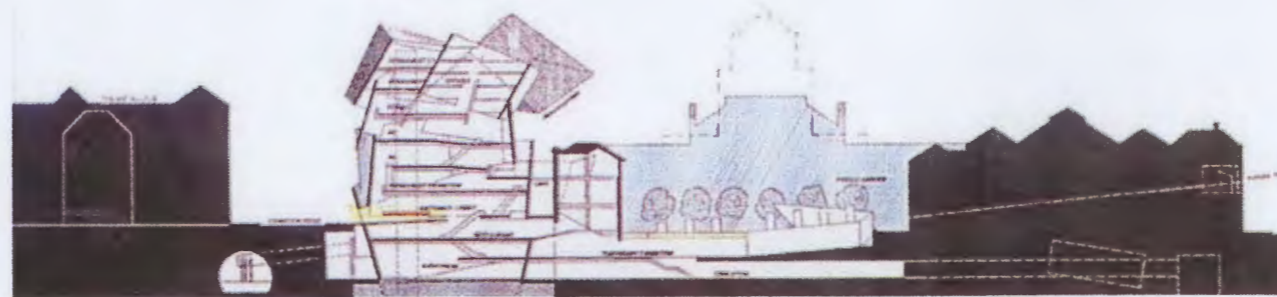
spatial experience:

Daniel Libeskind explains that the concept for the museum extension, the spiral of art and history, manifests itself in the overall form of the extension building and its circulation system. Visitors are implicated in a spiral movement as they circulate through the various functions of the museum. This movement distributes the public in a dynamic way to the rest of the museum through strategic connections and is a counterpoint to the horizontal movement in the existing buildings.

The structural skin results in an interlocking of the inside and the outside of the building by means of the winding and the unwinding spiral which brings the visitor into close relation with history and the present, the city and the museum, through a direct experience of interpenetrating views and histories. From the extension one sees ever-changing views of the existing facades and the skyline of London, while from within the old museum block one is re-orientated by the shifting movement of the new building.



One of the first perspective drawings Libeskind did to explain the spatial complexity of the building. (Architectural Review, 1996)



Section showing building's relationship to the context. (Architectural Review, 1996)

project 2: The Seattle Public Library

Architect: Rem Koolhaas

Structural Engineer: Cecil Balmond

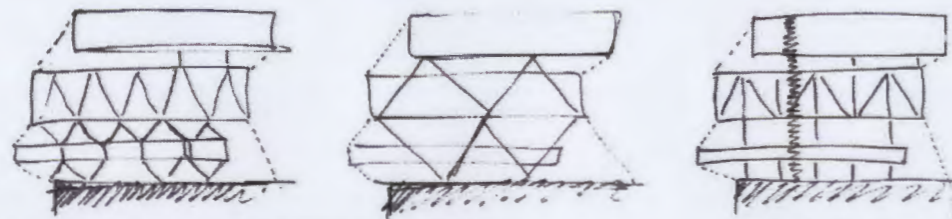
design/conceptual idea:

The building is divided into five horizontal layers, each varying in size to fit its function. A structural steel and glass skin unifies the multifaceted form and defines the public spaces in-between.

structural idea:

From the early conceptual meetings through to the completion of construction drawings, the structural system evolved through a very collaborative interaction between the architect, OMA and the structural engineer MKA and ARUP (Cecil Balmond).

Among the issues addressed between the architects and the engineers were the most effective ways to minimize the number of columns between and within platforms, use the structure's envelope or skin as its primary resistance to lateral loads, optimize the transparency and position of the envelope to manipulate light and shade throughout the structure. How to optimize the energy efficiency of a building with a complex geometry, soaring interior spaces, and extensive glass surfaces was also an issue.



Structural study sketches by Arup engineers (A&U, 2005)

From a structural design standpoint, one of the first considerations was the library's geometry. The building's five platforms are displaced vertically and horizontally to create ample public spaces and amazing external views. The Engineers devised a structural scheme that used the fewest possible interplatform columns (see red columns) and intraplatform trusses (see yellow trusses) and pushes the gravity and lateral forces of the enormous floating platforms to the edges of the building, thus maximizing the torsional resistance of the eccentric configuration.

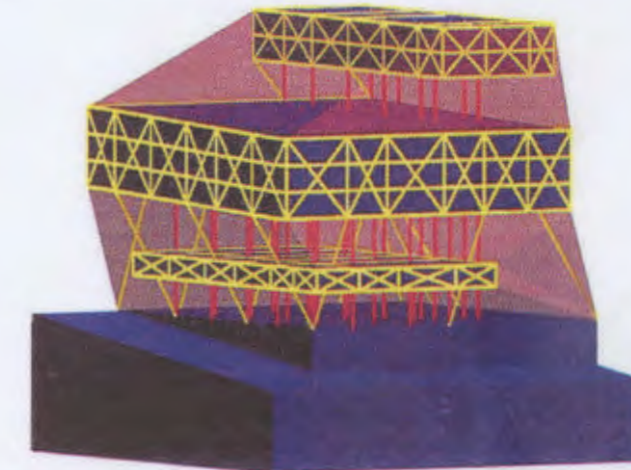


Diagrams showing five horizontal layers, wrapped in a transparent skin.



Photograph of Seattle Public Library, 2004

The building has three primary structural systems. The first, the concrete sub-structure, is located between 4th Avenue and 5th Avenue entry levels and houses the children's area. The second, the steel super structure, is located above the 5th Avenue entry level and houses the book collection and administrative offices. The third, the diamond grid skin, serves to envelope the building and tie the offset platforms of the steel super structure together in a "net-like" fashion (see figure).



Interplatform columns (red) and intraplatform trusses (yellow) (A&U, 2005).

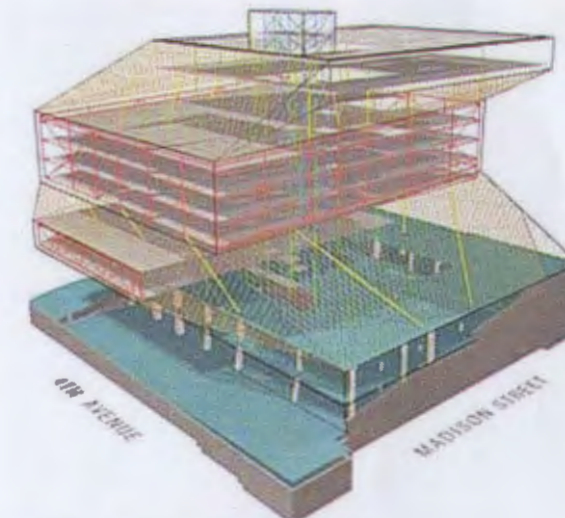
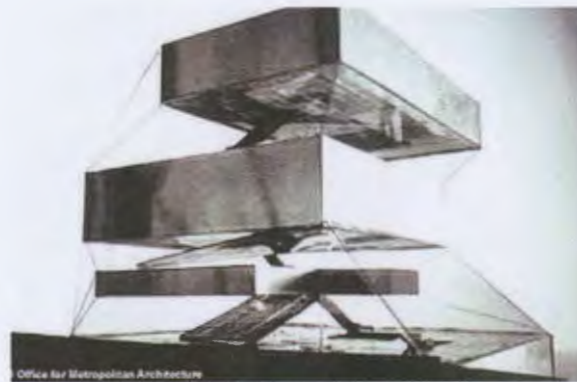


Diagram showing the three primary structural systems

Because the skin of the library is so critical to the building's structural performance linking the various platforms it was a primary focus of the early design process. Complex non-linear analyses were performed to determine a framework that could mitigate the lateral movement of the platforms and numerous studies were conducted to find a geometry and material for the grid's mullions that would optimize both light and shade.

Through many studies a grid density for the sloped structural steel diamond-grid-skin (see figure) was developed that could support a very fine façade system while transferring both wind and seismic loads. The façade system was then modified and adapted in many aspects to accommodate the performance and geometrical specificity required in each distinct location.



Office for Metropolitan Architecture
Early model showing the different platforms linked through the structural skin.



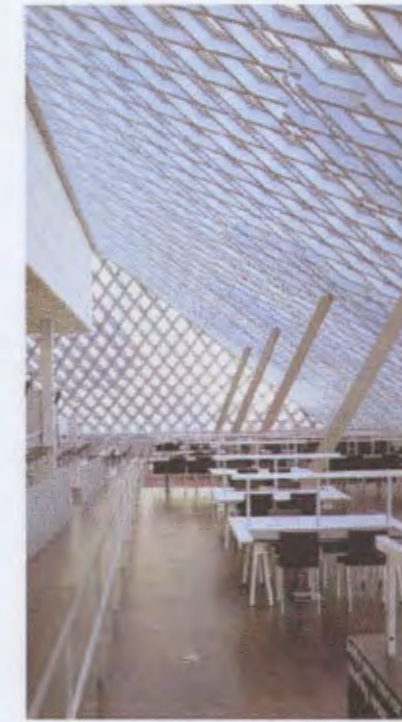
Interplatform columns (red) and intraplatform trusses (yellow) (A&U, 2005).

spatial experience:

The structural skin while mitigating the lateral movement of the platforms also results in creating serene interior spaces, orientated towards beautiful views of the city. The skin has been adapted according to its orientation through high performance glazing, thereby allowing a soft dappled light suitable for reading.



Interior view showing slanted diamond-grid-skin



Interior view showing soft light penetrating through the glass skin.



Conclusion

Challenging the grid

Project 1: Serpentine Gallery Pavilion by Alvaro Siza

Project 2: Taichung Metropolitan Opera House by Toyo Ito

Although the above mentioned projects do reflect a very innovative approach to structural design, it became evident that the grid or the modern (Cartesian) way of conceiving structure is still evident in the projects.

The Serpentine Gallery, although innovative in form, is a very literal, but morphed grid. The real innovation in the Serpentine Gallery is the connections of the grid, as Balmond described, *“Each point on the grid is allowed a charm live”*. The Taichung Opera House proposed a more radical challenge to the Cartesian grid, the final form of the building did not resemble a grid or Cartesian rationalism in any way, but it nevertheless started out with a grid.

It is perhaps rather the innovative manipulation of the grid that resulted in interesting structures and spatial experiences in these two buildings.

Continuous planes

Project 1: Arnhem Interchange by UN Studio

Project 2: The Jussieu University Library by Rem Koolhaas

It became evident in the Arnhem Interchange that there will always be a need for the grid in a building (as with the basement parking). The innovation of the Arnhem Interchange was a result of manipulating the rigid structure of the basement parking into the free flowing concourse area.

Structural skins

Project 1: Victoria & Alfred Museum Boiler house Extension by Daniel Libeskind

Project 2: The Seattle Public Library by Rem Koolhaas

The V & A proposed a very radical challenge to Cartesian derived structure. In this building Balmond's notion of a structural plane rather than a structural grid became evident. The Seattle library is not there exist a combination between the Cartesian derived structure, the column and beam structure supporting the platforms and the folded plane of the structural skin.

To conclude these projects do indeed propose innovations in structural design, what is particularly impressive to me is the strong relationship between the conceptual idea, the structural principle and the resulting spatial experience of these buildings they are all inextricably linked.

The Result: an structural and design integrity in the establishing of a free shapes.

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