Architectural Knowledge: the way that architects know and use knowledge embedded in design

Louise Wright
B. Int. Des., B. Arch.

A thesis submitted in fulfillment of the requirements for the degree of Doctor of Philosophy

School of Architecture and Design
RMIT University
April 2012
Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; and, any editorial work, paid or unpaid, carried out by a third party is acknowledged.

Louise Wright
DATE
Acknowledgements

Ageing of Aquarius Project
This thesis makes an exegesis of the process and method used in the Australian Research Council project ‘Ageing of Aquarius: designing new housing solutions for Australia’s Baby Boomers.’

The Chief Investigators of this project were Shane Murray, Peter Downton and Mike Berry. Simon Whibley was a Research Assistant. I was a Research Assistant and Australian Postgraduate Award industry recipient. I was involved in all aspects of the research.

Case Study Analysis Material
I collaboratively carried out with Simon Whibley:

Richard Hui, Bradley Wray, Nick Murray, and Ben Inman assisted in drafting and production on the above Studies.

I independently carried out:

Thesis
I acknowledge those involved with the Ageing of Aquarius project as formative to the foundation of this thesis.

I thank Peter Downton, my Supervisor, whose insight disguised in stories and great wit I couldn’t have done without. I also thank Shane Murray my Supervisor, Mauro Baracco and Catherine Murphy who encouraged and advised me invaluably.
## Contents

1   Introduction

**Part 1**

11  1.1 Unpacking the Themes
13  1.2 Unpacking the Case Studies

**Part 2**

39  2.1 Architectural Knowledge
49  2.2 Setting the Context for Inquiry
61  2.3 Revealing Architectural Knowledge
75  2.4 Application and Transformation of Architectural Knowledge
93  2.5 Extension to Practice

**Part 3**

118  Case Study Package

**Part 4**

391  Conclusion
397  Glossary
401  Image Credits
403  References
Abstract

This thesis uses case study analysis to discuss the nature of architectural knowledge, how architects know and what it is we know. I discuss the flexible way architects think to transform knowledge accessed in existing designs into new knowledge and the value of this type of thinking.

Through case study the architect can see their problem at hand, often in a completely different set of circumstances, as a sort of abstract concept, they then can apply that solution in a new and different context and integrated new whole. I describe this ability as afforded by the flexibility of design thinking. I argue that concentrating on this part of the design process contributes to an enhanced ability to inquire and apply flexible thinking and, by interrogating this method for its impact on my own practice, makes a valuable contribution to the design process. This thesis raises possibilities for further research as to how we teach architecture and the wider application of the mode of flexible thinking undertaken by the designer.

The thesis is structured around a series of case studies, many of which were carried out for an Australian Research Council project: The Ageing of Aquarius. I was involved in this research and carried out a significant amount of the material presented here. Over the many years it has taken to develop this thesis, I have been able to reflect on this material and use both the case study research method and knowledge revealed in the case study analysis in my own architectural practice.

The use of the case study by architects, or the capacity to ‘see’ the embedded knowledge in a design, demonstrates how the capacity to design and to understand design are interrelated (Ulusoy 1999, 126), they have in common the ability to think in abstract terms – visually decoding the relations among spaces in the visual conceptualisation of these ideas, usually through the plan. They use an understanding that is passive yet technical and rational to analyse and evaluate existing designs. Yet this evaluation is not instructive to them – it does not point to the way to create a new design. This is a distinguishing factor of the way that case study is used by architects. The ‘how to design’ can only occur through the action of designing. The knower is active (Ulusoy1999, 217). This point also accounts for the difficulty architecture has in accounting for its methods and contribution. This ‘explanation’ is supported in the presentation of the same concepts achieved through multiple arrangements in plan across different case studies and the development of new iterations of the knowledge through new design.

A graphic method was developed to reveal what is known by the architect in the case study. The method of articulation validates this aspect of how the architect knows as well as revealing what is known. By presenting the application of this knowledge in new designs I have undertaken, I argue that this research has led to an improved understanding of architectural knowledge and ability to transform it.

I argue that the method developed in the case studies to communicate what is ‘known’ within designs contributes to knowledge capture and articulation and validates the architect as the knower and the existence of a disciplinary knowledge base. I reflect on how the process of systematically analysing and articulating disciplinary knowledge has contributed to my own practice as an architectural designer through the transformation of knowledge in my own architectural practice.


Ulusoy, Z. “To design versus to understand design: the role of graphic representations and verbal expression”, in Design Studies, Vol. 20, no. 2 March 1999, 123 –130.
Introduction

The articulation of its tacit knowledge has not been widely tackled by the architecture profession. Largely because the knowledge is dynamic, and because architects would argue that they know it already and its articulation is not necessary. Also, it is not enough to describe what is known. The nature of the knowledge must partly be described through the architectural language of drawings and diagrams which further obscures its articulation. The benefits of studying and revealing architectural knowledge are multiple; development of techniques for revealing tacit knowledge and therefore the validation of a disciplinary knowledge base, development of design research processes of how to design and how to inquire, and development of architectural practice and education.

To articulate tacit knowledge has been described as requiring observation and "bringing it to surface"\(^1\). My thesis develops a technique for the articulation of architectural knowledge in 30 architectural case studies and reflects on its application to my own architectural practice.

The origins, where I started

This PhD began its life when I was part of a research team at RMIT University. The research project, *The Ageing of Aquarius: designing housing solutions for Australia’s ageing baby boomers*, embedded the architect within a team of researchers from the social science field and together we carried out primary and secondary research about the baby boomer cohort and the Australian housing system with the aim to design housing solutions that would meet the needs of this group within an Australian context of housing provision.

The aim of the cross disciplinary research method, was to place the designer in a leading position in the research much earlier than they would normally be. It was proposed that the designer may then be able to develop meaningful housing solutions by drawing upon their knowledge base that could address the issues identified. The way that this worked was that by exposing the designer to the data that would traditionally lead to a brief (the point at which the architect is usually involved) – identifying needs to be met by a design – the design may be able to circumvent the constraints and issues that pre-form the needs. For example, a brief may require three bedrooms. However, if a designer is exposed to the originating parameters,
being say that the bedrooms are needed to accommodate adult children who return home periodically, the designer could design spaces that can change to accommodate either a bedroom or alternative use. One could say that this is just involving the architect in brief development, which is a practice that commonly occurs. However, in this role, the architect also actively sought out design solutions to the issues identified in the background data by using a research method involving case study and the development of a technique described here as a matrix: an environment where something develops (refer p.50 for a detailed description). An expanding list (refer fig 31. p.53) admitted information obtained through case study to propose design-based solutions to the issues identified. This led to a wider range of possible solutions than would normally be proposed in brief development and the design process. The formalising of a process for the admitting of case study analysis, the method applied in the matrix research method is where a type of thinking described by Cross (1982, 221) as designerly thinking takes off in this research – a term explained further in Part 2.1 Architectural Knowledge. It is then used and demonstrated through the case studies and application and transformation of case study analysis in my own work.

This thesis presents many of the case studies carried out for the Ageing of Aquarius project and 6 additional further studies as a body of original research. The observations, reflections and conclusions of the PhD centre around the outcomes of the research method and application of the research outcomes. It unpicks a selection of studies that have influenced my own design work and thereby demonstrate designerly thinking in practice. The extension of the original case studies carried out as part of one research project, for its relevance to my own work assists the discussion of the nature of architectural knowledge being transformative.

This onion like research has been difficult to pin down into a clear set of research questions and answers. The thesis developed initially as an exegesis of the Ageing of Aquarius project and some of this material is presented in Part 2.2 Setting the Context for Inquiry to provide a background to the case study research. The time taken to this point – many years – has
consequentially been important as it has allowed the application of this research – both its method and outcomes – to my own architectural practice and teaching.

Unable to distill a single question/answer I have chosen to present the layers of research, discussing the method, and drawing connections and conclusions where they arise.

What I ended up doing
While the issues facing the diverse baby boomer cohort were the focus of the Ageing of Aquarius project, at the same time an argument was being indirectly made for the role of the designer, the existence of a disciplinary knowledge base of architecture, and *designerly thinking*. These are the notions that my PhD seeks to make explicit.

Using the case study analysis I discuss the nature of architectural knowledge, how architects know and what it is we know. I argue that the graphic and written method developed to communicate the design concepts validates the architect as the knower and the existence of a knowledge base. I reflect on how the process of systematically analysing and documenting disciplinary knowledge has contributed to my own practice as an architectural designer by analysing the application and transformation of the knowledge base in my own architectural practice.

Architectural knowledge and the use of case study
Architectural knowledge almost always exists as and is an extension of existing design knowledge in a kind of perpetuating cycle. This comes about through one of the key parts of the design process – the use of the case study, or precedent. Existing projects embody the discipline's knowledge base and architects consistently refer to existing designs which can be whole or partial pieces of designs.

This is an opportunistic moment to explain to the reader that the terms architecture, architect, design and designer are used interchangeably. It is acknowledged that architecture is a form of design and the architect a designer, but at the same time that architecture has its own particular

---

Passive Flexibility

Work from Home
An independent entry and appropriate amenity provided by glazed doors to the courtyard creates the possibility for a suitable work environment.

The direct connection to a bathroom and the possibility to circulate through the courtyard, separates work and private areas of the dwelling.

---

Architectural knowledge and the use of case study

Architectural knowledge almost always exists as and is an extension of existing design knowledge in a kind of perpetuating cycle. This comes about through one of the key parts of the design process – the use of the case study, or precedent. Existing projects embody the discipline's knowledge base and architects consistently refer to existing designs which can be whole or partial pieces of designs.

This is an opportunistic moment to explain to the reader that the terms architecture, architect, design and designer are used interchangeably. It is acknowledged that architecture is a form of design and the architect a designer, but at the same time that architecture has its own particular
knowledge and processes not common to all designers.\(^3\)

Without specific articulation, the architect ‘knows’ the value of an element of a case study. The form of ‘study’ is often quite informal and not articulated. This ‘knowing’ is a link made between the design and what it solves or enables as the case may be. It is a thought process that relies on projection (as in to think ahead) by the architect of that embodied knowledge to their own issue at hand, and may not even be the originating intention of the case study designer. The capacity to ‘see’ or ‘know’ embodied design knowledge, as well as ‘project’ are key elements of the design process – the architect’s primary mode of practice – and are largely implied and undocumented. These ideas are discussed in more detail in Part 2.1 Architectural Knowledge to the ends that they are meaningful to this thesis and are not intended to be an investigation of the literature.

The definition of architectural knowledge, or what it means here, was positioned in the originating Ageing of Aquarius project and has been followed through in the thesis.

Having said that, the type of architectural knowledge I identify is expressed primarily through the plan. It consists of partial pieces, or individual concepts, within a whole design project. It has been argued by Macarthur among others (1999:unpaginated) that the plan can be traced as a consistent artifact embodying architectural knowledge: “...in the plan we can see a base level of continuous stable development in architectural practice and technique across the nineteenth and twentieth centuries” and “...[historically] the plan no longer had a coherence as a pattern recognisable to a lay viewer; it became a code, a kind of spatial notation that could be read only by architects.” Plan disposition, spatial relationship, aspect and orientation draw on architectural knowledge. To propose recombined or new and innovative forms for their arrangement employs architectural skill. In this act (of designing) the architect draws upon this knowledge embodied in previous designs as well as developing new iterations, and therefore creates new knowledge. In this way architectural knowledge is dynamic and could be described as elusive, being known momentarily before it is transformed.

---


5 Ibid p. 96.
Although architecture is ultimately spatial (3 dimensional), it could be argued that the plan is critical to the functioning of the space. When architects design they do not always start with the plan as a rule, but it almost always is the principal method for codifying the spaces defined, their relationships, testing the arrangement, and integrating components. While a lot of architectural quality, and often use, is reliant on the section, the plan usually is the principal organising method.

While not unique to architecture, the use of the case study is a primary tool of the architect and embodies the necessary knowledge base of the discipline. As Lawson recognises, "Precedent is such a vital, central and crucial feature of the design process that it plays a central role in all design education." It is unusual in that this knowledge is constantly transformed and contextualised yet still recognisable to the architect. This aspect renders articulation difficult, never ending and open to infinite variations and very inaccessible to an audience outside the discipline. The same piece of design knowledge can be transformed countless times in new contexts taking on new physical forms. This is why design-based knowledge is difficult to capture and communicate, and why architects do not have the same systematic processes and accessible knowledge base of many other disciplines. Rather, it takes a built up experience to be able to 'see' it. The plan, in its complete form, is the result of the integration of all these different types of knowledge that comprehensively address the competing aims and requirements. As each plan is 'new', new knowledge is embedded there.

The use of the case study by architects, or the capacity to 'see' the embedded knowledge in a design, demonstrates how the capacity to design and to understand design are interrelated (Ulusoy 1999,126), they have in common the ability to think in abstract terms – visually decoding the relations among spaces in the visual conceptualisation of these ideas, i.e.: the plan. They use an understanding that is passive yet technical and rational to analyse and evaluate existing designs. Yet this evaluation is not instructive to them – it does not point to the way to create a new design. This is a distinguishing factor of the way that case
study is used by architects. The ‘how to design’ can only occur through the action of designing. The knower is active (Ulusoy 1999, 217). This point also accounts for the difficulty architecture has in accounting for its methods and contribution.

The thesis offers a demonstration of the dynamic nature of the knowledge supported in the presentation of the same concepts achieved through multiple arrangements in plan across different case studies and the transformation of the knowledge by the knower into new iterations of the knowledge in new designs.

**Thesis composition**

The thesis centres around the case studies. However, the discussion around them comes from many directions, all equally important and with their own contribution to the thesis. It has been difficult to articulate them neatly as singularly defined ideas as well as a sequence that may occur say in a scientific type of research. For the sake of clarity, I could have structured the thesis to reflect a historical sequence being: description of the research that led up to the development of the case studies, the case studies themselves, and then how the knowledge captured in the case study analysis was applied to my own design work. I did try this, where the case studies were presented as a separate package to this discussion. While explanation of what was done and why could sit separately, the coming together of the case study material with the various arguments, required an evidence based discussion where the example was close at hand and the point explicit.

The presentation of the case studies as a package, discrete from my reflections and discussion was a hangover from the background project. The presentation of the material in this way sat as an exegesis of a body of research: 30 case studies around 8 pages each which document analysis of housing designs through text and diagrams, revealing the way that (mostly) plan based arrangements impact on the way the house can be used. The presentation of the material in this two part way was a hindrance to the reader, and to my own interrogation of the material. It meant that I could
not get 'close' to the material I was discussing and did not really point to the evidence but rather discussed it abstractly leaving the reader to hunt for it within the case studies. It wasn’t until I started to dismantle the package, matching up my discussion of what was happening through the example of the case study, that I could really start to explain the concepts and themes that developed out of doing this research, rather than just explaining what came before and what was done. The structure of the thesis, therefore, starts with an expanded unpacking of several case studies in Part 1 Unpacking the Themes, where all the ideas and proposals of the thesis are introduced. They are ideas of the knowledge at play in order to be able to carry out the analysis and transform it rather than the information revealed by the analysis itself: what is happening, what type of knowledge and what are the consequences of carrying out the case study. In this way the case study material is extended beyond the originating project.

In the second section, Part 2, ideas and notions introduced in the Part 1 are discussed in more detail. As noted, Part 2.1 discusses the notion of architectural knowledge for how it relates to this thesis. The history of the case studies, how they came about and why they were chosen is suspended until Part 2.2 Setting the Context for Inquiry. The discussion in this section of the part of the original project referred to as the matrix is important, it addresses the origins of the thinking behind the thesis.

Part 2.3 Revealing Architectural Knowledge discusses the contribution of the method for capturing the knowledge. It compares the graphic method and distinguishes it from others. This aspect of the thesis recognises that the importance of knowledge capture to many of the arguments set out here.

In Part 2.4 Application and Transformation of Architectural Knowledge, I elaborate on the ideas of knowledge application, transformation and new knowledge creation by analysing the Adaptable House and Multi-family House, designed with benefit of the case study material by members of the original research team and using the same analysis method as carried out
in the case studies. This is expanded through the presentation of two more recent projects by myself, the Rose House (2009) and Fitzroy Community School Creative Space (2011) in Part 2.5 Extension to Practice to show the development of an approach to planning that could be placed in a trajectory of the case study material.

In Part 1 and 2, case study material is included where relevant to the argument. The reader will find that some case studies are discussed more than others, and some not at all. Their inclusion as a package however does comprehensively demonstrate arguments of the thesis and warrant close examination, but the explicit discussion of each does not necessarily benefit the argument anymore than the detailed discussion of a selection. The full set is presented as a package in Part 3.0, being a significant contribution in its own right to the capturing of design knowledge, methods of knowledge articulation and the actual design of housing.

Although there was a team of researchers, a significant amount of the analysis was carried out by me and I was involved in all aspects of the research method.

There are overarching contributions of the thesis, but also many other secondary conclusions of relevance, often in the form of issues raised for say education of architecture as well as issues of knowledge capture. These conclusions, limitations and opportunities for further research are spread throughout the document as they occur and create a fine grain texture to the thesis rather than a finale. However, for clarity, a summary of these is given at the end of the thesis.
1.1 Unpacking the Themes

In the introduction I described how the case studies were at the centre of the thesis. Their role is two fold: the captured knowledge in the analysis, and all the method, issues, and consequences associated with their existence.

This first section presents several case studies: Napier Street Townhouses, Farfor Houses and the Furlan House. Their analysis is expanded and the design concepts explained. This section could be thought of as a concentrated presentation of the thesis itself presenting method, research, issues, limitations, conclusions and opportunities for further research non hierarchically woven into the discussion. This approach captures the tangle of issues more narrowly, both opening the door to an elaborated discussion in the following sections and introducing what the case studies are all about.

If we remember that the case studies are the device used to weave the broader discussion, the following issues and themes are introduced in this section:

- the nature of architectural knowledge
- an architectural knowledge base
- the way that architect’s know and what it is they know
- flexible design thinking or designerly thinking
- articulation and capturing of architectural knowledge
- an example of design-based research in pre-design processes by applying architectural processes
- application of architectural knowledge.

In the introduction, I stated that the type of architectural knowledge I am referring to is primarily plan based, being what the planimetric arrangement allows, and the interconnectedness of parts of the plan as a whole. The case studies show and explain how the particular arrangement enables the house to be used in certain ways. Sometimes these are physical
consequences, for example: the inclusion of a door that connects to the outside in a room allows that room to be accessed separately to the rest of the house. Sometimes consequences of the arrangement effect the users 'life opportunities': the capacity to enter the room separately from the rest of the house through the door may enable renting of that room to a third party, or the use of the room for a home office. This consequence has an effect on income. It was this type of connection that the Ageing of Aquarius sought to make by placing the designer in a leading position in the research by using case study to 'see' solutions.

However, there's more to the concept than just the door: the door has to be easily accessible and therefore its success is paired with its location on the site; the room may need a kitchen and bathroom located adjacent to effect the work/rent option and so, is related to the arrangement of the services in the house.

The ability to recognise the element and its web of connections in another project referred to as a case study is one way that the architect knows. By accessing what is referred to as a knowledge base, which is embedded in architectural designs, what the architect knows, a second but related type of knowledge is used to transform the accessed knowledge into a new design – how the architect creates new knowledge. This is demonstrated through the discussion of the application of the case study material to some of my own design work in Part 2.4.

I would argue that the ability to identify spatial arrangements and apply them in new contexts, transforming the arrangement to suit the new context and thereby potentially altering and creating new knowledge is disciplinary specific knowledge. If one considers that each new design
1.2 Unpacking the Case Studies

is unique, responding to the particular scenario and circumstance, the notion of this type of knowledge is seemingly inexhaustible.

The unpacking of what is identified in the case studies explains the type of knowledge primarily studied: arrangement or plan disposition. The expanded discussion pauses the discussion around the case study to singularly discuss what is being analysed, i.e. what is the knowledge?

Napier Street Housing

The following unpacking of the Napier Street Housing by Kerstin Thompson Architects in Fitzroy, Melbourne, introduces several themes; the development of the graphic technique used for the studies so critical to the articulation of the embodied knowledge and validation of the architect as knower; the integration of the concept within the whole, and the notions of plan adjacency and configuration as central components of architectural knowledge.

In this Case Study the concepts are identified under the categories:

- **Site Siting shape:** Individual/Collective Housing
- **Internal Configurations:** Passive Flexibility, Alternative Configurations: Internal
- **Internal External Relationships:** Alternative Configurations: External

The categories described above are part of a larger set of categories used to catalogue the analysed information.\(^6\)

This design enables passive flexibility of spaces (e.g.: for use as a bedroom or living space as well as a workspace) achieved through plan adjacency, window placement and material choice; a greater degree of independence between residents by separating bedrooms across floors facilitating separate households and, a high level of amenity in a dense development through the outdoor space arrangement. These aspects address how

\(^6\) These are defined in a glossary at the end of the thesis.
Case Study One
Napier Street Townhouses

Melbourne, Victoria
Kerstin Thompson Architects
2002
Terraced townhouses

Configuration: 11 townhouses
Type 1: 4 bedroom, 2 storey and mezzanine
Type 2: 2 bedroom, 2 storey
Type 3: 3 bedroom, 3 storey
Type 4: 2 bedroom, 3 storey

Size: 1271m² site
287m² Type 2 townhouse

Project Description
This project is located in the dense inner-city suburb of Fitzroy, Melbourne. The site is bordered on three sides by a service lane and two suburban streets. Each unit faces one of these sides, which allows for independent pedestrian entry and vehicular access. The masterplan creates eleven units that occupy the site similar in shape and size to the existing historic terrace housing.

The eleven townhouses are split into four different types: Type 1 are four-bedroom units facing Napier and Little George Streets; Type 2 are two-bedroom units occupying the corner sites facing Webb Street; Types 3 and 4 are three- and two-bedroom units facing Webb Street.

This design provides elements that offer spaces for flexible use and configuration of the occupying household. The ground floor car park incorporates external connections and surface finishes that allow for other uses, such as workspaces. The sectional relationship between service and bedroom spaces allows a greater degree of independence between residents on the ground floor and mezzanine level. In addition, the site configuration of various unit types provides semi-communal external areas with high solar amenity.
design can impact the performance of the house: increased opportunities of a household such as working from home and co-habiting and a dense development with high amenity.

Site Siting Shape: Individual/Collective Housing

The siting of the individual apartments creates a high level of privacy, increased open space and solar penetration in a compact plan that is repeated to form collective housing. The main way this is achieved is through the placement of the outdoor space. Both ground floor courtyards and first floor terraces are grouped together. This adjacency of outdoor spaces creates a larger open space between apartments than would normally be encountered when the open space is separated. This arrangement is a design concept that could be identified as a generic lesson: 'group open space', however, although the individual idea is demonstrated here, its success in this particular application relies on the fact that it is elevated on the first floor – necessary in a three storey context. Each application of a seemingly generic concept must be integrated with a wide range of factors and is more than the sum of its parts.

Design concepts are shown using a diagram overlaid onto the conventional plan or section. A comprehensive set of plans and sections are presented as a reference page for the diagrams (Fig. 2) and serve to contextualise the design elements. Lines and shading (Fig. 4) are overlaid on the plan to graphically diagramise the concept while still showing its actual arrangement (Fig. 5), rather than a separate abstract diagram. For example, when presenting the increased amenity through the open space arrangement described in Individual/Collective housing, the open space is shown as a shaded block overlaid onto the simplified plan. The same tone is used throughout the case studies to show outdoor spaces. The grouping of the outdoor spaces are clearly shown. An image (Fig. 6) is also presented that shows the translucent materiality integral to the concept. Images are used throughout the case studies to show three dimensional or material aspects, but as the majority of the concepts are plan and section based, images are not the primary source of information.

In other examples, the same tone is used to shade areas that have the same function, for example: all bathrooms have the same tone, while all kitchens have the same tone and so on.

By themselves the diagrams have no meaning, they rely on the
simultaneous presentation of the plan. Without the diagrams the concept relies on descriptive text only and is not made explicit (Fig. 3). If a separate diagram, removed from the plan context were presented (Fig. 7), the full knowledge is not shown: how the concept plays an integral role in the overall plan and the particular way it is achieved (Fig. 3).

Figure 8, taken from the case study, explains how the terraces are part of the overall design. The concept ‘Group Open Space’ shown in a diagram (Fig. 7) does not reveal this integration.

Internal Configurations: Passive Flexibility, Alternative Configurations: Internal

In the Section the way that the Internal Configuration facilitates the performance of the house is analysed. In the Napier St housing, Passive Flexibility is achieved through surplus space and zoning. More space than required by a parked car in the garage, some additional 4 metres, is combined with a higher level of finish than for a typical garage and adjacency and aspect to a courtyard which creates a room that has daylight, ventilation and a pleasant outlook. The combination of space and amenity render the room useful beyond garage as a habitable space such as for a workspace.

This concept is shown by overlaying a dotted rectangle that indicates the space required by a car, a shaded space that indicates the surplus space, and a differently toned shaded space that indicates the courtyard (Fig. 9). These areas are labelled as such and the access to the space off a hallway and the access and aspect to the courtyard is indicated by arrows. In the case study, an explanatory text runs alongside the illustration and explains this concept.

This example also demonstrates how flexibility can be achieved through minimal extra cost. The flexibility achieved in this arrangement stems from the placement of the courtyard adjacent to 4 rooms. It is an effective position because it services all the rooms and also allows for a deep plan shape.

While it may not always fall neatly under the heading Passive Flexibility, it is the type of flexibility most often identified in the case studies. This
The courtyard provides an alternative access route.

The courtyard separates the two first floor terraces.

Terraces in centre of site admit light into the depth of the site allowing for narrow deep plans.

Surplus Space used as Workspace.

Main access route

Living Zone

Bedroom

Alternative Living Space
occurs where a range of changes are possible through the inherent design rather than requiring physical change. The change of use of a space as described in the garage example is Passive Flexibility.

Again, in this example, the existence of the individual design concept integrated within the whole project is demonstrated. While it is not the intention to unravel the integrative nature of design, this nature is revealed in the multiple roles of the courtyard. The courtyard services the garage facilitating its flexible use, but also provides: amenity and a separate access path to the central and rear room, a window to the bathroom, and plays a role in the first floor arrangement by separating two outdoor terraces. At a larger scale it allows for a compact deep plan arrangement and thus a dense site coverage, while still achieving amenity - aspect, air, outdoor space and daylight to all rooms (Fig. 10).

The integrative nature of design is further demonstrated in the way that the large scale is linked to the small scale – the decision to have individually accessed garages rather than a single collected garage eliminates space dedicated to driveways and access while allowing the garage to be positioned within the individual apartment and be used directly by the household. In this way many aspects of the design are connected and their reapplication and transformation into new designs requires architectural skill.

Zoning is a technique architects often employ to achieve passive flexibility. It involves grouping rooms and programs (uses) from others. For example, in Napier Street Townhouses bedrooms are grouped into two zones separated by the Living zone (Fig. 11). This is unusual in the typical house where bedrooms are often grouped all together. This configuration means that there is physical separation between one bedroom and another. Each bedroom zone is serviced by a bathroom, described as ‘Extent of Services’. In this example two households could co-habit with a high level of independence, and the ground floor could also function separately to the first floor and mezzanine, for example: office use of the ground floor is possible without accessing the private house. Similarly, the ground floor could be rented separately to the upper floors (with the addition of a second kitchen). This is achieved because the ground floor has an independent bathroom and outdoor space, and a room that could function as a living/kitchen space (Fig. 12) because it is larger than a typical bedroom and has
access to the outdoor space.

Internal External Relationships: Alternative Configuration External
The role of the outdoor spaces is made explicit in this analysis. Their role has been explained above in detail to support several arguments sustained throughout the introductory essay in a way that is not detailed in the case study section itself.

Often in the case study analysis, elements are identified across several categories. In this example, outdoor spaces are presented in the Internal External Relationships section even though they might be integral to and presented in an earlier concept. Each concept is made explicit in its own right.

'Aspect and Private Sheltered Open Space' are identified as important factors in the flexible performance of the house. In the Napier Street Townhouse's courtyards at the ground floor provide external aspects from bedrooms and private, sheltered external space to ground floor residents (Fig. 13). This concept is integral to the flexible use of the ground floor as a separate dwelling as identified in Alternative Configurations Internal: Zoning.

The position in section of the main external social space is identified as an important element of the overall plan. An elevated terrace allows greater solar penetration and views (Fig. 14). Amenity is achieved through adjacency of the Living and terrace in plan, the elevated position in section and the adjacency in plan of open space between apartments as seen in Site, Siting, Shape: Individual Collective Housing.
The Farfor Houses

Amenity is consistently identified in the case studies as a crucial component of flexibility.

I will use the Farfor Houses to discuss the way that the background research related to the case study in order to introduce what will later be elaborated on as the matrix.

By linking design concepts with issues identified in the background research in the Ageing of Aquarius project, design led outcomes offset issues facing the baby boomer cohort in retirement, for example: a need for multiple household accommodation to facilitate mutual support between households, a need to fund retirement through the sale of the main asset, the house, requiring a more cost effective housing solution (multi-unit types) and the need to cater for working from home or returning adult children within a probably smaller house. In the case study method, we were considering the background information, and how design might positively interfere, with our designer’s hat on. This is different to how a design brief is usually presented to an architect. A brief is often highly defined in terms of accommodation, site, type of building and budget. This design led process demonstrated very early on the existence of an architectural knowledge base, and the way that architects use it.

As a designer I could link these issues to some design-based solutions. This was through sheer experience and built up knowledge - I could cite examples of design projects that would allow an element of a house to be used in a way that could be a solution. From this, together with the research team, we developed a method where through a wide project review of not only our own built up knowledge, but also through the Web, publications, journals, and peer consultation we built up a database of designs that embodied certain design concepts, or arrangements relevant to the issues identified in the background research.

We were pausing on and articulating the use of precedent and case study in the typical design process that is largely invisible, often informal and not articulated. This method was successful in widening the possibilities,
Case Study Twenty
Farfor Houses

Portsea, Victoria
Grounds and Boyd
1968
Single family semi-detached houses

Configuration: 4 houses, 3 bedroom and garage
Single storey

Size: 2330m² site
244m² house

Project Description
In this project, four dwellings are organised as two semi-detached houses. The site has one street frontage and one crossover. The shared driveway occupies a considerable amount of the site and can accommodate visitor car parking, however its presence is subdued by its loose stone materiality. The houses are typical in plan, but are orientated differently and mirror each other. A shared garden separates each house and all have a private, un-roofed courtyard and a verandah. Each dwelling also has an internal roofed courtyard, that also acts as a hallway connecting bedrooms to living areas. The internal courtyard allows sunlight to enter all houses, despite their different orientations. Each house has a garage for two cars. The project was speculative, with the client, Mrs. I. W. Farfor retaining one of the houses.

This project demonstrates economical siting by placing four houses on a lot that would typically accommodate a single family detached house. The plan of individual houses supports the shared occupation of the site by providing private external space within each dwelling. The orientation of the houses and the use of landscaping further articulates shared open space between them. The internal configuration of the houses allows passive flexibility in the use of the bedrooms.
as evidenced in the catalogue of design solutions captured in the case studies collection, and the development of the case study method used in the *Ageing of Aquarius* is a significant contribution to pre-design processes and brief development. It contributes to the design solution but also to the reframing of the issues. This last point came about through the method being design-based. This involved using the way that architects know to reframe the criteria for solutions. For example, by analysing a design project, keeping in mind the issues facing the cohort, the architect recognises design solutions in that project and this solution is used as a further search criteria. I might recognise how a project solves an issue facing the cohort, say that of children staying at or returning home and how this leads to constraints in life opportunities by not being able to downsize the house and realise wealth, and thereby retire, through its arrangement of rooms, entries and service locations being amenable to both downsizing and the flexible size of the household. In the Farfor house, this could be achieved in several ways – described under the headings: Internal Configurations: Building Modification: Within Envelope, Alternative Configurations: Internal, Passive Flexibility. This process is contributory to the architectural profession because it uses the discipline’s own knowledge base and way of knowing as the primary research tool. The loop of information starting at the original criteria being then reframed by admitting new information identified in the case studies was described in the *Ageing of Aquarius* project as a *matrix*. I describe this type of process and the thinking employed there in Part 2.1 *Architectural Knowledge* by comparing it to Argyris’ notion of double loop learning (Anderson 2008).

The Farfor Houses demonstrate how particular design concepts introduce high levels of amenity and flexibility in the low rise multi-unit type: four houses on a lot that would typically accommodate a single-family detached house. Design concepts are employed that benefit a collective design. Passive flexibility is achieved through the position of rooms, separate access and an unusual circulation design. It provides examples of how to address many issues associated with the multi-unit type such as repeatability of the plan siting while maintaining optimum orientation, outdoor space, privacy and capacity to extend while at the same time revealing concepts applicable beyond the type: a shared garden separates each house (Fig. 16); all have a private, un-roofed courtyard and a veranda (Fig. 17); the internal courtyard allows sunlight to enter all houses, despite their different orientations (Fig. 18).
Each house has a garage for two cars. The plan of individual houses supports the shared occupation of the site by providing private external space within each dwelling. The orientation of the houses and the use of landscaping further articulates shared open space between them. The internal configuration of the houses allows passive flexibility in the use of the bedrooms.

In the case study the following concepts are identified under the categories:

- **Site, Siting, Shape: Alternative Configurations: Buildings on Sites, Individual/Collective Housing, External Elements**
- **Internal Configurations: Building Modification: Within Envelope, Alternative Configurations: Internal, Passive Flexibility**
- **Internal External Relationships: Alternative Configurations: External**

Site, Siting, Shape: Alternative Configurations: Buildings on Sites, Individual/Collective Housing, External Elements

The inclusion of courtyards within the overall rectangular plan of the house means that the plan can be repeated in different orientation and positions, i.e.: windows face onto the courtyards and so the plan does not rely on the site conditions, orientation or its perimeter for amenity (Fig.18). This concept addresses the typological aspect of housing by proposing that to achieve a denser arrangement of buildings on the site, a house and its amenity be contained and self reliant. This generic concept is achieved however through particular arrangements made explicit further on.

This aspect points to the approach carried out in the case study analysis. Rather than categorise projects into typologies such as high-rise or single-family, the design concept is given prominence despite or, in support of the type. In this way design knowledge is foregrounded and shown to be applicable across diverse housing types, sizes and styles.

Internal Configurations: Building Modification: Within Envelope, Alternative Configurations: Internal, Passive Flexibility

Physical alteration to achieve flexibility is described as Building
Modification: Within Envelope. This type of flexibility usually results in a use being changed from one thing to another through measures such as the erection or removal of a wall, addition of an entry and so on. The intervention must be as simple as just described and would not be considered a major alteration. It is a type of flexibility that relies on the original design being amenable to such change – a kind of planning ahead.

In this example, this type of flexibility supports the larger scale placement of the building on the site. By positioning the garage on the corner of the plan it can be accessed from two directions by modifying which wall has the opening (Fig. 18). Car access is often a key component of site organisation and concepts that broaden the possibilities are very helpful. This concept could be thought of as: include two approaches to a garage by positioning it on the corner of the plan. However, once again, its success relies on the interaction of elements in plan: the flexible garage position is facilitated by the multiple possibilities to enter from either side of the building achieved through the central corridor and courtyard position. This interconnectedness of the design element is what makes architectural design difficult to articulate – each scenario relying on particular arrangement defined by a range of specific parameters. This character of architectural design requires very flexible thinking by designers. I describe this as being able to 'see' and 'project' when accessing and architectural knowledge. Flexible thinking, also called designerly thinking is also used when applying this knowledge, transforming the physicality of the design element to integrate within a new whole.

Identification of Passive Flexibility is a concept that relies heavily on the architect's analytical skills as it is often intangible, being what could be, enabled through the arrangement, rather than what is; allowing for a use to be changed without physical modification of the building.

In the Farfor Houses, several spaces could be used flexibly because of their arrangement, shape and amenity i.e.: passive flexibility. The first room serviced by the hallway could be used as a suitable workspace (Fig. 19). Its 'front' location means that visitors do not access the private house. Also, the high level of amenity provided by the garden-like hallway, with a semi-outdoor, or veranda quality provide an aspect to these rooms not offered by a conventional hallway (Fig. 21).
Another design concept is employed to achieve Passive Flexibility. The main bedroom has a large sliding door that opens onto the living space. The potential to create a large connection with the living space creates a possibility for the extension of the living space or multi-programming of the bedroom space (Fig 20). This plan arrangement is supported by the continuous window wall of both rooms which makes the space feel united and non-bedroom like. A conventional bedroom has a small window and if used in this example would not support the capacity to join the two spaces, or provide the amenity for daytime use (multi-programming). This design concept relies on the adjacency in plan of the living room and bedroom as well as a higher level of amenity to the bedroom to achieve the flexibility in performance.

The notion of multi-programming as a type of flexibility is revealed again in the category Internal External Relationships. The hallway is also a roofed garden – glazed sides and exposed earth floor (Fig. 21). The bedrooms open onto this semi-outdoor space. This space therefore is a combination of both hallway and outdoor space (Fig. 22). This spatially efficient concept of the overlap of uses serves the surrounding spaces with a high level of amenity. It is a good example of unusual and experimental planning techniques often found in architect designed houses in Australia of this period.

A similar arrangement and type of flexibility found in that of Napier Street housing is identified in the garage and courtyard adjacency. The location of the courtyard adjacent to the garage provides high amenity to the carport space, and it can therefore be used as a habitable room, in fact one of these spaces has since been converted into a bedroom (Fig. 23).

As will be revealed in the discussion of further case study in the following pages, the same concept can be found over multiple case studies yet is achieved differently (Fig. 24) For example, arrangements that facilitate a ‘suitable workspace’ are shown in the Malgueira Housing, Stanga Apartments and the Where House.

Furthermore, the transformation of the knowledge is demonstrated by discussing the project I designed, Multi-family House, in Part 2.4 in that design elements and concepts identified most particularly in the Farfor Houses have been transformed into new iterations. I show the transformation using the same descriptions: Site, Siting, Shape: Alternative Configurations: Buildings on Sites, External Elements, Internal Configurations: Individual Collective Housing, Alternative Configurations
Internal Configurations: Suitable Workspace

Malagueira Housing

The additional bedrooms are also able to be used flexibly to accommodate other uses such as workspaces.

External Space
A workspace occupying bedroom 3 in a Type D house has a direct connection to the main courtyard.

Access - Separate
Because bedroom 3 runs between the initial house and the perimeter wall, a workspace occupying this room has direct potential connection to the street. Openings to the courtyard could also provide direct access off the workspace.

Fig. 24.1 Plan diagram showing potential access from workspace to internal courtyard and direct access to street.

Services
The workspace has strong connections to kitchen and toilet services. The addition of a screen at the edge of the living area would further separate dwelling and working activities.

Fig. 24.2 Plan diagrams showing connections from workspace to services spaces.

Stanga Apartments

Appropriate Size
One of the apartment types includes a large bedroom space that can be utilised as a workspace.

Levels of internal Separation
The workspace can be accessed directly from the entrance lobby, and is separated from the main bedroom by a stairway. The bathroom is placed in the services zone, disconnected from more private areas of the house and therefore able to be used by both residents and employees.

Storage
A storage room is placed opposite the bathroom, within the services zone. This independence from the private areas of the house allows it to be used as storage/cloak room accessible by employees.

Fig. 24.3 Plan diagram showing size of workspace and separation from bedroom and bathroom.

Fig. 24.4 Plan diagram showing independence of bathroom and storage room and proximity to workspace.

Where House

Levels of Internal Separation
The bedrooms are located on the floor above, separating private areas from the workspace. ‘Crossover’ spaces, such as the kitchen/dining area, used by both employees and residents, are screened from the workspace by less rigid elements such as the circulation strip. This creates a graduation in privacy/separation that matches the way these spaces would be used.

Fig. 24.5 Plan diagram showing internal configuration of ground floor spaces.
Fig 24.1

Fig 24.2

Fig 24.3

Fig 24.4

Fig 24.5

Fig. 24.

An example of the transformation of the concept of multi-programmed external space is shown at Figure 25 in the Multi-family House in the form of a roofed outdoor deck also being the hallway.
In this case study, Furlan House by Paulo Mendes da Rocha in Ubatuba, Brazil, the following concepts are identified under the categories:

- **Site, Siting, Shape: Internal/External Relationships, Contextual Relationships, Vehicle Egress and Parking**
- **Internal Configurations: Alternative Configurations Internal, Passive Flexibility**
- **Internal External Relationships: Alternative Configurations External**

This single family house reveals how the site choice itself can be a determinant in facilitating possibilities. It also shows that if a room can be accessed from outside, ramifications for the use are created for the room but also the remaining house. Once again amenity achieved through the location of outdoor space and the internal/external relationships defined by windows and doors are central players in the performance of the house.

**Site, Siting, Shape: Internal/External Relationships, Contextual Relationships, Vehicle Egress and Parking**

The corner site provides the catalyst for the flexible use of some outdoor spaces. Two courtyards on alternative sides of the block can be shared between car space and courtyard/outdoor space (Fig. 26). Rather than having a dedicated double car space, the two areas maximise the amenity of the site through two separate spaces that can be used at different times of the day according to sun or shade requirements. This concept is a very efficient and effective one. It economises the use of outdoor space and the outcome is an increase of amenity. As emerges in the case studies, the multi-use of the car space consistently presents as a flexible opportunity.

It is described as Vehicle Egress and Carparking, with a subtitle of Multi-use External. Sometimes concepts – the combination of physical elements and spatial arrangement – could be considered under several headings, and often they are integral to other concepts. Their categorisation settles...
Case Study Thirteen
Furlan House

Ubatuba, Brazil
Paulo Mendes da Rocha
1973
Single family detached holiday house

Configuration: 3 bedroom house
              Single storey

Size: 800m² site
      320m² house

Project Description
This holiday house for Artemio Furlan is located on the beach in the town of Ubatuba near Sao Paulo in Brazil. The primary
design intent was to provide an abundant level of external living spaces for the beach house, and to maximize the linkage
between them and the indoor areas.

This house uses two basic elements – a bedroom block and a raised indoor/outdoor living platform – to create multi-
functional external courtyard spaces and internal circulation paths. External walls composed of large doors in the raised
living area maximize the relationship between internal and external space, allowing multiple combinations of indoor/
outdoor living arrangements. All of the internal spaces of the house – the kitchen, bedrooms and bathrooms – have
external entries, emphasising its informal nature.
1 Terrace
2 Living
3 Dining
4 Kitchen
5 Bedroom
6 Bathroom
7 Service Quarters

Ground floor and site plan

Section a

North elevation

Perspective view from street
on a kind of overall consideration of the heart of the concept and an aim to present breadth in what concepts address.

The position of the building on the site – the siting – is arranged to respond to the site’s orientation. In this particular compact rectangular shaped plan, all the living spaces are arranged on the solar aspect (north) side of the building, or, if considering the internal/external relationship in determining the siting, one could describe that the external space is distributed along the perimeter of the living spaces. In this design therefore this relationship provides significant amenity through solar aspect throughout the day (Fig. 27).

Furthermore, the placement of the building in the middle of the site allows users to circulate around the building, a secondary circulation route to the interior one, and so access the building at multiple entry points or bypass the interior to access other rooms. This example reveals how the concept of an alternative access is generated through siting that could otherwise be a hindrance to such possibilities, but how it also relies on the doors to the bedrooms to be effective (Fig. 28).

Internal Configurations: Alternative Configurations Internal, Passive Flexibility

In the Furlan House passive flexibility is again identified. The living space is autonomous from the rest of the house. This is achieved by separating it using the circulation hallway in the centre of the plan while at the same time providing multiple entry points directly to the living space from outside (Fig. 29). In a more conventional plan a living space is often part of the circulation space, i.e.: you need to pass through it to reach other areas of the house. The ramification of this arrangement is not as obvious as some other examples of passive flexibility, however the result is a space that can operate relatively independently and this opens up opportunities. In combination with this concept (provide a space that can perform independently), the living area is raised above the level of the rest of the house by around a metre. This technique separates the spaces from the rest of the house without enclosing it and so increases the feel of openness and space beyond the actual dimension of the plan area. Such concepts can contribute to efficient use of space in a compact plan with high amenity: fundamental to achieving higher density housing through smaller plans.
The living space dimension at 10m x 5m is larger than most domestic living rooms. The rectangular proportion of this space is useful for absorbing multiple activities at the same time being able to split into two 5m x 5m zones. This space is highly effective because it is not relied upon to circulate through the house and so can be arranged in any way (Fig. 29 and 30).

Internal External Relationships: Alternative Configurations External
The flexibility of the living space is further enhanced by its internal/external relationship. The living space can also expand and connect into the exterior terrace through large doors (Fig. 30). This type of flexibility is achieved through moving parts and is described as Actual Flexibility different from Passive Flexibility. While a door is a simple example of Actual Flexibility, in the Furlan House the doors are split horizontally into two panels so that they also perform as windows. The capacity to create a range of relationships from inside to outside, from closed to fully open, extends the possibilities for flexible uses.

The Living space is the focus of several design concepts. In this example they exist individually but also in combination to produce a simple but effective range of possible configurations and sizes of space and amenity. In combination with the other design concepts identified, the Furlan house demonstrates how aspects that are simple to implement through plan and section arrangement such as siting, circulation, multiple access, level change and doors can increase the performance of the house.

Throughout the discussion of the case studies I have at times pointed out how the same concept occurs in other projects. This aspect became an important part of the method used to widen the design-based solutions, captured in the matrix research process. The design solution identified in one case study, would ‘feed’ back into the search for others, in this example that of a room made flexible by its amenity, location within the plan and multiple access points was used when searching for more physical design solutions, or iterations of this concept. This method is expanded on in Part 2.1 where it is described as a spiral that doubles back on itself: design knowledge is used to extend design knowledge. Comparisons are made with concepts of single and double loop learning.

Furthermore, the way that architects still recognise the solution even though its arrangement is completely different – they can see the same solution in different forms – touches on the intangible and dynamic nature
of the embodied knowledge base that creates challenges for its capture. A further reflection on this point is that this raises issues for design education. While I recognise that experience is an irreplaceable part of a designer’s education, the process of articulating elements of projects, much as is found in the case studies presented here, may assist students to grasp the ‘what’ it is architects know and the interconnected nature of design. This type of study is not routinely carried out in my experience.

In this process of building up a database of case studies, what became evident was that the case study was central as a repository of embodied architectural knowledge. Through articulation of that knowledge, a knowledge base is validated as is the architect as the knower. This last point then placed importance on the method for capturing the embodied
2.1 Architectural Knowledge

knowledge set out in 2.3. Similarly, its articulation greatly assists a discussion of the way architects know and apply this knowledge, and the nature of the knowledge itself.

"Knowledge is a slippery and elusive concept and every discipline has its own secret realization of it."

In Part 1 I introduced the theme of architectural knowledge. I argued that it is articulated in the case studies, and thereby the architect is validated as the knower. I also introduced the theme of the way architects know and how they apply this knowledge and transform it in new designs. In this section I explore these themes further as an extension and outcome of the case study work. I discuss how architectural knowledge is largely obscure and dynamic and therefore propose that its articulation, and methods for its capture, are contributions of this thesis. I also arrive at several implications of this argument for further research, particularly concerning the application of flexible or designerly thinking and how architectural education may be rethought in this trajectory.

The obscure nature of architectural design knowledge and architecture's modes of practice have often prevented it from being systematically studied, researched or documented and therefore hindered the communication outside the field of its disciplinary value beyond qualitative aspects. The design process has been studied at length and thorough accounts are given of the sequence of steps, moves and other logical procedures of the design process (Rowe 1987,1-250). Most attempts do admit that they can not fully account for the subtle variations and shifts employed in the design process and that each project is infinitely different in its variables and influences. Theories of neither the design process, nor other parts of the architectural practice are advanced here, although sometimes discussed for their relevance. I am concerned with the actual knowledge necessary to enact any such a process, the way it is accessed and transformed.

The nature of designing and design knowledge is such that it resists and
documentation, remaining largely within each individual and unique design process and embodied within a design project. Of concern here is what is argued as a disciplinary knowledge base of seemingly invisible concepts such as solutions in plan disposition and physical adjacencies and so on. As the knower, the architect can identify these and understand their value and relevance in a design project or other source. This type of knowledge is generally referred to as a tacit knowledge (Polanyi 1967) and is characteristic of the expert, who acts, makes judgments and so forth without explicitly reflecting on the principles or rules involved – a knowing-how. Whereas a knowing-that (Ryle 1984, 25–61) is distinguished as a theoretical knowledge being a "consciously accessible knowledge that can be articulated and is characteristic of a person learning a skill through explicit instruction."9

Architects use both types of knowledge. Often tacit knowledge is built up over time as a kind of expertise developed from a sort of knowing-that. For architects the process is not so neat, the knowing-that is not an articulated knowledge that can be taught that then over time becomes a knowing-how. Rather, the knowing-that is developed simultaneously with the knowing-how by learning through doing. This situation accounts for the use of the design studio in architectural education. You do not learn how to design, and then design, you learn by doing design. Accounts of this type of learning have been compared to learning to ride a bike – something you can’t know unless you ride the bike. The use of case study in education allows the tutor to show examples of design outcomes, but does not account for how it was achieved. It does however account for one aspect of what architects know i.e.: this is one way to achieve a particular outcome.

In the design process this knowledge identified is applied and altered for a new circumstance and context. The architect can 'see' (or know) the knowledge embedded within the source but can also at once understand its relevance to a new context – to 'project'. When the architect uses that knowledge in a new context it is altered and becomes new knowledge. This results in a knowledge base that is limitless and constantly transforming. It also therefore cannot be presented as an explicit instruction as the knowledge iteration changes in each circumstance and context. In this way the education of the architect relies significantly on experience and learning this flexible type of thinking of 'seeing' and 'projecting' through case study as a part of the design process in order to access the discipline's

knowledge.

Also at play is the ability to ‘see’ with intent. The architect is seeking out possible solutions embedded within case studies. They are at once guided in their searching but also open to unexpected possibilities. This is a highly flexible type of thinking where one is searching for an answer that one does not yet know. The ‘answer’ may be in the form of an arrangement identified but also a number of arrangements pieced together to suit the new problem.

It may at first seem not only difficult but inappropriate to document a knowledge base that is constantly transforming and with a tacit quality. I argue that this constantly transforming quality of architectural knowledge is valuable and innovative and can be heightened through methods that capture moments of the knowledge. In addition, the thinking involved in the knowing and application of this knowledge is valuable: in the term of Schön the **reflective practitioner** has the ability to apply intuitive processes to situations of uncertainty, instability, uniqueness and value conflict.10

These characteristics are often used to describe contemporary issues and so the development of methods for capturing architectural knowledge and processes may make them more available in the development of problem solving beyond design.

Within the profession of architecture, there is little recognition of this tacit type of knowledge in the act of creation – instead architectural design is mostly focused upon for its outcome of a discrete object and examined and valued for qualitative aspects. Cross argues repeatedly that design is a discipline that should seek to develop domain-independent approaches to theory and research in design:

*The underlying axiom of this discipline is that there are forms of knowledge peculiar to the awareness and ability of the designer...just as the other intellectual cultures in the sciences and the arts concentrate on the underlying forms of knowledge peculiar to the scientist or the artist, so we must concentrate on the 'designerly' ways of knowing, thinking and acting.***

The embedded knowledge almost always exists as and is an extension of

---


12 Lawson, B. *What designer's know*, Elsevier, 2004, p. 96. Lawson writes that precedents might be experienced live but are more typically through images in magazines, journals, books and on the internet or television.

existing design knowledge and is a kind of perpetuating cycle. This comes about through one of the key parts of the design process – the use of the case study, or precedent. Architects consistently refer to existing designs which can be whole or partial pieces of designs. Existing projects embody the discipline’s knowledge base. Cross (1982, 221-7) maintains that design has its own “things to know, ways of knowing them and ways of finding out about them”, so-called “designerly ways of knowing”. The description ‘ways’ accurately implies that there is more than one thing to know and one way of knowing it. As previously defined, the knowledge base I am referring to here consists of physical arrangement. Yet it is more complex than that. Each iteration of a design concept or projected physical solution is full of ramifications for the building as a whole, the user, and the originating problem. The architect has the skill to consider these holistically.

While not unique to architecture, the use of the case study is a primary tool of the architect and embodies the necessary knowledge base of the discipline. As Lawson (2004, 96) recognises, “Precedent is such a vital, central and crucial feature of the design process that it plays a central role in all design education.” The knowledge embedded in the precedent is unusual in that this knowledge is constantly transformed and contextualised yet still recognizable to the architect. To repeat the point made earlier, this aspect renders articulation difficult, never ending and open to infinite variations and very inaccessible to an audience outside the discipline. Without specific articulation, the architect ‘knows’ the value of an element of a case study. This ‘knowing’ is a link made between the arrangement and what it solves, or enables as the case may be. It is a thought process that relies on projection by the architect of that embodied knowledge to their own issue at hand, and may not even be the originating intention of the original designer. The capacity to recognise the knowledge embodied in a case study while understanding its use in a new context are key elements of the design process – the architect’s primary mode of practice and are largely implied and undocumented. Lawson describes the important use of precedent and recognises the unusual mysteriousness of its use and application as quite particular:

*Precedent is seen by designers as an important part of their knowledge upon which they are able to draw upon in a 'designerly way'...they are whole or partial solutions...(and)*

15 Ibid p. 96.
16 Ibid p.98
demonstrate possible ways of doing things in design... What problems they solve are not necessarily identified, are seldom recorded and are hardly ever analysed...In many fields of knowledge this would seem a curious if not questionable way of proceeding...And yet throughout the history of professional design we have seen such knowledge plays an important if not central role on the process.¹⁶

Schön’s description of the practitioner’s (not specifically the architect) capacity to ‘see’ is a fitting description of what goes on when an architect is the knower:

When a practitioner makes sense of a situation he perceives to be unique, he sees it as something already present in his repertoire. To see this site as that one is not to subsume the first under a familiar category or rule. It is, rather, to see the unfamiliar, unique situation as both similar to and different from the familiar one, without at first being able to say similar or different with respect to what. The familiar situation functions as a precedent, or a metaphor, or an exemplar for the unfamiliar one.¹⁷

Through the case study I attempted to take the tacit knowledge base of architecture, that is embedded within designs, and make them explicit by using diagrams and explanation through case study. I stopped short of codifying the knowledge as a sort of manual for design, because, while I can reveal the embedded knowledge in this way, I cannot fully account for ‘how’ it evolved or, instruct one how to use this knowledge. I can show the ‘what’ but not the ‘how’ and consequentially not the ‘how to’. The knowledge revealed is more than the sum of its parts and the skills required to integrate this articulated knowledge are developed through specific education techniques and built up experience.

The application of the ‘extracted’ knowledge results in a transformation where the knowledge is reformed in a new context and may have undergone many changes to become part of a whole. The originating knowledge might be unrecognisable in form, and generally unacknowledged. I therefore argue that while these conditions are fundamental and contributory to

the obscurity of the processes of architecture, it is the 'what', the knowing that, to use Ryle's term, that is known by the architect that is so difficult to define because of its transforming and disguised nature.

The situation described above limits the recognition of the value of architecture beyond the qualitative aspects of the discrete project and so it is argued here to its wider application. To change this situation would require focusing on this part of the design process, the 'what', and finding ways to account for it, document and communicate it within a context that can demonstrate its value.

Returning to the use of the case study, the account above describes one that would be referred to, say, in a publication. Importantly though, the concept of case study also exists more loosely, as built up knowledge that can be referred to without the explicit reference of the case study as a sort of built up depositary. This assists the designer to make presuppositions, hunches about solutions, sort of skipping a few steps and then backtracking to test the hunch. Lawson describes this ability as a 'knowing what might work'.18 I previously described it as 'projecting'. Neither this heuristic approach, nor the use of case study or other inflections of the design process are unique to architecture. Although, the heuristic approach of 'knowing what might work' does contribute to a mystique around the knowledge used as part of that process and therefore a difficulty on architecture's part in accounting for its role. There are however aspects that seem very important to this process when carried out by an architect.

When an architect designs she must take into account much and often contradictory empirical and tacit information and integrate the solutions into a unified whole. It is the very interconnectedness of each decision that is so peculiar to design.19 Designerly thinking (a construct of Nigel Cross) is a term used to describe what happens when an architect designs. Designerly thinking has been interestingly described as the architect “walking on a thin line between passive knowledge and active knowing”.20 It involves constant cycles of action and reflection and significant ‘leaps’ which are not articulated or documented but rely largely on experience and tacit knowledge. The leaps, are evidence of the architect’s ability to ‘project’. This ability relies on built up architectural knowledge of the type already defined. The use of this skill and its value when applied to a ‘problem’ is discussed further where it was evident in the development of the matrix

20 Ibid.
research method – a sort of expanding list that simultaneously defines a set of problems (a brief) and ‘projects’ physical solutions that further define the problem.

In the design process the transformation of information needed to design a building produces some new knowing and an enhanced ability to inquire (Downton 2003, 96). The focusing on the part of the process that identifies the embodied knowledge and articulating it is considered here very important if these processes are to be critically extended. I argue that it does result in an enhanced ability to inquire and makes the knowledge base available for use as a research tool as was the case in the Ageing of Aquarius where architectural knowledge was used to reframe the issues.

While very articulate accounts have been made of the design process architects themselves rarely deliberately or extensively systematically analyse their own work or working practices as a way of extending their architectural skill and knowledge (Heylighen et al 2002, 251). There is a lack of a genuine research tradition that establishes access to the profession’s knowledge, “let alone extends its potential reach” and a generally acknowledged lack of cross-fertilisation between academia and practice (Watson and Grondzik 1997). Instead, this is more passively gained through accumulation of experience leading to the skill of being able to ‘know’ and ‘project’.

*Designerly thinking*, which enables existing knowledge to be extended and transformed, has been discussed for its capacity to ‘draw forth’ an idea. The value of the application of *designerly thinking* to other disciplines has been recognised, particularly to business. However, the obscurity of the design process itself has meant that designing, the design process and the designed outcome are not generally accepted as valid research tools. Shane Murray properly observes in his PhD titled *Knowing Through Doing* that architects have been either unwilling or unable to develop a discourse that adequately accounts for their knowledge base in their execution of design. Instead they either remain mute or develop a more disconnected architectural discourse in the dissemination of their projects. In so doing they imply an acceptance granted to discourse rather than disciplinary procedures and knowledge. This is problematic for architecture both at the level of pedagogy and for the value of the discipline in contemporary culture where it sits side by side and often indistinguishable from lifestyle.
images in the built environment (Murray 2004).

I return to some of the notions already discussed to lead into the method chosen to address these problems. The knowing-how of an architect – the transformation that occurs during the design process – is different to a theoretical knowledge that can be assessed or instructed. Barbiero (2002) argues that theoretical knowledge (that) is necessary to acquire a tacit knowledge – a knowing-how – but it is not an equal sum of its parts. Barbiero\textsuperscript{23} refers to Polanyi when he suggests that designers acquire a 'corresponding' as a tacit knowing-how which I have previously described as the ability to 'project' that defies articulation. Architectural knowledge created through the design process is the product of a creative process rather than a mechanistic one. It requires a theoretical knowledge but also a knowing-how and relies on the act of doing. This condition has been explained as 'artful doing'\textsuperscript{24} and the acceptance of this explanation, while it is agreed here is a right one, has further hindered architecture's investigation into such processes especially its primary activity of designing using its disciplinary knowledge base.

The focus on the part of the design process that can be extracted and articulated establishes an account of a knowledge base and allows it to be revealed. Developing a method for this accounting contributes to the development of the systematic study of the discipline's knowledge base and therefore makes it available for extension. Focusing on this recurring part of the design process contributes to methods for investigating what designers know\textsuperscript{25}, where "designers must have used a considerable amount of knowledge which has never been externalized or articulated"\textsuperscript{26}.

It should be noted here that this focus is on one part of the profession's practice and does not try to account for how the experience or tacit knowledge is built up, or to explore the reflection-in-action (Schön 1983, 50) or other types of research the architect undertakes. The discussion of these concepts here is so as to describe the nature of the knowledge and why it is obscure. The PhD is concerned with one path through the design process where the case study is used for a type of knowledge it holds and validating that this type of knowledge forms a significant knowledge base critical to the act of designing.

A method is developed for revealing embodied design knowledge by focusing on the case study. The section Revealing Architectural Knowledge

\textsuperscript{23} Barbiero, D. "Tacit Knowledge", accessed at \url{http://philosophy.uwaterloo.ca/MindDict/tacitknowledge.html} 11 May 2004

\textsuperscript{24} Usher et al. \textit{Adult Education and Postmodern Challenge}, London, Routledge, 1997, p. 43

\textsuperscript{25} Lawson B., \textit{What designer's know}, p. 4. Lawson argues that they use their knowledge in ways they do not even fully understand themselves

\textsuperscript{26} Ibid, p. 3–4
discusses the development of ways to document and communicate it.

The extraction of the embodied knowledge of case studies takes the form of design concepts, or elements. That is they are more often than not designed parts of a whole: the position of an entry, the position of a room amongst others, the location and size of a window and so on. They are part of a whole project yet when analysed by the architect can be identified separately as valuable elements. In order to be able to identify this, the architect must have a context – probably a new or different 'issue' which they are trying to address and so they can see a potential solution in the element. In the design process this element is then creatively re-combined as a part of a new whole.

To identify elements rather than study the 'whole' is a more accurate reflection of the way the architect 'knows' and the type of knowledge that is useful to them. Architectural design is mostly highly specific to the issue at hand and so complete prototypes are generally not useful in the whole. The context of the demonstration of this process is the proposal of a design problem – housing solutions for Australia’s ageing baby boomers. The use of a context is an important and central part of the method. It demonstrates the elements for their value in addressing particular issues as opposed to a set of designs. This is a more accurate account of the way architects work, rarely using patterns in a pure state as they are too static to be of use in the design process. Patterns propose a solution – a door is a pattern – one person wants enclosure another wants access – a hinged or sliding piece of wall is the answer; the idea of an operable barrier (Duffy and Hutton 1998,11). In this way the knowledge that is extracted could be seen as a set of patterns for application by others. However, while constituting a part of the knowledge base, it does not evidence the knowing and therefore the disciplinary skill of the architect and mode of practice which is at question. The establishment of patterns in architecture has been taken furthest by Christopher Alexander and I will discuss their relevance further on.

While the architect usually assimilates information of many types, the architect in the original research project, was exposed to multi-disciplinary primary and secondary data, and could understand the contributing factors that would typically go into a brief. She could ‘project’ and make links to physical solutions in response to this information as opposed to the response to a pre-formulated brief. Usually, a brief is where the architect is first involved although professional development literature concerned

27 Blyth & Worthington, Managing the brief for better design, Spon Press, London & NY, 2001
2.2 Setting The Context For Inquiry

with the role of the brief argue strongly for the architect’s central role in formulating the brief. This method – placing the architect outside their traditional role and much earlier in the scenario – further validated designerly thinking and developed a method for the extension of the practice through the matrix research method.

**Using a design based research method**

The originating research project, Ageing of Aquarius, set a context for the inquiry into architectural knowledge and its articulation. It provided a context for ‘where to focus one’s looking’. Rather than proposing that the issues facing the baby boom cohort identified in the background research form a brief for architectural design, the consideration of this material anew by the architect results in a circumventing of the hierarchy of the traditional architectural brief. The knowledge base of the architect was used to ‘project’ and ‘see’ through case study how the physical design of a dwelling may positively intervene and address issues and create outcomes that would not have been considered if the architectural design was curtailed to an outcome of a set of constraints.

The method uses architecture’s disciplinary knowledge and thinking as a research tool applied to a seemingly non-design set of issues. In this way a method is developed that allows for architectural processes and knowledge to enter and alter the conditioning variable of the brief. It applies the unique and flexible way that designers think and their disciplinary processes when designing to integrate many complex and often contradictory elements found across a range of disciplines such as socio-economics and demographics. It will be argued the disciplinary skills of the architect were used to intervene much earlier in a scenario and provide enhanced architectural processes.

What is described as a matrix in the Ageing of Aquarius project was at the centre of this process and was developed using the ability to project a physical solution when presented with an issue and also ‘see’ or ‘know’ physical solutions, with the issue in mind, embodied in architectural designs. This method uses designerly thinking to overcome the problem of validating the design process as a research tool. I present this method by comparing it to ‘double-looped’ learning as described by Argyris and
Schön (1978, 2-3).

The process led to a breadth of concepts that would not otherwise be produced, it provides many examples that act as a useful framework when considering housing design.

These solutions are expressed as hunches – they are the outcome of a built up experience. In the design process an architect would test these hunches by the dynamic integration of a range of physical solutions into a whole (building design). The originating knowledge is transformed and new knowledge is created.

By distilling the background research into a list, links are articulated between the issues arising in the data and physical solutions: a matrix (an environment where something develops, refer to the capturing of a moment of development in fig 31, p.53). The capacity to project these solutions is required in order to be able to start the method employed here. This method involves a systematic approach and documentation of this linking by taking the projected solution and ‘looking’ for examples in case studies. The solution example took the form of a concept and was sometimes physical but sometimes abstract, for example: two entries; work from home. The concepts identified are documented in the Case Studies in text and diagram rather than as an uncontextualised list.

The looking revealed the ability to ‘see’ or ‘know’ embodied architectural knowledge in two ways – a type of knowing that corresponds a solution directly to a physical design, and one that can ‘see’ a physical solution to an abstract concept. The latter type enabled the development of the matrix as a list of physical solutions, a ‘slice’ through this documentation is shown at Figure 31.

Rather than the case study analyses being at the end of the research it ‘feeds’ back into the method and effects the outcome. While the matrix is documented as a list, the ‘leaps’ made by the architect are evidenced by the communication of the linked solutions in the case studies. The actual elements are diagrammised, revealed, and described as evidence of this process of seeing, knowing, projecting and corresponding and at the same time make this knowledge explicit.

The actual drawing and explanation of the physical solutions – or abstract
design concepts – articulate what the architect sees and knows in the case study and further validates the links being made by the architect as well as communicating the knowledge. It aims to capture the ‘what’ that the architect knows in their use of embodied design knowledge. It shows many physical iterations of a similar ‘what’, disguised or embodied as it were in a case study. The act of articulating and communicating this knowledge demonstrates this disciplinary skill to 'see' and 'know' and accounts for the architect as the knower.

The development of the matrix is important to the aim of the PhD, it is where the thinking occurred that set off the reflections and developed thesis set out here.

The use of the knowledge as a research tool
The diagrammatic representation of one section of the matrix (Fig. 31) shows that many possible physical consequences and related design concepts were uncovered and that when considered in this way they develop as solutions to issues rather than outcomes revealing the potential of design to intervene much earlier in a scenario. This is presented as a spiral that loops back onto itself to alter the parameters of the original problem (Fig. 32).

This research method relies on the architectural knowledge in order to make the relationships between issues, physical consequences and design concepts. The preliminary analysis of case studies collected in a database that was further refined, contributed to the breadth of design concepts proposed. It is this part of the research that places this PhD specifically within the discipline of architecture, and proposes this method that uses disciplinary skills of an architect to ‘see, know, project and correspond’ – a body of knowledge to other ‘issues’ – as a useful form of research for design: a process that results in design solutions being considered that may not have been. The way that designers think is applied: corresponding, projective and holistic as opposed to analysing researched data into reductive and descriptive outcomes. It demonstrates a cross-disciplinary method which can be applied to other design problems.

In this process projects were selected for the case study database on the basis of plan and/or sectional relationships that address specific physical consequences of extended retirement of this cohort. Importantly the case studies utilise housing models that were not initially intended as retirement dwellings. This reveals an important aspect of the process whereby architectural knowledge that was intended to address one set
Fig 31
Fig. 32 Spiral representation of double loop learning in the matrix development.
of criteria can be analysed and utilised for purposes that may not have been initially intended, revealing the ability to ‘know’ and ‘project’ as well as both the embedded and transformative nature of the knowledge. The matrix process enabled an account of the capacity of the architect to ‘see’ and ‘know’ by creating a context that is not necessarily related to physical solutions as say a conventional prescriptive architectural brief is. The multi-disciplinary research was necessary to the initial summarizing of non-design related issues, while preliminary case study research was necessary to investigate whether design solutions could be demonstrated, and both strands of information were simultaneously shaping the matrix ‘list’ that is narrowed to set of physical solutions (Fig. 31). The case study research contributed to the depth of design solutions proposed, where the knowledge was recognised within the design project and fed back into the list rather than being identified as an end output of the matrix. Therefore, in order to ‘build’ the matrix, pre-existing architectural knowledge was necessary. The case study research method was present from the beginning of the research in the leading role of the architect exposed to the context of the research problem and using their built up knowledge to provide a start of where to look.

Argyris and Schön (1978, 2-3) define the use of a knowledge to reframe criteria and then extend this same knowledge as double-loop learning and I apply it to describe this method. Single-loop learning involves the detection and correction of an error in strategy or action. Whereas, double-loop learning leads to an alteration in the governing variables and thus, a shift in which strategies and consequences are framed (Smith 2001). Double-loop learning ‘involves questioning the role of the framing and learning systems which underlie actual goals and strategies’ (Usher and Bryant: 1989, 87). This emphasises the how rather than the what. Yet it has profound effects upon the what.

Using this description, double-loop learning was enacted when the architect employs their capacity to know a solution to positively intervene in the variable that would usually be used to form a brief. There was a focus on the ‘how’ which significantly altered the outcomes. Alternatively a focus on the what would result in the design of dwellings as a direct consideration of a range of issues. Specifically, using my architectural knowledge I could ‘project’ physical solutions while considering the range of issues presented in the background data. In Part 1 I described how the Farfor Houses came to my mind as a possible design solution to a set of issues established in the background research on the baby boomer cohort. The background multi-disciplinary research was necessary to the initial
summarising of non-design related issues facing households in Australia. This criteria was used to begin a list of design-based solutions. Preliminary case study research as well as the use of the architect's own built up knowledge was necessary to investigate how design might be part of a solution to these issues. Both strands of information simultaneously shaped a set of criteria that were identified in the case studies, and that then widened the criteria used when studying further case studies. By placing the architect in a much earlier position in the process, an argument for a role for design in addressing issues not normally connected to buildings is made. Often, when an architect designs, they are presented with the perceived solution to the issue: for example a household's requirement to finance their retirement may result in an instruction for

The contribution of the matrix process

Argyris argues that double-loop learning, as employed in the matrix process, is necessary if practitioners and organizations are to make informed decisions in rapidly changing and often uncertain contexts (Smith 2001).

To this end, Blyth and Worthington devote much discussion in their book *Managing the Brief for Better Design* to the idea that the process of developing the brief is often more important than the brief itself. They argue that the process should allow for inconsistencies to be aired and explored without a reductionist approach. They consider that in a pre-project stage an assessment of needs should be carried out and that there should be no presumption that the solution to the need will be a property based project. This was the experience when developing the matrix.

This last point implies that what goes on in the brief development part of the architectural design process may not have design outcomes. In this way, this part of the process could be considered more of a creative problem solving technique and applied outside of the architectural discipline. Techniques, such as the use of case study knowledge to form the matrix that widened the solutions, are an important contribution to the extension of this part of the design process and are applicable to problem solving generally. It is the flexible thinking, projecting, leaps and corresponding that are valuable.

Often briefing is taken as a short meeting at which someone is given an instruction, the 'Brief' and a bit of background on a project and asked to deliver the solution. This can result in limited outcomes.

Architectural design has a strong connection to social, economic and demographic factors – conventionally the constraints of these forces define programmatic and prescriptive requirements in the brief. In the matrix method, the architect applies their disciplinary methods to the consideration of the background research. This multi-disciplinary approach to housing design is not normally encountered. It gives equal prominence to the disciplines involved. This combination of two forms of research leads to the possibility of designing new housing models that respond to specific criteria relative to a complex and multi-disciplinary understanding of a need.

By facilitating two modes of research, one concerned with data and the other with problem solving processes and the consideration of disparate data simultaneously, the matrix forms a kind of hinge between the background research and the design solutions. Usually the background data is left at the level of abstract data, or distilled to a set of key issues disconnected from physical consequence.

The development of the brief through lists of possible design solutions, some of which are arrived at through initial examination of case studies, and that are then explicitly sought out in case studies would rarely be carried out so prescriptively by an architect. An architect would follow a similar process through a largely intuitive process that draws on experience, design skill and experimentation, and the development of physical forms that dynamically relate to the brief (this could be described as a type of design research through doing and may also be used to seek knowledge of a briefing kind). I note that what is not occurring in the method described here is the development and editing process driven by the cultural and artistic concerns of the architect and project. I also note that the experience of the architect does introduce limitations to the method.

30 Ibid p.3.
2.3 Revealing and Articulating Knowledge

This section describes the development of the method of communication and its rationale by distinguishing it from other seemingly similar methods. The use of the diagram to reveal the knowledge embedded there aims to overcome the obscurity of design knowledge, capturing the ‘what’ and thereby validates the architect as the knower, a knowledge base, and its value when demonstrated within the context of a ‘problem’.

As set out in Part 1, each architectural case study is presented through an initial overview of the project describing its attributes and documenting its site, floor plan and sections through conventional architectural drawings. The analyses are organised through key themes where design concepts are revealed. The themes are defined as: Site Siting and Shape, Internal Configurations and Internal/External relationships. Under such themes, very specific concepts are analysed for example the use of a door as a window, or the placement of a door within a room that allows for a future subdivision and so on such as those shown in Part 1.

The case study is primarily plan based. A common research tool for architects is to study other architect’s plans. In the history of architectural publication many books present the plans of houses. When the plan is presented by itself, the reader is expected to have architectural experience to understand and interpret the knowledge contained within, like musical scores, you have to know how to read them. What is being conveyed is not made explicit.

A combination of annotated diagrams overlaid onto conventional plans and sections with a supporting text communicates the design concept (Fig. 33 and 34). The overlaying of the diagram so that the plan is still visible allows a clear and direct relationship between the concept and overall design, presenting its individual nature within an integrated design simultaneously. This approach has not been encountered in other case studies and distinguishes these case study analyses from previous similar research.

To diagramise the embodied knowledge immediately into a stand alone diagram does not reveal the context in which the element was ‘known’ and ‘embodied’. It also does not sufficiently communicate the complex nature of the plan where for example a concept may rely on its position within a larger plan.
3. Internal/External Relationships

Alternative Configurations:
External

Egress and Circulation
Separate egress from each bedroom creates an independent external aspect and connection. This relationship also applies to the bathroom, allowing the space between boundary and house to be used as an external hallway.

Fig. 13 Plan diagram showing independent access to bedrooms from outside.
Fig. 14 View of external aspect from bedroom.
Fig. 15 Plan diagram showing use of space between boundary and house as external hallway.

Service Space
The external space adjacent to the service quarters and kitchen area is an external laundry area for washing and drying clothes.

Fig. 16 Plan diagram showing external service area.
The development of the diagram graphic language aims at being revelatory. It highlights the elements and relationships using simple graphic representations: for example: permeability - dotted lines; hierarchy - tonal shading; enclosure - solid lines, and so on (Fig. 35). In this way the diagram's key purpose is to be revelatory (rather than instructional).

**Precedents of articulation and diagrams**

The use of case studies and diagrams has long been used in architecture. Generally, they remain knowable to the discipline only, are not explicit, and usually identify an intention or architectural notion or as for diagrams generally, are instructional. This can be seen in some examples that are typical of this use of the diagramised case study. I will discuss these examples and compare them to the method adopted by the analysis carried out here.

Conventionally, architectural case studies are presented in three ways: the plan or architectural drawings with commentary text; the architectural drawings and a separate diagram and commentary text, or a sole diagram with commentary text. These are usually also shown with photographs of the project. The use of the diagram is important, it shows an idea separate from its physical context. However, as already discussed, to merely diagramise the embodied knowledge immediately into a stand alone diagram does not reveal the context in which the element was 'known' and 'embodied'.

A recent and typical example of the cataloguing of plans, "Formats for Living: Contemporary Floor Plans in Amsterdam", presents floor plans in their conventionally drawn architectural language (Fig. 36), with a commentary text on a separate page. The floor plans are not annotated and the text does not specifically address the design concepts.

There is a reliance on the skill of the architect to 'see' and 'know' the embodied knowledge. When the plan is presented by itself, the reader is expected to have architectural experience to understand and interpret the knowledge contained within. It is not made explicit. Similarly, the 2004 edition of Birkhauser's "Floor Plan Manual" is a comprehensive collection of floor plans categorised by type: Multi-storey or Low-rise, then further categorised by themes such as Multi-storey: urban infill, corner

---

**KEY**

- **External**
- **Living, Dining**
- **Circulation**
- **Flexible space**
- **Bedroom**
- **Sight/light line**
- **Movement line**
- **Air movement**

---

Fig 36

buildings, freestanding structures and so on. The projects are presented in conventional architectural plan and section but are specifically focussed on the plan design. They are described through a text. Unlike the analyses of the case studies presented here, the ideas are not explicitly drawn out, abstracted or described to the reader.

While this may not be thought of as a problem to the architectural profession, as I argue, we can ‘see’ the knowledge: “...it should be a useful source of advice to the architect, a reference handbook...”31. However, I also argue that it is the actual capturing of the knowledge in the method set out in this thesis that validates the knowledge and knower, and facilitates the discussion of a type of knowledge. I argue that this contributes to the use of the knowledge base as a research tool as discussed earlier and also to a wider extension of the knowledge base than would have otherwise been possible.

Although conducted independently, several categories are defined and isolated in a similar way 32 to those identified in the Case Studies: access, number of units, parking, open spaces and so on. In the Floor Plan Manual, these are presented as issues of central importance when designing a plan and are discussed for their potential and effect as ideas isolated from the specific examples or context of a problem. For example when discussing the significance of Access:

Just as important as opening the apartment is the suitability of accessing facilities to serve as a place to stand or sit. This characteristic is most important for the area just in front of the apartment and building entrance...33

and

...Horizontal access units – so called passageway types – are based on the principle of a row configured sequence of apartments or apartment groups along a common horizontal access axis. This access axis can be arranged centrally or at the outside of a building...34

Without a context of an actual project this sole method of description is unable to show how the architect can know or project because links are not made. This type of knowledge is better described as a presentation of...
design knowledge as an instructional pattern. A differentiating factor of the method used here is that it links a need to an outcome, as opposed to showing a design and discussing its value. This part of the method – the use of a context – by showing the original project – validates the ability to 'know' of the architect through the search for physical iterations embodied in case studies and the revelatory diagrams and the way that the knowledge is embedded and accessed within designs rather than instructions.

The *Floor Plan Manual* is an impressive collection of floor plans and would be a valuable resource for an architect as a precedence reference. When designers study an architectural drawing or built project, they recognise the possible precedence without the need for explicit explanation yet, at the same time, understand how the precedence will be different and transformed in the uniqueness of their developing project. The recognised situation is understood as both similar yet different. In this particular context there is little need to articulate the design knowledge. To repeat a point made earlier, the main distinction of the case studies presented in these catalogues and the ones in the thesis is one of aim. The analysis of case studies here is aimed at the revelation and articulation of architectural knowledge and so the 'what' that is understood by the architect, is explicitly drawn out and shown. This has not been encountered in such a manner in *The Floor Plan Manual*. This articulation also allows for the extension of the knowledge in a more comprehensive and deliberate manner than if it remained unarticulated.

The publication *Team 10 Primer* in 1968, edited by Alison and Peter Smithson, made a valuable contribution to the communication of architectural knowledge. The document aimed to establish a 'primer' of a group of architects, that is, to communicate the essential ideas in this case of urban design in response to the generic rules and guidelines of town planning:

"The object of the primer is to put into one document those articles, essays and diagrams which Team 10 regard as being central to their individual positions."

Many of the diagrams are annotated, extracting their essential message in what are referred to as ideograms. They are drawings in their own right that attempt to convey a concept (Fig. 37).
The publication is an attempt to reveal and discuss the knowledge of design that is central to the way that each member of Team 10 designs and the ideograms are symbolic of an idea that is often qualitative and so concerned with an approach.

The contribution of Team 10 Primer to the research is through the notion of architectural primer, documenting key concepts of design through ideograms. It led to the consideration of the stand alone diagram and its capacity to convey an idea. In this way the diagram is symbolic and not necessarily identifiable with a specific project such as the diagram shown above. While the ideogram is a powerful technique for communicating the essential quality of a concept, it does not explicitly reveal how this is carried out in a physical design. It bypasses the revealing or capturing that demonstrates the capacity to know and without articulation accepts that this occurs. The diagrams developed for the case studies here are distillations of physical representations rather than symbolic ones used to highlight a relationship.

A further and different reference for the communication of architecture design through diagrams was found in "By Design – Changing Australian Housing" by John Baird. This excellent book presents alternative housing designs addressing perceived fluctuating household and living arrangements that are not reflected in the conventional nuclear family house. It provides a direct example of the discussion of architectural concepts within a house through diagrams. A context is presented.

Baird presents projects as abstracted plans that identify the main elements of the house such as the rooms, doors and windows, illustrating in diagrams concepts such as staged additions and divisions according to changing needs of the house (Fig. 38). The concepts are illustrated in abstract diagrams and actual plans. The ideas presented are concerned with the arrangement of the dwelling plan primarily for its adaptability to be subdivided and/or added to as a household changes and the diagrams reflect this identifying stages of addition, subdivision and the use of zoned planning. The concepts remain at this level, however, without articulation through detailed analysis. They reveal a type of knowledge that was employed by the architect when assessing the background research in the Ageing of Aquarius project the ability to project an abstract solution. These are shown as organizational instructional diagrams, a
Fig 39
method sometimes referred to as the bubble diagram which allows usually programmatic relationships to be considered prior to their geometric and distributive arrangement (Corbellini 2006, 88-95). Where the case studies presented here differ is that they then seek iterations of these ideas thereby demonstrating the capacity to know and the existence of a knowledge base embodied in existing designs.

Abstracted plans identify the main elements of the house such as the rooms, doors and windows, illustrating in diagrams concepts such as staged additions and divisions according to changing needs of the house. (Fig. 39)

Previously, I argued that to communicate abstract design concepts without a context was to propose patterns i.e.: this is ‘what’ to do and ‘how’ to do it, rather than the ‘what’ that is known. A key and highly regarded example of this is Christopher Alexander’s A Pattern Language. In A Pattern Language, evidence based solutions to the ‘problems’ of architecture and urban design are illustrated and described. Although a context is proposed in the form of a problem to be solved, the problems are different than the context set up by the background research in that they are concerned with qualitative and stylistic issues of the built environment and reveal distinct philosophical differences. The design knowledge is presented through diagrams, photographs and text description. The diagrams are philosophical visions of an idealised scene. They are arrived at by studying existing scenarios according to values of beauty and function. Alexander acknowledges these are subjective notions. Although it can be said that the patterns were to be tested in new applications (and so open to change rather than a rule), they are highly prescriptive and work together to form a ‘language’; each one is reliant on several others being present to complete the pattern, “In short, each pattern can exist in the world only to the extent that it is supported by other patterns.” They require almost total control of the building, its immediate environment and ultimately an entire built area. In this way they are considered outside of other complexities involved in bringing a building into being.

In Alexander’s Pattern Language, designerly thinking is not admitted a voice. Design is presented as empirical knowledge that can be put together through the assemblage of a series of elements. Alexander is arguing for a change of built environment to a highly qualitative, even utopian end that relies on prescriptive elements forming patterns. These designs are presented without a physical, social, cultural or economic context.

In order to use the pattern for a high rise building you would have had to already establish that as the appropriate outcome. In this way design would not be contributing to a ‘whole of world view’ strategy. In the case studies presented here, the research proposes design examples so as to demonstrate a way to approach scenarios using designerly thinking as a strategy to affect the governing variables: it is an anti-language, or lingua franca that emphasises the very flexible nature of design and establishes the knowledge base by revealing the architect’s capacity to ‘know’ and ‘project’. This is argued by presenting the same design concept through different physical iterations that are capable of absorbing and integrating their variable contexts and peculiarities. Alexander does suggest that one can alter the designs and that in different applications they would always result in different outcomes. Although, given the highly evocative and prescriptive qualitative nature of the patterns, their successful reapplication is unconvincing.

A study and diagramisation that at first appeared very similar to the case studies enabled some key differences to be determined. Precedents in Architecture attempts to ‘reveal an architectural idea... The technique for this search is the careful examination and analysis of buildings’. While seemingly similar the aim is reflected in the way the projects are diagramised: "the desired result is the development of theory to generate ideas with which to design architecture". These analyses are very similar in graphic technique to the ones carried out for the case studies as they attempt to convey essential characteristics or relationships in a building by overlaying a diagram on top of a simplified plan, elevation or section (Fig. 39). This has the effect that orientation is clear, and the knowledge revealed does not have meaning if the diagram were presented alone, rather, a further diagram would be required in order to sustain the meaning.

In this case the diagram is revelatory rather than instructional and its presentation with the design project (plan etc) is critical to the aim of revealing knowledge embedded within a specific design. The concepts presented are isolated as approaches that achieve a desired outcome. In this way the aim is actually quite different than that of the case studies, being concerned with an overriding concept that is followed to achieve a particular outcome such as Symmetry and Balance or Unit to Whole, as opposed to addressing an issue. They are concerned with opposite ends of a process as it were. This does have an effect on the diagram. The analyses represented in diagrams in Precedents in Architecture retain a
level of obscurity, best showing the 'how' rather than the 'what', without a context of an issue or a description of what is known in the case study or revealed by the diagram.

In the case studies, the diagram’s key purpose is to be revelatory and so relies on the simultaneous presentation, annotation and descriptive text to be explicit. The use of the context demonstrates the 'link'– to see what the architect is looking for, and makes a case for the value of this type of 'thinking' and knowledge. At the same time the ability to make hunches and 'project' was carried out at the level of the development of the matrix. This communication method does not rely solely on an architect’s ability to understand and interpret architectural plans – a validation of the success of articulating tacit knowledge.

Meaningful interpretation, or design, into a unified whole would however require the skill of an architect and this could potentially be considered a limitation of the outcome. I argue that this requirement validates discipline specific skills of the architect.
2.4 Application and Transformation of Architectural Knowledge

The Multi-family House and Adaptable House are designs that were carried out after the analysis and were in different ways influenced by this research. The Multi-family House, designed by me, applies a range of design knowledge identified in the case studies, most clearly linked to some particular elements of the Farfor House by Grounds & Boyd in Portsea Melbourne. The Adaptable house, designed by Shane Murray, Diego Ramirez, and Graham Crist applied a range of design concepts identified in the case study analysis. These two projects have been analysed by me using the same technique and categories. This assists a discussion of the transformed concepts and the claim of creation of new knowledge through new iterations. This comes about through the admittance of other architectural knowledge as well as the new scenario of each new project and I argue that the flexible thinking of the designer integrates and transforms the knowledge into new knowledge.

The Adaptable House and Multi-family House are shown in this section to demonstrate the notion put forward in this thesis of the transformation of knowledge into new knowledge. Both the Adaptable House and Multi-family House are included in complete form in the case study package itself. Both projects have a direct relationship to the case study work, one I can explain being the designer, and in the case of the Adaptable House, Shane Murray, the Chief Investigator of the Ageing of Aquarius project was also part of the design team.
Case Study Twenty Nine
Adaptable House

Melbourne, Victoria
Shane Murray, Diego Ramirez-Lovering, Graham Crist
2008
Single family detached house

Configuration: 2–3 bedroom with multi-purpose space
Single storey

Size: 375 m² site
150 m² house

Project Description

Designed for a typical subdivision site, this rectangular planned house contains two bedrooms and a third space that could be used as either a bedroom, workspace or a second household. The flexible uses for this room are supported by an independent entry and kitchenette, the large room size and its adjacency to a bathroom. In addition, careful thought has been given to the aspect, materiality and amenity of the carport to create a high quality space that can be used for various sheltered outdoor activities. The passive solar orientation and an adaptable building envelope of the design suit different orientations.

This project was designed according to common Australian construction processes to demonstrate several design principles while addressing affordable housing. It comprises a simple arrangement that can be adapted for various uses without physical alteration through careful spatial planning, arrangement and adjacencies.
The Adaptable House

The method that arose from the Ageing of Aquarius project, the matrix, could be considered to have been followed through to its outcome in an actual design of a house some years later. The Adaptable House (Shane Murray, Diego Ramirez-Lovering, Graham Crist) employed many of the design elements identified throughout the case studies. I have carried out a study using the same case study method to reveal their iteration and creation of new knowledge (Fig. 40). Although I was a member of the research team, I was not involved in the design of this project.

The Adaptable House was carried out with the benefit of the designers having systematically analysed and acknowledged the knowledge base which led to an increased capacity to design for and intention to achieve flexibility of use. This process reveals the value of the articulation to the profession.

In this case study the following concepts are transformed under the categories:
- Site, Siting, Shape: Alternative Configurations: Buildings on Sites
- Internal Configurations: Individual Collective Housing, Alternative Configurations Internal, Passive Flexibility
- Internal External Relationships: Alternative Configurations External, Multiprogramming External

This project was designed according to common Australian construction processes used in the housing market: concrete slab, brick veneer construction (external brick skin with internal timber frame) and is a detached single house on a lot, commonly described as a single family house. However, the house can actually be used by two households independently, provide a suitable workspace and provide a large open space through multi-use of car parking spaces. This flexibility house is achieved through plan arrangement, access and amenity.

Site, Siting, Shape: Alternative Configurations: Buildings on Sites
Designed for a typical Australian rectangular shaped subdivision site, this rectangular planned house is positioned to one side of the site, as opposed to the centre of the site, with the larger setback facing north. This connects the outdoor space to the living area (Fig. 41). It also defines three separate
outdoor spaces: the patio style space shared with carparking, the north facing side yard and a rear yard (Fig. 42). These design concepts of siting can also be seen in the Furlan House (Fig. 43 and 44.). They achieve a range of spaces that have different functions and spread the amenity across the site as opposed to a single backyard which limits the internal/external relationship with multiple spaces. The siting aspect of the design has significant consequences for the amenity and access to internal spaces, and therefore their use.

Internal Configurations: Individual Collective Housing, Alternative Configurations Internal, Passive Flexibility

The house contains two bedrooms and a third space that could be used as either a bedroom, workspace or a second household – individual collective housing (Fig. 45). This last possibility is facilitated by the zoning, or grouping of components that would enable two households i.e.: a bedroom with a bathroom, living, kitchen and outdoor space (Fig. 47). The uses for this room are supported by an independent entry, kitchenette, the large room size and glazed doors and its adjacency to a bathroom (Fig. 47). These concepts are described generically as Access and Egress, Serviced Space, Surplus Space, Internal/External Relationship and Adjacency. This type of plan adjacency was a focus of the ‘looking’ in the case study analysis. In the matrix research method, the flexible use of the house for either work or a second household (returning adult children, ageing parents, rental income, or mutual support households) was identified as a ‘housing solution’ to several of the issues facing the baby boomers. As a solution, a hunch was made using design experience that a house that could be used by two households would address a range of issues as described above. This hunch gave a purpose to the looking, where previously unconsidered and nuanced solutions were then identified in case studies that then widened the possible design solutions and in turn, the ‘looking’. Rather than the solution remaining abstract – ‘house that accommodates two households’ – the actual components that facilitate this are identified in a physical iteration. The combination of several components becomes apparent: reliance on an independent entry, service distribution, amenity and size of room.

Passive Flexibility is achieved through the techniques described above, but is underpinned by the amenity provided to the front room from the treatment of the carport space through materiality and adjacency to the garden.
Zone separated from house by sliding door

Fig 45

Detail Plan

Zone 2

Living
Dining
Bedrm
Bathrm
Large room
Serviced room
Kitch
Amenity via transparent roof + outdoor space

Fig 46

Detail Plan

Fig 47

Ground Floor

Surplus space used as workspace

Fig 49

Garage

Courtyard

Covered Terrace

Hall/transparent roofed garden

Fig 48
The carport is connected to the side outdoor space and front garden by large openings. This adjacency and the light transmitting roof material (polycarbonate) transforms the carport into a pergola type space suitable for shared outdoor use.

This ‘underpinning’ of amenity can also be found in the Farfor Houses in the veranda type hallway; (Fig 48: the location of the open space allows sunlight to penetrate the plan in any orientation and therefore has the potential to rotate and mirror the plan. Each room can open onto a private open space;); in the Napier Street Housing garage materiality, adjacency and aspect to a courtyard (Fig. 49: the garage space is large enough to accommodate a car with additional space. This surplus space can be utilised as a workspace or workshop area. In order to accommodate these uses, the garages are designed with a higher level of concrete finish than is normal. The use of a screen and glazed entry to the courtyard improves the amenity of the garage and transforms it into a habitable space); and in the Furlan House where the car space can also be shared as an outdoor space (Fig. 44).

Internal External Relationships: Alternative Configurations External, Multiprogramming External

The ability to change the internal external relationship is realised by the construction system. The rear wall of the house is lightweight timber frame and cladding. Windows, or glazed doors, can be added into this system with no affect on the overall structure. This type of flexibility, that relies on the construction system, is only touched upon a few times in the case studies in favour of a more user and occupier led flexibility facilitated by the actual arrangements.

In this instance the flexibility through the construction system allows the house to retain its amenity in an alternative orientation (Fig 50). The living space could receive northern light if the orientation of the lot were to rotate through 90 degrees. This type of flexibility is very effective in this example. It is a simple realisation of construction based flexibility and is a predictable and easily implemented option that addresses the common issue of orientation in market designed housing by using their own construction techniques.

This concept, to allow for different window placement, relies however on
the siting arrangement as described in the Site, Siting, Shape section. The siting of the building creates an outdoor space at the rear, which in this example would become the north facing yard and the side yard would become the service yard.

The different elements that facilitate the use of a house in a particular way can be identified throughout the case studies. However, they have been recombined in the Adaptable House. The success of an element often relies on its pairing, or multiple combination with other aspects of the design, and furthermore, their adjacency and overall position in plan to one another, but also on the site. The capacity to recombine the elements into an integrated whole most often requires a physical change in that element from how it may occur elsewhere, or, from the case study from which it was known. By unpacking what is 'known' through the articulation such as that carried out in the case studies here, the nuanced way that an element 'works' enables the designer to then change it without compromising the performance. It is in this change that new knowledge is created both in the new physical iteration (this is another 'way' this can be achieved) but also in a further nuance of the original element and how it performs.
The Multi-family House

This project was carried out in 2006 in the practice I share with Mauro Baracco, Baracco+Wright Architects. The actual study was carried out later, 2009, by me. I discuss it here, and acknowledge how several of the concepts identified in the Farfor Houses in particular are transformed in this new design. The inclusion of this project as a case study in the same manner as those analysed in the earlier studies shows further what I mean when I say that designers can think flexibly to transform knowledge they ‘see’ in a study in a new context to create new knowledge. In this example this idea is validated in that I carried out this case study – I am the knower – and I carried out the design in which this knowledge was transformed.

I recognise the catalytic nature of concepts identified in the Farfor Houses in the generation of the Multi-family House. At the same time I can recognise a different physical manifestation of knowledge contained in other case studies unknown to me at the time of designing, such as the use of outdoor space as hallways in the project Alfonso Reyes Apartments. The same knowledge occurs in different projects and is both iterative, such as in the case of the transformation of concepts identified in the Farfor houses in the Multi-family House, but also unrelated such as the relationship to the Alfonso Reyes Apartments. It is my analysis that identifies the same knowledge in different physical outcomes rather than the intention of the designers which also validates the description of how designer’s think being able to identify the same concept even though it is physically different.

The Farfor Houses have been a consistent reference for my own design work. I was aware of this project prior to undertaking the case study work and it came to (my) mind as containing a range of design solutions to the issues established in the background research when using the matrix research method.

The Farfor Houses have influenced, directly and indirectly, my approach to planning. In particular, the role of circulation spaces as plan generating catalysts and multi-use spaces, as well as an attention to the spatial quality of circulation spaces rather than rudimentary hallways or links.
Case Study Thirty
Multi-Family House

Wye River, Victoria
Baracco+Wright Architects
2006
Multi-family detached house, unbuilt

Configuration: 3 bedroom, 2 kitchen
Elevated, single storey

Size: 1600 m² site
150 m² house

Project Description
This house was designed as holiday accommodation for three separate couples, one with children. It allows each to have one separate space and private bathroom, with shared kitchen and living space. All rooms are united under one roof but separated by an internal deck with a transparent roof that operates as a hallway with open ends. The concept of the open hallway was primary to the program of a holiday house, which would be used during the day and should therefore have a high level of amenity. It is three metres wide at its maximum, allowing for alternative use as a room.

This project is a model for a single-storey house that has independent and shared facilities. It re-interprets design concepts seen in Individual/Collective case studies where rooms can be separated or united allowing for different levels of privacy. It also refers to Passive Flexibility case studies such as the multiple use of spaces due to independent access, and the use of doors as walls with particular consideration for door sizes and room types serviced by openings.

View of house and undercroft
Western view towards entry
1. Covered Deck
2. Entry
3. Bedroom
4. Bathroom
5. Kitchen
6. Dining
7. Living
8. Open Deck
I argue here that the Multi-family House creatively recombines knowledge articulated in the case studies into new iterations and that, more than the sum of its parts, results in a hybrid typology that could be considered a significant contribution to the architectural knowledge base that would not have been realised without the interrogation of the knowledge applied.

The Multi-family House project combines the typology of the single family house and multi-unit through a mix of independent and shared facilities. It transforms design concepts revealed in the case studies, where rooms can be separated or united allowing for different levels of privacy, use and combination, access, and the use of doors as walls. As found throughout the case studies, the circulation and amenity are central elements of the flexibility. This last point has been particularly important in the development of the planning approach in my design work. Two recent projects that could be placed in this trajectory, the Rose House and Fitzroy Community School Creative Spaces are discussed in more detail in the next section.

Four contained spaces – three rooms each serviced by a bathroom and a fourth space accommodating shared kitchen and living room are united under one roof but separated by an internal deck with a transparent roof that operates as a hallway and open space (with openable ends) (Fig. 53). In the Farfor Houses the internal courtyard and covered hallway with a transparent roof, provide a variety of private semi-external spaces (Fig. 51 and 52). The location of the open space allows sunlight to penetrate the plan in any orientation and therefore has the potential to allow the plan to rotate and mirror. Each room can open onto a private open space. The hallway is also a roofed garden. The bedrooms open onto this semi-internal space and therefore ignore the boundary condition. The space is an extension of the private open space, but is a sheltered alternative.

In the Multi-family House the use of the hallway as a semi-outdoor outdoor space, its use to admit amenity through daylight and its dimensions (3m wide) being amenable to multiple uses have clear relationships to the design elements identified in the Farfor Houses. These elements however are transformed through the forces of the site, program and integration into an overall whole. The following discussion identifies these links and also describes the new knowledge generated. In particular the elevation of the volume distributes the outdoor space sectionally (Fig. 54).
I use the same categories used throughout the case studies to develop the discussion:

Site, Siting, Shape: Alternative Configurations: Buildings on Sites, External Elements

The building is elevated above ground, in response to a fragile and steep ground plane. The elevation creates an undercroft space that can be used as an outdoor space, car park and storage area (Fig. 55). The open undercroft allows for vehicle access from any direction enabling a flexibility of placement on the site, a notion identified in the Farfor Houses as introducing flexibility into the siting. This concept is also used in the Furlan house where car access is provided from two directions. The use of the space beneath the first floor for a sheltered car park is also seen in the Latapie House. However, the elevation of the house to introduce density and siting flexibility was not encountered in the case studies but was an outcome of the site conditions.

Three outdoor spaces, or external elements, are all located within the footprint of the building: a deck in the undercroft; a semi-enclosed deck as 'hallway'; and a rooftop deck (Fig 54). The multiple outdoor spaces support the capacity to house multiple households and the use of space in many weather conditions (Wye River is a high rainfall area making the use of sheltered outdoor space particularly useful). This last aspect increases the performance of the house to offer a high level of amenity: shade, shelter and solar aspect.

This configuration is an economical use of land, where car parking, the house and the outdoor space occupy the same area achieving an increase in density of spatial use (Fig. 56). Although this area is low dense, it has significant trees, under storey vegetation and is sloping. These characteristics meant that a compact footprint was important.

In this project the four rooms are supported to achieve a level of individual within collective not only by the deck hallway, but also by the servicing of each separate room by its own bathroom (Fig. 57) and one has its own kitchenette. The grouping of separate serviced spaces allows for the co-habitation of two or three separate households with a shared kitchen. This maintains independence as well as mutual benefit and support for each. The whole is achieved by a common floor and roof giving the project a
Pool/Deck
Courtyard
South element:
Couple + Child

East element:
Mother + Sister

North element:
Kitchen/Dining/Living

Fig 58

Fig 59

Apartment Type 3 Plan

Fig 60
collective sensibility. This approach to individual collective housing, where occupants can adjust their independence as required, can also be seen in the Mt Eliza House (Fig. 58: the house forms a three-sided courtyard. The south element accommodates the couple and child, the west element houses the mother and sister. The angled northern element contains communal kitchen, dining and living spaces.); the Stanga Apartments (Fig. 61: each apartment has one party wall and one wall facing a circulation path. This provides separation between individual apartments of each block and creates the sense of collected yet semi-detached housing); and Alfonso Reyes Apartments (Fig. 59 and 60: apartment type seven has three separate ‘buildings’ linked by glazed hallways, and separated by the internal patios. The separation of activities created by the patio system allows spaces to become flexible, as different use of some parts of the dwelling will not disturb others. The arrangement of several apartment’s plans and sections supports the co-habitation of two semi-independent households. This is facilitated by the separation of one bedroom area from another, a bathroom for each bedroom, and the Living and Kitchen space located centrally).

This type of housing design significantly improves the performance of the house to cater for a range of requirements.

The key design concept that facilitates the possibilities outlined above in the Multi-family House, is the placing of the outdoor space within the plan. As ‘known’ from the Farfor Houses, the plan then is autonomous from its boundary conditions and so its amenity protected.

This arrangement also facilitates a suitable workspace. The large rooms (surplus space) have their own entry (access and egress), bathroom (serviced space) and a high level of amenity for daytime use.

While there are many concepts identified, it is the multi-use circulation space afforded through amenity and dimension, that is the ‘gel’ of the concepts listed above. This can be directly traced to the knowledge articulated in the Farfor Houses.

This architectural knowledge was of most relevance to the Multi-family House. The concepts identified in Farfor may not have been the intentions of the original designer, but as the designer of the Multi-family House,
I could ‘see’ how the concepts could be useful to the new situation even though the program and site were quite different and applied the concept of a semi-outdoor, multi-use hallway. This approach was transformed into the cruciform shape that achieved a number of requirements: separate and service four individual spaces as a response to the brief for a multi-family holiday house, provide a sheltered outdoor space, and provide a compact plan (being elevated and on a sensitive site).

The plan dimension of the hallway is critical to its multi-use as an outdoor space. It is 3 metres, wider than a conventional hallway, open at the ends and with a transparent roof. The hallway is its widest adjacent the living area. The living space can be extended by opening sliding doors to the deck adjacent (Fig. 62). This condition can be seen in the Alfonso Reyes Apartments (Fig. 63): The glazed floor to ceiling sliding doors facing the patios, as well as the shape and adjacency of the patio – a rectangle shape parallel to the living space – create an extension of the living space when open. The living room space and deck space are combined to create a larger room enabled through the adjacency, shape of both 'rooms' and sheltered nature of the deck.

Internal External Relationships: Building Modifications: within envelope, Alternative Configurations External, Multi-programming External

Building Modification: within envelope, is a type of flexibility that requires the plan arrangement to be amenable to a future physical modification that changes the use through a minimal intervention. Strategies that allow for modification within the building envelope are particularly useful as they are more economical and realizable than extension of the building envelope. They also are applicable across the types of housing, especially apartments or dense housing that are often limited by their boundary conditions.

The Multi-family House could be extended within the existing envelope by infilling the undercroft space, or an addition to the rooftop (Fig. 64). The internal deck could also be in-filled, joining two rooms to make two independent dwellings each with a living room and kitchen (Fig. 65). The latter option is possible due to the extent of services, central access and individual nature of the spaces.
The Alternative Configuration: External, shown here as the placement of the outdoor space within the plan as well as its materiality (transparent roof) increases the amenity of each room by creating four exposed facades capable of receiving daylight and ventilation in all orientations and admitting light deep into the plan (Fig. 66). This can also be seen in the Barnard House (Fig. 67: the adjacency of the courtyard spaces to each interior space provides a high level of amenity. The use of glazed doors also allows each space to open onto the courtyard) and the Alfonso Reyes Apartments (Fig. 68: the use of the patios to separate each apartment provides four exposed facades capable of receiving daylight and ventilation in all orientations). Both were unknown to me at the time of designing.

The way that one design decision, such as the 'hallway as deck', has consequences such as separate access, amenity and multi-use of space is typical of the nature of design thinking. The design embodies multiple concepts that can be analysed as an individual idea, but often are reliant on each other in the design to work and this is reflected in the integrated whole of a design. This last point was an important consideration when developing the graphic communication technique to present the knowledge closely related to its originating context. When the knowledge is transformed it is both via the new problem at hand but also the way it must become part of a whole. The transformed concepts become new iterations and add to the knowledge base. The transformation can lead to, as in the Multi-family House, typological development: a hybrid of multi-family, multi-unit and single house type.
The consequences and conclusions of this thesis are several and are dotted throughout. It is not my intention to present a complete account of the implications of this thesis on my own design work and that would be a subject for further study. However, in aid of some of the arguments put forward here, I present two additional projects to the Multi-family House, that were designed in my practice with my significant input. When asking 'what came out of the thesis', I can place these projects in the trajectory of the Multi-family House with its own transformation of the case study material. They validate the claim of an enhanced ability to inquire (Downton 2003, 96) and the contribution of processes developed using the disciplinary knowledge base. I also argue that through the analysis and articulation of the knowledge embodied in the case studies, I was able to better understand the knowledge, how it worked and what it facilitated which enabled me to extend my architectural practice when it came to access, apply and transform architectural knowledge.

What has developed over the course of doing this thesis while at the same time being a practicing architect, is an expansion of the design process that I believe would not have occurred to the extent if I did not carry out the matrix and case study research and the subsequent reflection on this through this thesis. Although the use of case study and precedent in the design process is commonly undertaken by designers, the systematic nature of doing so in the manner set out here, and the actual articulation of the knowledge is not common.

This postgraduate study was a kind of in-depth training in architecture that has enabled me to widen my 'looking', knowing 'what' to look for and ability to 'see' knowledge embedded in design projects and articulate, study and control the transformation of the knowledge. It has developed an awareness of the disciplinary skills and knowledge base of my profession. This may sound odd. Why wouldn't I already know this? I couldn't say I understood architecture, the design process and design thinking prior to undertaking this thesis in the way I now do. For me at least, but I think this is also common of the architecture profession as discussed elsewhere in this thesis, I knew things and I knew how to make a design, but it was occurring in a sort of fog. Decisions were made dynamically through hunches, tested and then developed. Knowledge was accessed through case study and precedent in a less systematic way, often through encounters where the...
meaning or value to my problem at hand was understood quickly but often without the depth encountered in the case study material.

The type of understanding of the knowledge afforded by carrying out the research in the manner set out in this thesis, particularly its articulation, widened my understanding of the way the knowledge worked and its integrated nature. This is very valuable when it comes to apply that knowledge as one understands what is of value. The innovation of new knowledge is assisted by a better understanding of its development and there is a level of control not present prior. It could be said that this is also due to an increase in experience gained over this time. Although it is difficult to distinguish the contribution precisely from built up experience, I would say that it has contributed significantly to the development of that experience.

In the next section I discuss how this has occurred in The Rose House\textsuperscript{40} (2009) and Fitzroy Community School Creative Space\textsuperscript{41} (2011).

\textsuperscript{40} The Rose House was designed primarily by me. I acknowledge the contribution of Mauro Baracco in the critique of the design which was of great value to the process and eventual design outcome.

\textsuperscript{41} The Fitzroy Community Creative Space was designed in collaboration with Richard Stampton Architects. I was the principal designer. I acknowledge that the design was realised collaboratively with Richard Stampton and Mauro Baracco.
The Rose House

In this project the design response benefitted from using the thinking employed in the matrix process. Presented with a traditional brief for 4 bedrooms and 3 bathrooms (and so on), through interrogation of the brief we uncovered factors contributing to the requirements. This led to the development of particular design concepts being employed that are identified in the case study research.

A defining factor for the accommodation was the requirement to separate teenage children from the parents. This was reflected in the brief as a two storey outcome, where bedrooms would be separated between floors. However, this solution did not integrate with other decisions influenced by the site and context response. The site is situated amongst the Coastal Banksia and Tea-trees along the edge of Westernport, south of Melbourne. Buildings, mostly small houses, are loosely arranged around and under the trees (refer Site Plan overpage). They have a scattered arrangement dictated by trees, solar orientation, the views on the site and relationship to surrounding buildings. Properties are mostly unfenced so that buildings sit within a visually continuous landscape. A two storey volume was inconsistent with these conditions: small, scattered, low or single storey, and 'in' the landscape rather than above it. A solution was sought that could integrate a response to these conditions as well as distribute two accommodation zones.

Rather than make one large or two storey house, the house is split into two separate volumes (Fig. 69), pavilion 1 and 2 being respectively a big and small house, connected by a central outdoor deck. This move continues the building pattern of the area of small buildings scattered in the landscape with the deck and main living area orientated to the winter sun. The same technique is used for the Garage, rather than attaching it to the main volume. This response was also influenced by the inclusion in this spatial condition of an existing cottage (small existing boatshed built circa 1940).

In the matrix and case study research, a recurrent concept was the use of two volumes connected by an outdoor space or a type of flexible link such as a hallway. This was often the catalyst for a high level of flexibility and amenity. This can be seen in the Pavilion House (Fig. 70: two volumes...
Floor Plan

1. Entry
2. Deck
3. Kitchen
4. Living
5. Bathroom
6. Bedroom
7. Perimeter hallway
8. Garage
9. Cottage (library)
View of two pavilions and connecting deck from north east

East elevation of pavilion 1 showing perimeter windows

View of deck connecting pavilions
View of main house (pavilion 1) showing screened core

View of main house (pavilion 1) showing ‘inhabited’ hallway around a core

View of main house (pavilion 1), garage and cottage in distance, scattered in landscape
are linked by a glazed passageway) and the Kempsey House (Fig. 71: the sleeping and living activities are grouped into separate zones that each occupy a pavilion). The transformation of this concept in the Rose House occurred through a combination of the new brief, site conditions and our response to those. This particular design outcome would not have occurred if the design concept had not been integrated into a new whole.

I accessed the built up knowledge that I gained by doing the case study research when considering solutions for this project. While I did not undertake new case study in the same manner as carried out here, I attribute an enhanced ability to identify embodied knowledge in case study to this study. The time between doing the case study and carrying out the design was close\textsuperscript{42} and so the knowledge was fresh in my mind. However, I strongly argue that the value of the case study method lies in the articulation and capturing of the knowledge. Time constraints in practice may limit such in depth study and this could be seen as a limitation to the value of this method to disciplinary development. This could be addressed if the critique and documenting of architecture in journals and magazines could encompass such a discussion and knowledge capture that is then available to the profession. Also, the use of knowledge capture techniques such as the case study method set out here in education would at least provide an enhanced ability to continue this type of development into practice.

When applying the knowledge in this new setting of the Rose House, a better understanding of what made the concept successful and what it had to offer as a consequence of the built separation was afforded by the case study articulation method. It is reflected in several decisions such as the inclusion of multiple entries that allow the volumes to be linked or accessed separately (Fig. 71 and 72).

The entwined nature of design decisions is revealed in how the interior plan was developed in sympathy with the two volume approach and what it had ‘to offer’. A more compact footprint is afforded, allowing the volumes to sit with space around them, that is, within the landscape. The plan was developed to both aid the compact plan and take advantage of the landscape condition particular to this place and afforded by the two volume concept. The plan of the big house employs the perimeter veranda typology, enclosing it for a cooler climate, and using it as the

\textsuperscript{42} Several of the case studies presented here were carried out by me in 2009 in addition to those carried out for the Ageing of Aquarius project (circa 2005): Courtyard House and Flat, Barnard House, Courtyard house, Alfonso Reyes Apartments, Adaptable House and Multi-family House.
There was no overriding main view on this site, but rather a consistent vegetated outlook.

Fig 74

Fig 75

main circulation (Fig 73). Bedrooms and bathrooms are placed in the core of the plan, opening onto the hall through louvered walls. The 'veranda' widens in places to become a room, and is occupied by a Kitchen and Living space. The perimeter hallway transforms the concepts of multi-use space and room borrowed for circulation (Fig. 74). The perimeter windows create a continuous connection with the landscape as you move around the edges of the plan. The use of continuous windows means that spaces can be shaped as required rather than defined by their relationship to a window or key view\(^43\). The casual, flexible and day time oriented nature of such spaces was considered suitable for a holiday house.

The perimeter hallway facilitates these concepts into an integrated whole. Circulation spaces as organisational and spatial catalysts have been a focus of my practice that I attribute in large part to the case study analysis. Much of the case study analysis reveals how critical the circulation spaces are to the performance and amenity of the house. The focus on this aspect of the plan has led to the development of solutions to problems of program, amenity and flexibility. It has also been used by us to achieve multi-programmable space. This is an important area of investigation when requirements for the accommodation and performance of the house are increasing while land availability is decreasing. In the same way, high amenity solutions are necessary to successfully achieve a denser urban fabric.

Aspects of the plan were able to be developed further having had the benefit of in depth understanding of where opportunities lay in the plan arrangement by having been exposed to a wide range of concepts in the case study work. In the main house, pavilion 1, the two bedrooms are highly flexible rooms. The south eastern room can connect into the hallway space to make one large room by sliding away the louvered wall. This area can then be further separated from the remaining house through two sliding doors. The combined area could be used for activities beyond bedroom use due to its size and high level of amenity afforded through the perimeter windows. A level of separation from the rest of the house is supported by its adjacency and direct access to a bathroom (Fig. 75).

The second room can ‘borrow’ the hallway space by sliding open the louvered doors (rather than a single hinged door). It also has direct access to a bathroom by including a second door linking through to the bathroom.

\(^{43}\) There was no overriding main view on this site, but rather a consistent vegetated outlook.
The implementation of the design described above 'works' because you can access both rooms without crossing through the circulation path of the other. If you needed to access the same hallway, these arrangements would not be possible. In this way the connected nature of each concept (identified across a range of case study projects) in this new arrangement validates the flexibility of design thinking that leads to a transformation of the knowledge base.
Fitzroy Community School Creative Spaces

This new campus for an existing school is comprised of two buildings: a new volume facing the main street and a refurbished volume at the back of the site adapted from a mechanic's garage (refer plan overpage). The new building is positioned to create a generous, shared, sun filled courtyard between the two volumes and so as to maintain a consistent building set back to the street; both of which are typical qualities of this suburban fabric in Melbourne.

The more 'industrial' spaces in the volume at the back of the site provide workshops in which the 35 children of this school can engage with the making of art projects, various science investigations and theatre.

In the new building we developed the perimeter circulation design concept employed in the Rose House. However, to different ends, in this iteration the site conditions couldn't be more different than that of Merricks Beach: a busy road, rectilinear site and building pattern. The perimeter veranda here serves to create a protective outer layer to the core spaces from the busy road rather than expose the user to the site. It is a secondary circulation route to that within the central space which is useful in a public building and especially to a school programme, allowing spaces to be accessed separately (Fig. 76). Parts of the veranda are able to be opened up, enclosed, or shut off. The way that the veranda works could be compared to concepts employed in the Latapie House (Fig. 78), where a large volume is able to be open or closed.

Similar to the Rose House the veranda circulation planning technique facilitates a complexity and flexibility of spaces and access points within a compact footprint and introduces a high level of amenity to the circulation spaces. The abstract concept is transformed into this new situation afforded by a proper understanding of the parts that make it flexible or amenable to multi-use: the width and proportion being amenable to a range of uses, particularly in the case of the eastern veranda (3 metres wide), the ability to shut off the space to make an enclosed space, the reliance on alternative circulation when the veranda is used as a dedicated space, amenity through daylight and shade and the location of the spaces intended for multi-use in the plan which is also closely connected to its adjacency to outdoor spaces. The width of the veranda being room-like was studied in the Farfor houses and developed in the Multi-family House. The concept to shut
Context Plan

Street Elevation 1:200

Section 1:200

1. Entry
2. Veranda/learning
3. Kitchen/learning
4. Library/learning
5. Bathroom
6. Office
7. Classroom
8. Flexible room
9. Backyard
Street view showing double height veranda

Street view showing double height perimeter veranda
View of ‘core’ of the plan, kitchen and library from south (top) and north (bottom)

View of veranda space from north east (L) and front veranda (R)

View of enclosed ‘veranda’ office spaces
off the space as well as its adjacency to an outdoor space is found in the Latapie House (Fig. 78) under the heading Multi-programming Internal, Enclosed Exterior: the dwelling is configured into two linked elements. A street-facing element contains all living, bedroom and service functions. A 'greenhouse' element to the rear operates as an enclosed yard, supporting multiple semi-external functions for living, dining and service.

In the Fitzroy Community School, unlike that of the Rose house, the veranda perimeter circulation works in combination with the circulation within the 'core' volume. This arose out of the program at hand being more complex and requiring several routes: one around the perimeter that allowed users to bypass the hierarchy of the front door entrance to enter to yard space, back volume, backdoor or separate entry to the first floor (Fig. 76); and an internal circulation (Fig. 77) that allows the user to access the front and rear veranda, bathroom, offices and connect directly into the stairwell to the first floor – this last point allowing the first floor to be connected or remain separate via its own entry directly off the veranda, which bypasses the interior circulation.

The use of two circulation routes and multiple access points supports the different ways that spaces can be used where they were required to be able to be discrete yet also connected, multi-use and informal.

I attribute this proper understanding to the articulation process carried out in the case studies which makes the knowledge explicit rather than cursory and therefore able to be developed in such a manner. The multiple dependencies of concepts must be well understood to be able to transform it and still 'work'. For example, a cursory understanding of the enclosed outdoor space may identify that the space is clad in a lightweight material and able to be opened via large doors. The case study examination brought to bear several other components such as the connection to an outdoor space as well as the indoor space. However, importantly what is happening when such a concept is transformed, is that other similar concepts are also referred to for how they may solve the issue the designer is facing in the new project. This occurs because the new problem is different in use and context and because it is subject to the transformation of having to fit within a new whole. The example of the Latapie House does not fully account for the way that the enclosed outdoor space concept works in the School. The knowledge of several concepts are at play to combine an
outdoor enclosed space with the perimeter circulation: multi-programming of circulation spaces such as that in the Alfonso Reyes Apartments (Fig. 79) and Farfor Houses (Fig. 80) as well as multiple access points and rooms borrowed for circulation both found in the Barnard House (Fig. 81) and Courtyard House and Flats (Fig. 82).

It could be argued that this type of understanding is the knowledge architects tacitly hold. While I agree, I also propose that it is through finding ways to analyse, articulate and capture this knowledge that it can be widened and developed beyond what would occur when the application of tacit knowledge is applied without exploration.

The program of the school, and in this case, the particular teaching style of this school impacted on the development of the knowledge transformation. The brief asked for non-institutional and almost domestic type spaces. A lot of the teaching activity occurs informally and the design of multi-use flexible space in the room like veranda enabled learning and social activities that occur in an informal, play based and interrelated way, where every activity is a learning opportunity enhanced by an informal non-institutional setting. This is also reflect in the central space, a large room that contains a kitchen and library space. Following the approach of the school, the preparation and consumption of the everyday lunch is an integral part of the education curriculum, equal to that of the library.

The concept of multiple access points has been noted several times throughout this thesis as an effective way to increase the performance of a building. In this case the provision of two doors, one being separate to that of the school interior off the veranda, means that the first floor can be used as part of the school learning spaces but also, as a caretaker residence or visiting teacher accommodation. The first floor plan, containing one bathroom and 3 spaces aims to facilitate this flexible use. The bathroom is located off the stair landing, so it can be used by the school independently from the other spaces. This type of arrangement in plan while simple – the consequence of the bathroom position – is a good example of decisions learnt directly from the case study analysis that are now integrated into all the planning in our practice.

Similarly, two rooms on the first floor open onto small balconies via glazed doors. This introduces a higher level of amenity than would be found in a
Dining room

Circulation shared with room living room

Fig 79

Patio and access hallway from lift
Glazed sliding doors

Third Floor

Fig 80

Roofed garden as hallway
Courtyard as hallway

Fig 81

Circulation within house borrowed from rooms
typical bedroom. The northern room also opens to the hall through large sliding doors, also shifting the bedroom-like feel. These are other examples of simple techniques applied in many of our projects learnt form the case study: the nature of the doors as well as access to an open space for their impact on the performance of the room (Barnard House, Farfor Houses, Courtyard House and Flat, Napier Townhouses).

The development of typologies for learning settings is an important outcome of this project. The application of the circulation and veranda design concept can be traced to the understanding of architectural knowledge gained through doing the case studies and reflection involved with this thesis. As described for the Rose House, the concept both facilitates other concepts, such as separate entry to the first floor, and ‘works’ because of important factors such as the width, location and adjacencies in plan, that are integrated into a whole. For example, the eastern veranda can be circulation, but can also be a discrete room due to its size and the ‘support’ of alternative circulation routes, the capacity to close it off from the rest of the veranda and its amenity.

The way that concepts learnt in the case study analysis are transformed into an integrated whole in this new project validates the flexible thinking taking place when transforming knowledge in a new design.
3.0 Case Studies

119 1 Napier Street Townhouses
127 2 Wynnstacy Street Townhouses
137 3 Mt Eliza House
149 4 Queens Park Townhouses
157 5 Where House
169 6 Poll House
179 7 Ivan Calnin House
189 8 Courtyard House and Flat
199 9 Malaguerina Housing
207 10 Fukuoka Apartments
217 11 Stanga Apartments
227 12 Latapie House
235 13 Furlan House
245 14 Nomi House
253 15 Prototype Houses
261 16 Gifu Kitagata Apartments
269 17 Barnard House
279 18 Courtyard House
289 19 Alfonso Reyes Apartments
299 20 Farfor Houses
307 21 Pavilion Houses
315 22 Growth House
323 23 Coolangatta Road Villas
331 24 Commonwealth Games Housing
339 25 Cheddar Road Units
349 26 Elliston Subdivision and Houses
357 27 Kempsey House
365 28 Winterpark Subdivision and Houses
375 29 Adaptable House
383 30 Multi-family House
A Note on the Selection of the Case Studies

The case studies presented in this thesis were selected from a database of approximately 200 housing projects. A further 6 were then chosen and carried out independently by myself later (2008): Courtyard House and Flats, Courtyard House, Barnard House, Alfonso Reyes Apartments, Adaptable House and Multi-family House.

In the original project the studies were organised as follows: Post WW2 to 1983 Australian Housing projects, Australian Housing Projects between 1984 - 2010, and International Housing Projects between 1974 - 2010: (Australian Historical, Australian Contemporary and International Contemporary). In the contemporary categories there was not a focus on strict historical categorisation of dates or periods, but rather a focus on the value of examples and a convenient grouping made.

These groups aimed to ensure a range of housing types, scales and design intentions. For example, the majority of international housing available for study is medium to high rise, while in Australia it is low-rise single family detached houses. Post WW2 housing in Australia is generally smaller than later housing, yet often characterised by a higher level of typological experimentation than many contemporary architect designed houses and encompasses a rich period during the 1960’s and 1970’s. The decades prior to Post WW2 hold many excellent international examples of experimental housing designs, however we wanted relatively contemporary examples that present a range of housing types.

The case studies also vary between low rise (single family houses: single storey, multi-unit Farfor houses: single storey) and medium rise (Napier Street Housing: 3 Stories, Stanga Housing: 4 stories).

While many common themes emerge across the majority of the case studies and do not rely on their type, some unique concepts are encountered between the different types and highlight how some concepts are of particular relevance.
Six methods were used to source projects for database:

1. Architectural database searches on topics seen as important from initial research (e.g. collective housing, flexible housing).
2. Housing focussed international/national periodicals and books.
3. Noted projects further investigated: specific, well-known housing projects researched in greater depth. (e.g.: Malagueira).
4. Housing focussed well known International/ National Architects: monograph searches for particular architects and subsequent review.
5. Reviews of key national journals for projects: reviewing award winning housing projects.
6. Survey emailed nationwide to architecture schools and forwarded to architectural practitioners attending focussed workshops to review the research.

Projects were selected from this database on the basis of plan and/or sectional relationships that demonstrated a number of such design concepts or elements and relationships and as a set, provide a range of approaches. Their criteria for selection is outlined on the first page of each case study.
Napier Street Townhouses
Case Study One  
Napier Street Townhouses

Melbourne, Victoria  
Kerstin Thompson Architects  
2002  
Terraced townhouses

Configuration:  
11 townhouses  
- Type 1: 4 bedroom, 2 storey and mezzanine  
- Type 2: 2 bedroom, 2 storey  
- Type 3: 3 bedroom, 3 storey  
- Type 4: 2 bedroom, 3 storey

Size:  
- 1271m² site  
- 287m² Type 2 townhouse

Project Description
This project is located in the dense inner-city suburb of Fitzroy, Melbourne. The site is bordered on three sides by a service lane and two suburban streets. Each unit faces one of these sides, which allows for independent pedestrian entry and vehicular access. The masterplan creates eleven units that occupy the site similar in shape and size to the existing historic terrace housing. The eleven townhouses are split into four different types: Type 1 are four-bedroom units facing Napier and Little George Streets; Type 2 are two-bedroom units occupying the corner sites facing Webb Street; Types 3 and 4 are three- and two-bedroom units facing Webb Street.

This design provides elements that offer spaces for flexible use and configuration of the occupying household. The ground floor car park incorporates external connections and surface finishes that allow for other uses, such as workspaces. The sectional relationship between service and bedroom spaces allows a greater degree of independence between residents on the ground floor and mezzanine level. In addition, the site configuration of various unit types provides semi-communal external areas with high solar amenity.

View along Little George Street of Type 1 Units  
View of corner  
Detail of Type 1 Units
1. Site, Siting, and Shape

**Individual/Collective Housing**

Private/Collective External Space and Combined Amenity

The primary external space extends off the living area on the first floor. These external spaces are grouped together to combine skyviews, and decrease overshadowing. High perimeter walls create privacy to individual terraces. Partly clad in translucent material, these walls maximise visual privacy to terraces while maintaining solar amenity.

*Fig. 1 Plan diagram showing grouped terraces. Fig. 2 Aerial view showing translucent privacy fencing to individual unit terraces.*

2. Internal Configurations

**Passive Flexibility**

The Napier Street housing project is capable of passive flexibility. The spatial configuration, circulation paths and program arrangements of each townhouse allow for various uses of the ground floor. Typically, these are used as bedrooms, but can also be workspaces, or form part of a semi-separate household.

**Surplus Space**

The garage space is large enough to accommodate a car with additional space. This surplus space can be utilised as a workspace or workshop area. In order to accommodate these uses, the garages are designed with a higher level of concrete finish than is normal. The use of a screen and glazed entry to the courtyard improves the amenity of the garage and transforms it into a habitable space.

*Fig. 3 Plan diagram showing visual and circulation connection to courtyard from surplus garage space. Fig. 4 Perspective showing potential use of surplus area as workspace and connection to courtyard.*
2. Internal Configurations

Zoning
The living space of the Type A townhouse is positioned on the first floor, inserted between the ground and second floor bedroom areas. This separates the townhouse into three distinct zones and the ground floor can function independently from the rest of the house. The central placement of the living space also allows for varying household constituents. Ground floor residents can share the living/dining area with those on the second floor, or can use a ground floor bedrooms as a separate living space.

Fig. 5 Sectional diagram showing living zone on the first floor between bedroom zones. Fig. 6 Sectional diagram showing flexible use of ground floor to create a semi-separate dual household.

Alternative Configurations

Extent of Services
Bathroom and WC facilities are located on the bedroom floors. Their adjacency to passively flexible spaces supports alternative uses of the bedroom and surplus garage spaces.

Fig. 7 Plan diagram of ground floor showing connection between garage workspace and WC. Fig. 8 Plan diagram of ground floor showing connection of bedrooms and potential living space to bathroom. Fig. 9 Plan diagram of mezzanine floor showing connection between bedroom and bathroom.
3. Internal/External Relationships

**Alternative Configurations**

**External**

Aspect and Private Sheltered Open Space
Courtyards at ground floor provide external aspects from bedrooms and private, sheltered external space to ground floor residents.

*Fig. 10 Plan diagram of ground floor showing location of external courtyard spaces adjacent to bedrooms and potential living space.*

Elevated Terrace
The main external social space extends from the living zone on the first floor. An elevated terrace, it provides greater solar aspect and sky views than if it were on the ground floor.

*Fig. 11 Sectional diagram of Type 1 Unit showing living space extension onto elevated terrace.*
Case Study Two
Wynnstay Street Townhouses

Melbourne, Victoria
McBride Charles Ryan
2000
Attached townhouses

Configuration: 10 Townhouses
Type 1: three variations, 1-3 bedrooms with study/flexible space, 3 storey
Type 2: three variations, 1-3 bedrooms with study/flexible space, 2 storey

Project Description
Located in the inner Melbourne suburb of Prahran, this project uses an interlocking design that creates two types of apartment: a rear courtyard type and a three-storey terrace type. An existing laneway at the rear of the site allows through access and the guest car parking area is landscaped to create an overlap between parking and garden.

This design provides an alternative terrace model for a medium-density housing project. Units are arranged to accommodate internal parking and independent entry while preserving sizable private external spaces. The internal partitioning of the units allows for flexibility in use and room combination, accommodating different households and allowing the possibility to be reconfigured over time.
1. Site, Siting and Shape

**Alternative Configurations:**

**Buildings on Sites**

The building reconfigures the terrace model to increase amenity for each unit.

**Terrace**

The design of the building uses an 'offset' terrace model. The individual units interlock, with alternate ground and second-floor living areas. This maximises the external space for each unit and the connection to internal living spaces.

*Fig. 1 Plan and section diagrams showing offset terrace model and interlocking of units.*

**Individual/Collective Housing**

The building combines individual variation and privacy with communal facilities.

**Unit Repetition**

The units are of two basic models: the Courtyard and the Terrace. The Courtyard type has ground floor living/dining and an external courtyard. The Terrace type has third-floor space for living/dining and an external terrace. Each of the unit types has three variations, combining additional bedrooms, studies and rooms for flexible use. This variation accommodates a wide variety of households.

**Courtyard Type**

1a: 2 bedroom plus study or extra living
1b: 1 bedroom plus 2 bedrooms or 2 flexible rooms
1c: 1 bedroom plus bedroom/study

*Fig. 2 Plan diagrams showing unit types.*
Terrace Type:
2a: 3 bedrooms plus study
2b: 2 bedrooms plus
bedroom or flexible room
and study/flexible space
2c: 1 bedroom plus bedroom
and flexible room or flexible
room and study

Fig. 3 Plan diagram of first floor
showing apartment variations.

Accessibility
An existing laneway is used to
create a vehicle throughway. This
allows a single width parking lane
for the carpark, reducing its size.

Fig. 4 Plan diagram showing use
of existing lane for car access.

Privacy
Each unit has an independent
entry. The offset arrangement of
the units protects the privacy of
external space to individual units.

Fig. 5 Plan diagram showing independent
entry to each unit and private courtyard.
Fig. 6 Sectional diagram showing
privacy of external spaces.
1. Site, Siting and Shape

Vehicle Egress and Parking

The shared external parking is designed as a landscaped area rather than a service area.

Consolidation/Separation
Parking is arranged in two types: a single car space attached to each dwelling adjacent to its entry; or a shared additional/guest car parking area opposite.

Fig. 7 Plan diagrams showing car parking types.

Permeable Surface Treatment of Car parking/Garden
The shared parking area is grassed and planted with trees to become a semi-garden space.

Fig. 8 Plan diagram showing planting to shared parking area.

Shared Facilities

Additional facilities for residents are provided.

Recreational
A pool for shared use by residents is provided at the Wynnstay Street end of the units.

Fig. 9 Plan diagram showing location of pool.
2. Internal Configurations

Passive Flexibility

The internal configuration of the units allow some spaces for variable use.

Circulation
A large landing on the first level provides a passive flexible space. This space could be used as an additional study or secondary living area.

Fig. 10 Plan diagram showing flexible space at landing area.

Actual Flexibility

Movable components are used to allow spaces for reconfiguration.

Doors as Walls
Large sliding doors are used as movable partition walls to connect or separate rooms within units. This can enlarge shared spaces (socially flexible) or create semi-independent zones (privately flexible).

Socially Flexible (Unit Type 2)
The study and bedroom can be combined to create either an increased study/workspace area, or a paired study/living area.

Privately Flexible (Unit Type 1)
Two bedroom/flexible rooms can be joined to form a semi-independent private bedroom/living or bedroom/study enclave.

Fig. 11 Plan diagrams showing room combinations utilising sliding partition doors.
3. Internal/External Relationships

Expectation and Provision

The form of the building protects the environmental quality of the external courtyards.

Light
The cross-sectional profile of the building has an angled rear wall to increase sunlight entering rear courtyards. The curved junction with the roof maximises sun penetration.

Fig. 12 Sectional diagram showing solar penetration to rear courtyards.
Mount Eliza House
Case Study Three
Mount Eliza House

Mount Eliza, Victoria
Bird de la Coeur Architects
2003
Inter-generational family detached house

Configuration: 5 bedrooms, office, darkroom and studio
2 storeys

Size: 2858m² site
480m² house

Project Description
Designed as a collection of individual houses within an overall dwelling, the house accommodate the clients – a couple and their child, an adult sister and elderly mother. The basic plan arrangement of the house creates a three-sided courtyard: one side contains the living and dining spaces; each of the other sides accommodate the mother and sister, and the couple and child. The ground floor of the latter side is used as a shared workshop that includes a darkroom, office and studio.

This house responds to the needs of individuals and groups of an inter-generational family. It combines communal areas with those for individual use. Each of the occupants has a ‘residual area’, a part of the house that is designed specifically for their needs, while work, recreation, kitchen, dining and living areas are shared. The project illustrates a residential model of mutual support relationships between residents.
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

The house plan establishes a relationship between individual and shared areas.

Courtyard
The house forms a three-sided courtyard. The south element accommodates the couple and child, the west element houses the mother and sister. The angled northern element contains communal kitchen, dining and living spaces. A partially closed fourth side contains a shared lap pool and deck. The courtyard itself is landscaped and paved.

Fig. 1 Site plan diagram showing courtyard model and individual elements.

Individual/Collective Housing

Combined Amenity
In addition to the large living and dining area, the grouped dwelling provides additional shared facilities for residents. These range from the lap pool and workshop, to other more subtle benefits such as the courtyard space provided by the grouped plan, and the surplus external space of the large site gained from collective ownership.

Fig. 2 Site plan diagram showing facilities gained from collective dwelling.

Articulation of Part
Courtyard façades of each side have a different materiality. This identifies the house as a series of individual elements, demarcating areas that are shared and those that are private.

Fig. 3 Plan diagram describing materiality of each element.
Fig. 4 (opposite) Material differences of each element.
Expectation/Provision

The plan arrangement is also influenced by site and environmental conditions.

View/Orientation
The shape and orientation of the open-sided courtyard maximises exposure to afternoon sun. The angled placement of the living/dining element aligns with a northern view to a stand of trees along the north boundary.

Contextual Influences

The design of the house reinterprets existing beach house architecture.

Formal Relationships to Existing Building Types
The south element uses the undercroft parking form of 1950s and '60s modernist beach houses to further establish the idea of a 'house within the house'. It is a family 'unit' within the larger family grouping.
2. Internal Configurations

Alternative Configurations: Internal

The elements set up by the plan are configured internally to respond to the needs of each occupant.

Zoning – Dispersed
Each occupant (or occupant group) has a zone within the house. These are dispersed to maintain a sense of personal territory within the collective household. Additionally, a work zone occupies the ground floor of the southern element that is shared between residents.

Fig. 6. Plan diagram showing distribution of zones within the house.

Container versus Specific Use
Each of the zones is planned to respond to occupant’s needs.

Fig. 7 Plan diagram describing design specificity of occupant’s areas.

Suitable Workspace

The work zone has several design elements that make it a suitable workspace.

Shared Among Residences
The workspace can be accessed separately from other areas of the house, allowing it to be used as a communal facility.

Levels of Internal Separation
The workspace is located on the ground floor of the southern element. There are no other habitable rooms on this floor. It is further separated from the other areas of the house by a short staircase.

Fig. 8 Plan diagram showing individual’s access to workspace.
External Access
The workspace can be accessed directly from the undercroft parking area.

External Space
The workspace has direct access to a lower paved section of the courtyard. It is the only space that connects to this area.

Configuration within Workspace
The workspace is further partitioned into three different areas: a studio, office, and darkroom, to cater for each resident’s use. (The workspace is shared by the couple and the sister.)

Egress and Circulation
Circulation paths are designed to both link and separate the zones.

Articulation of Distribution
There are two circulation corridors in the house. The paths link the entry to the south element and connect the east element to the north living/dining element. The paths intersect at the entry. The corridor of the south element is framed by the walls within the couple’s bedroom, implying a continuous connection to their private outdoor deck. The corridor along the east element is the primary public route of the house. The third and fourth corridors are external, and link the house to the road and beach.

Fig. 9 Plan diagram showing separate access to workspace.
Fig. 10 Plan diagram showing separation of external access to workspace.
Fig. 11 Plan diagram showing external courtyard area connected to workspace.
Fig. 12 Plan diagram showing internal partitioning of workspace.

Fig. 13 Plan diagram showing circulation corridors.
2. Internal Configurations

Room Borrowed for Circulation
The mother's bedroom links to the living/dining/kitchen zone via her library space. This differs to the circulation connection made from the sister's zone, and separates these two areas of the eastern element.

Fig. 14 Plan diagram showing borrowed circulation creating separation from sister's zone.

Material Articulation
The material articulation of the south element visually disconnects it from the corridor. Its external walls are constructed of masonry, as are the internal walls of the adjoining corridor. The effect is of a covered external walkway adjacent a separate building, rather than an internal domestic hallway.

Fig. 15 Images showing material articulation of south element corridor exterior and interior.

Thresholds/Changes in Level
In conjunction with the material articulation of the corridor, a large raised threshold is located at the entry to the bedrooms for the sister and guests. This acts as a porch, an external entry element used internally to distinguish between the bedrooms and the corridor.

Fig. 16 Plan diagram showing internal porches.

Mobility

While level changes and circulation distances are used to create privacy for individual areas, the design also considers mobility access.

Planning Adjacencies
The mother's room and library are adjacent to the living/dining and kitchen zone. The primary external living areas connect to this zone. These areas are all on the same level.

Fig. 17 Plan diagram showing plan adjacencies.
3. Internal/External Relationships

Landscape

Landscaping elements are utilised to further articulate the external spaces.

Spatial Relief
A landscaped area in the central courtyard provides a spatial break between the workspace courtyard and the deck opposite.

Aspect
The landscaped area of the courtyard provides an external visual aspect from the primary corridor.

Screening /Shade
Tree planting and landscaping provide a visual screen, reinforcing the spatial separation between the deck and the workspace courtyard. Low screening gardens are also provided between the trees along the northern boundary and the mother’s zone, maintaining views and privacy.

Health-Based Recreation

The collective housing model provides a health-based recreational facility for communal use.

External Pool
A lap pool is connected to the communal living/dining area.
3. Internal/External Relationships

External Elements

The project provides a variety of external areas to accommodate a larger household.

Elevated Terrace
There is an elevated terrace above the carport.

Internal Courtyard
A paved courtyard with landscaped garden occupies the center of the plan.

Deck/Veranda
A timber deck surrounds the living/dining/kitchen area and the pool. A sheltered verandah occupies the north and northwest side of the deck.

Alternative Configurations: External

The external spaces all have specific relationships to internal rooms.

Nature of External Space and Connection to Internal Room
The upper terrace connects to the couple's bedroom forming a private external space. The verandah and external deck connect to living and kitchen areas to provide external living and dining spaces respectively. The courtyard contains a paved area that is only accessible from the workspace.

Fig. 20 Plan diagram showing external elements.

Fig. 21 Plan diagram showing internal connections to external spaces.
Case Study Four
Queens Park Townhouses

Sydney, New South Wales
Durbach Block
2002
Semi-detached townhouses

Configuration: 2 houses, 2 bedrooms with attached garage
2 storey

Size: 485m² site
170m² house

Project Description
This project of two houses is located to the rear of a single subdivided plot. The existing house faces the street, with the new houses
aligned along a rear service lane. The houses are identical two-storey, two-bedroom arrangements. The main bedroom is on the first
floor and connects to a raised external terrace. The ground floor bedroom connects to a courtyard which also serves the ground
floor living and dining space. Both units face the street and have independent car and pedestrian access.

This project uses a repeated module along a street edge to create a model for multiple courtyard housing. The configuration of the
plan, in conjunction with vertical separation of spaces, provides opportunities for multi-programming and passive flexibility. The
project also utilises landscaping to organise external space in response to potential internal living and work arrangements.
Street Perspective

1. Entry
2. Garage
3. Bathroom
4. Laundry
5. Kitchen
6. Living/dining
7. Courtyard
8. Bedroom
9. Ensuite
10. Void
11. Roof terrace

Unit Plans

Site Plan 1:500
1. Site, Siting and Shape

Contextual Influences

The plan form of the units and their siting is informed by the surrounding density and character of buildings.

Relationship to Existing Housing
As the houses face a service lane, the neighbouring buildings are typically garages that abut and line the street. The design responds to this by building across the entire width of the site. The main street elevation includes the garage and pedestrian entry for the houses. This street facing wall is slightly inflected to include a planter – which provides variation to the street edge and responds to the small but constant variation of garage setbacks along the street.

Edge Conditions
The direct adjacency of the internal spaces to the street is modified by locating service spaces along the street elevation. The second bedroom, also located against the street, faces away from this edge, opening onto the courtyard.

Fig. 1 Street view showing garages on service lane.
Fig. 2 Plan diagram showing street-facing wall and planter inflection.
Fig. 3 Plan diagram showing service spaces located along edge, and inward orientation of bedroom.
Alternative Configurations: Buildings on Sites

Though consisting of only two houses, this project provides a model for possible modular house units.

Zero Lot Lines
The houses are built along the boundary on two sides. This creates a party wall separating the second bedroom from the neighbouring garage. Arranging a habitable room beside a service room minimises noise problems.

Fig. 4 Plan diagram showing party wall and neighbouring rooms.

Unit Repetition
The L-shaped plan allows the adjacent house to provide one side of the rear courtyard. In this way external space is completed by the neighbouring house. This relationship, combined with the independent entry to each house, allows for a series of these houses along a street edge.

Fig. 5 Plan diagram showing entry and external spaces created by repeated house plan.

2. Internal Configurations

Passive Flexibility
The plan of the house is arranged into two main zones.

Zoning
The plan splits the house into one zone for core programs and one for flexible use services. The core programs include kitchen, living, sleeping and dining. These are located to the rear of the house and on the second level. The ground floor bedroom is associated with the service areas, allowing it to operate flexibly and independently from the areas of core use.

Fig. 6 Plan diagrams showing the core domestic and flexible/service program zones.
2. Internal Configurations

Suitable Workspace

The second bedroom is suitable for use as a workspace. Its partial overlap with spaces for domestic use limits public interaction with the workspace.

Circulation

The central position of the entrance and main hall allows an independent path from the potential workspace to the outside, either via the front door or garage. The second bedroom also directly accesses the kitchen.

Appropriate Amenity

The bedroom faces the rear courtyard and has its own access.

Extent of Services

The bedroom is located adjacent to the bathroom allowing independent access.

Fig. 7 Plan diagram showing independent access from workspace to entry/garage and to kitchen.
Fig. 8 Plan diagram showing adjacency to courtyard and bathroom.

3. Internal/External Relationships

Alternative Configurations: External

External spaces are connected to a number of the internal areas of the house. These external spaces can be multi-programmed, and can accommodate simultaneous occupation.

Internal Courtyard

There is a large rear courtyard that connects to the second bedroom and living/dining area.

Elevated Terrace

The main bedroom is oriented towards a terrace which runs above the ground floor bathroom and bedroom.

Fig. 9 Plan diagrams of courtyard and terrace showing connection to internal spaces.
Multi-programming: External

The external spaces allow for various activities, rather than solely social or private occupation.

Circulation
The primary use of the terrace is as a private external space for the main bedroom. The inclusion of a side entry from the first floor landing allows this terrace to be alternately programmed as a social external space connecting to the kitchen/dining area below.

Fig. 10 Plan diagram of alternative terrace uses.

Landscape
In an unbuilt proposal, landscaping was used to define the spatial occupations of the courtyard.

Spatial Definition
A small group of trees is located between the external space shared by the living area and second bedroom/flexible room. This landscaping provides some separation between different users.

Fig. 11 Plan diagram showing separation of external areas using planting.
Where House
Case Study Five
Where House

Perth, Western Australia
Simon Anderson
1993
Single family detached house

Configuration: 2 bedroom and study area
2 storeys

Size: 500m² estimated site
260m² house
100m² first floor

Project Description
Wherehouse replaces an early twentieth-century timber-framed cottage and its design responds to more recent commercial construction nearby rather than its residential predecessor. A large setback at the front of the site marks where the house stood; the new building is sited to the rear. Internally, Where house is loosely planned as a two-bedroom family house. However bedroom, living, and kitchen areas are larger than conventional sizes to allow for different uses. This strategy means the house can be used as a workspace, allowing employees and clients to visit while maintaining privacy to family areas.

This project uses the built context surrounding the site to order the internal arrangement of a single family house that has multiple potential internal configurations. The large volume within the house is created with low-cost construction methods and materials, and with limited internal divisions.
First floor
Plans of House

<table>
<thead>
<tr>
<th></th>
<th>Entry</th>
<th>Bathroom</th>
<th>Kitchen</th>
<th>Living</th>
<th>Bedroom</th>
</tr>
</thead>
</table>

View from street

Section a

Section b

Ground floor

Context plan
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

The 'block' of the house organizes the site into distinct external areas.

Single Family Detached
The position of the house on the site determines the two external spaces. A large front setback space is created, leaving a smaller external service space to the rear.

Fig. 1 Site plan diagram showing two primary external spaces created by single volume of family house.

Contextual Influences

This project uses the existing context in a variety of ways. In addition to its influence on formal and material design decisions, context also informs external spatial configurations and internal planning strategies.

Relationships to Existing Building Types
The mass and external materials of the house reflect the existing warehouse directly opposite. Where house is sited to the rear, providing a large open space in front. This space is framed by the two buildings, creating a semi-courtyard that includes the site and also the part of the street between the two buildings.

Fig. 2 Sectional diagram showing semi-courtyard created between the two buildings.
Fig. 3 View of site showing relationship between Where house and existing warehouse.
Edge Condition
The articulation of the open space responds to the edge conditions of the neighbouring house boundaries. The external neighbouring wall is built to the boundary and provides a partial enclosure to the semi-private external area. The unfenced boundary on the opposite side provides an open aspect to the multi-programmable area of the external space.

*Fig. 4* Plan diagram showing differing edge conditions that articulate the large external space.

Vehicle Access and Parking
The design of the parking area assists arrangement of the external space.

Formal/Material Articulation
A separate garage is used for car parking. This unobtrusive, light structure means that the existing buildings and the house ‘block’ primarily frame the external space. The garage is located opposite the terrace and provides further visual screening of the semi-private external area.

*Fig. 5* Site plan diagram showing additional screening of garage.

*Fig. 6* Plan diagram showing paved surface forming edge/path/garage.
2. Internal Configurations

Contextual Influences

The internal planning of the house extends the warehouse model derived from the building opposite. It also influences the overall building form and material articulation.

Internal Relationships to Existing Building Types
The plan of the house maximizes the plan and volume of a few spaces, creating a flexible, warehouse-like space with a domestic use.

*Fig. 7 Warehouse plans showing large spaces.*

Alternative Configurations: Internal

The design of the domestic use translates to a warehouse typology by creating a small number of large volumes that can support various domestic functions.

Container versus Specific Use
Individual areas within the house are large enough to support uses beyond their ‘named’ activity. Because of their size, additional functions can be located within them, allowing alternative household configurations.

*Fig. 8 Plan diagrams showing rooms with possible additional activity spaces.*
Zoning through Volume
The main living area on the ground floor varies in ceiling height to provide passive zoning for different activities without fixed partitions.

Fig. 9 Plan diagram showing double and single-height areas of main living area.
Fig. 10 View of single-height living area.

Passive Flexibility
The servicing, size and location of rooms allows passive flexible use of the house.

Serviced Room
The first floor bedroom is similar in size to the kitchen, allowing it to operate as a semi-independent serviced space. The adjacent bathroom supports the bedroom, study and living activities. This arrangement would suit a lodger or adult child who requires independent social and study space as well as a bedroom.

Fig. 11 Plan diagram showing supported activities in bedroom.
2. Internal Configurations

Surplus Space
The size and configuration of the main internal spaces allow a variety of room combinations. The living area can be relocated to different parts of the house in order to support a ground-floor workspace. The second first floor bedroom is the only ‘fixed’ internal room.

Fig. 12 Plan diagrams showing configurations for different uses.

Egress and Circulation
Most of the circulation space in the house is incorporated into the individual rooms. The remaining, defined circulation space plays an important role in zoning the internal activities.

Social/Private Articulation
The house is split into two main zones by a band of circulation and services. This acts as a buffer between the living/workspace area and the kitchen/dining/tertiary living area. In this way, private/meals and social/work functions are spatially ‘screened’ from each other.

Fig. 13 Plan diagram showing band of services and circulation separating the kitchen from the main living area/workspace.
Suitable Workspace

Levels of Internal Separation
The bedrooms are located on the upper floor, separating private areas from the workspace. Spaces such as the kitchen/dining area, which could be used by both employees and residents, are screened from the workspace by less rigid elements such as the circulation zone. This creates a gradation in privacy/separation that matches the way these spaces would be used.

Fig. 14 Plan diagram showing internal configuration of ground floor spaces.
Fig. 15 Sectional diagram showing separation of domestic spaces and workspace.

Configuration within Workspace
The workspace itself is split into two areas. The largest area of the workspace is a double height volume adjacent to the entry. This space is suitable for the primary work/office area of the workspace. The second area, the 'waiting room', is a single height space under the secondary bedroom. This space is suitable for meetings or as a lobby/waiting area for visitors.

Fig. 16 Sectional diagram showing workspaces.
2. Internal Configurations

Staff Spatial/Environmental Amenity
The size of the workspace is large enough to accommodate employees. The large kitchen/dining area can support a meals area and accesses external space. A large glazed entry provides natural light to the workspace.

Fig. 15 Plan diagram showing elements providing amenity to employees.

Services
A large bathroom on the ground floor provides WC/wash facilities for employees and visitors.

Actual Flexibility
Both large ground floor spaces can be subdivided using flexible partitions.

Freestanding Screens
Two concertinaed timber screens provide privacy to the glazed entries and can also subdivide the workspace and kitchen/dining space. This provides an additional level of privacy to the ‘waiting room’ and to the kitchen/dining space, and also allows for an alternative living area without compromising amenity for employees.

Fig. 16 Plan diagrams showing alternative configurations of timber screens and corresponding variation in internal use.
3. Internal/External Relationships

Alternative Configurations: External

The location of the house to the rear of the site creates a large external setback in the front that can be configured for different uses.

Large Singular Articulated Volume or Combination
The setback is divided into two main zones. One zone has parking facilities, planting, a garden, and a small external area in front of the house. These elements combine to articulate the semi-private social area to the front of the house, accessed internally from the kitchen. The other external zone supports open, less private activities.

Fig. 17 Plan diagram showing two main external areas and supported activity.
Fig. 18 Plan diagram showing different privacy levels for external spaces.

Privacy
Elements provide screening to the semi-private social area and to the adjacent garden.

Fig. 19 Sectional diagram showing screening.

Recreation
Two areas are created for recreational use: the garden area and the large open space which can accommodate recreational sport.

Fig. 20 Plan diagram showing the two types of external recreation space.
Poll House
Case Study Six
Poll House

Perth, Western Australia
Gary Marinko Architects
2002
Single family detached house

Configuration: 3 bedrooms and study, detached single storey house
1 bedroom semi-detached single storey flat

Size: 1160m² site
338m² house with courtyard
117m² flat

Project Description
This project is located in an inner-western suburb of Perth. The surrounding context is predominantly large, detached single family dwellings. The shape and siting of the project respond to this context, however its planning and materiality strongly differ. The external precast concrete wall of the house borrows from the construction of industrial buildings. Like a warehouse, it provides a shell in which the internal planning is independently configured. The main bedrooms are grouped around an internal courtyard and accessed from a perimeter corridor. A guest bedroom is located to the rear of the house, together with the living, dining and kitchen areas. The garage and semi-detached single-bedroom flat are located to the rear of the site connecting to a laneway.

The design of this house responds to individual and collective needs in a single household. Internal and external spaces are located adjacent to bedrooms, providing multiple private zones within the dwelling without level or height change. Circulation paths also filter activity away from bedroom zones, depending on whether a household member or guest is entering or exiting the house. The house and semi-detached flat are sited to create several external spaces. Each has a different relationship to the dwellings and performs a particular role of private, shared, public and service space.
View from main courtyard to living room

Section a

Section b

1 Entry
2 Bedroom
3 Ensuite
4 Retreat
5 Courtyard
6 Informal dining
7 Laundry
8 Kitchen

9 Study
10 Dining
11 Living
12 Central courtyard
13 Pool
14 Sauna
15 Bathroom/laundry
16 Garage

Plan

0 10

N
1. Site, Siting and Shape

Contextual Influences

Relationship of site and form to existing house types

The shape and siting of the house is based on a typical detached family dwelling. However, the material treatment and planning of the house are configured differently to allow for greater independence between residents than a traditional model. One of the formal aspects of this dwelling type, the hip roof, provides an overhanging eave that shelters the entry and external space.

Alternative Configurations: Buildings on Sites

The project uses the siting strategy of a suburban single family dwelling, combined with a courtyard house plan to create various external spaces. The boundary forms an external corridor, creating different levels of privacy between the front of the house, the flat, and courtyard to the rear.

Courtyard House
The house has an internal courtyard that provides private external space.

Additional Building
The rear flat is attached to the garage in an offset configuration. In conjunction with the main house, this arrangement creates two external spaces. The first is the primary outdoor living and pool area of the main house; the second is the private courtyard for the flat.
Individual/Collective Housing

The house articulates external space of three types: private, semi-private and semi-public.

Individual Siting

The front setback of the house is articulated as a semi-public space. The boundary of the house is made ambiguous by placing a fence at the front of the house rather than at the boundary. This strategy could be employed by adjoining houses to create a continuous strip of semi-public space and shared amenity.

Fig. 4 Plan diagram of house showing fence and boundary lines with ambiguous front setback space between.

Fig. 5 Plan diagram showing potential strip park created by a series of houses using this strategy.

2. Internal Configurations

Alternative Configurations: Internal

The main house is configured into four overlapping zones articulated by perimeter access routes and adjacent to external spatial configurations.

Zoning

The four zones within the house are split into two pairs. The first pair are the main bedroom zones. These are separated from other parts of the house by an adjacent flexible space. The other pair is the guest bedroom and living/dining/kitchen zones. These zones occupy the rear of the house and connect to the primary shared open space between the house and the flat/garage.

Fig. 6 Plan diagram showing bedroom zones and adjacent flexible spaces.

Fig. 7 Plan diagram showing living and guest bedroom zones adjacent flexible space.
2. Internal Configurations

Articulated Circulation
The circulation path increases the privacy of the bedroom areas by providing optional paths from the front to the rear of the house. As it is serviced by a rear lane, residents arriving by car enter from the back of the house directly into the living areas. For guests, entry is via the front and along the perimeter corridors to the living/dining area, allowing residents to choose which bedroom the guests pass.

*Fig. 8* Plan diagrams showing optional paths to bedrooms from front or rear of house.

Internal Courtyard
Both bedrooms access a small courtyard, which is intended to be private as it is separated from the living area and guest bedroom.

*Fig. 9* Plan diagram showing connection of bedrooms to courtyard.

Egress and Circulation
In addition to articulating the internal zones of the house, the relationship between circulation paths and rooms alters between the living area and the bedroom areas. This allows for varied occupation of these areas.

Articulated or Distributed Circulation
In the living areas, circulation follows multiple paths and is absorbed into the overall room area. This allows residents to use the living space in various, independent ways. The flexible areas adjacent to the bedrooms are open to the perimeter corridor which corresponds to their semi-private role. The perimeter corridor is more defined near the bedrooms, making a clear division between private and circulation areas.

*Fig. 10* Plan diagram showing articulated and distributed circulation.
Egress Path Borrowed to Increase Space of Room
The spaces adjacent to the bedrooms are able to increase in size by borrowing corridor space.

Fig. 11 Plan diagram showing increase in size of room by borrowing corridor space.
Fig. 12 View of meals area showing combination of room and circulation space.

Active Flexibility
The project uses active flexibility to increase/decrease bedroom size.

Walls as Doors
Two sliding doors form the corner of the master bedroom and open to the adjacent flexible space allowing extension of the bedroom into this area.

Fig. 13 Plan diagram showing use of sliding doors to extend bedroom space.
3. Internal/External Relationships

Alternative Configurations: External

The siting arrangement provides a variety of external spaces, each with a different function and different level of privacy. This variety potentially allows for inhabitation by four couples.

Privacy
Private external spaces are adjacent to the bedrooms. A large semi-private social external space exists between the house and the flat. At the front of the house, a semi-public external space is provided outside the fence-line of the house but within its boundary.

Fig. 14 Plan diagram showing levels of privacy in external spaces.

Multi-programming External
The front yard is used as a setback for the house but can also be used as a public external space.

Fig. 15 Plan diagram showing multi-programmatic front setback.

Service/Circulation
The overhanging eaves of the house provide a sheltered external circulation corridor down each side of the house.

Fig. 16 Plan diagram showing sheltered external circulation corridors.
Calnin House
Case Study Seven
Ivan Calnin House

Location: Victoria
Edmond and Corrigan
1984
Single family detached house

Configuration: 2 bedrooms and study, detached garage
Single storey

Size: 260m² house

Project Description
The Calnin house was designed for a sloping rural site. The separate internal zones seen in plan are expressed as semi-detached, almost separate, buildings. Consequently the project is understood as a house that is a collection of smaller dwellings, similar to a village gathered around a meeting hall. These internal zones also have different relationships with the extensive surrounding external terraces, courtyards, pergola and verandah. Other more unusual landscaping works such as a fernery, toad pool and trout pool are also part of the proposal.

This project uses the available size of the site to explore relationships between individual and collective spaces and programmes within a single family house. Instead of composing individual areas of a house in a singular resolved building, the individual service, study and bedroom areas are clustered around a central living and dining area. The project also provides various external spaces to further disperse spaces in this model for domestic dwelling.
1. Site, Siting and Shape

Individual/Collective Housing

The Ivan Calnin house is not a collective housing project but aspects of its design are relevant to this type of housing.

Articulation of Part

The shape and material articulation of the Ivan Calnin house expresses the individual functions of the house. It becomes like a collection of individual buildings rather than a singular form.

Fig. 1 Perspective drawing showing individual articulation of house parts.

2. Internal Configurations

Alternative Configurations: Internal

The formal expression of parts reflects a plan arrangement that combines individual and collective dwelling within the house.

Zoning – Grouped

A large living and dining room forms the centre of the house. Other functions of the house including the entry, bedrooms, study, laundry and kitchen are grouped into individual ‘wings’ that connect to the central space. This zoning gives privacy and independence to the bedrooms whilst maintaining shared use of the living and dining spaces.

Fig. 2 Plan diagram showing zoning of internal functions into ‘wings’.

Zoning – Volume

The central living and dining room is articulated as a double-height volume. This makes it the primary volume in the house, which is appropriate for its role as the place where individual members of the household meet.

Fig. 3 Section diagram comparing volumes of central area and ‘wings.’
Container Versus Specific Use

Each of the wings are designed to accommodate a specific use. This specificity underlines the personal aspect of the bedroom spaces. It also provides a contrast to the container design of the central living/dining area. This central space is reinforced by the four walls of this area, each with an external exit. The dual system allows occupants of the house to have both personal (specific) space in which to retire or study, and communal (container) space in which to interact with other members of the household.

Fig. 4 Plan diagram showing specific and container spaces in the house.

Services Location

The kitchen is located in the southwest wing. Its dissociation from the dining area breaks the link between the use of the kitchen and the sit-down meal. This makes it more a ‘food service’ area, used independently by household members at different times, but also able to accommodate group meals when they occur.

Fig. 6 Plan diagram showing ‘food service’ area nature of kitchen.

Bathroom facilities are located in each of the bedroom wings, which allows for independent operation of these zones. Within this system there is economy: the WC associated with bedroom 1 can also be used by guests. It is adjacent to the entry and can be separated from the bedroom by a sliding door.

Fig. 7 Plan diagram showing location of bathrooms and alternate guest use of bedroom 1 bathroom.
2. Internal Configurations

Egress and Circulation

Egress and circulation articulate the distinction between the 'wings' and the central living and dining space.

Social/Private Articulation
The bedroom wings contain short corridors that connect the living/dining space to the bedroom. The living/dining space itself has no articulated circulation, which is appropriate to its role as a communal, social area. The formalised wing corridors separate the bedrooms from the living/dining space and contrast with the informal circulation through the living/dining space.

Fig. 8 Plan diagram showing formalised corridors contrasting with informal circulation of central space.

Thresholds/Changes in Level
Separation through circulation disconnects the kitchen and study spaces from the living/dining space. Shallow stairs at the threshold of the two small rooms lead into the main space.

Fig. 9 Plan diagram showing threshold stairs disconnecting kitchen and study spaces from living/dining space.
3. Internal/External Relationships

Room Borrowed for Circulation
The plan arrangement of the wings and central space creates potential perimeter circulation paths that link to each wing. This perimeter circulation is an alternative to moving directly through the room.

Fig. 10 Plan diagram showing potential perimeter circulation within central living/dining space.

Egress and Circulation
The design of egress and circulation between internal and external spaces is consistent with the individual/collective aspects of the internal planning.

Usability of Room Altered with External Connection
Each bedroom has an external connection that provides visual and egress access to external spaces. These exits connect with independent paths to the garage, allowing occupants to enter and exit the house without passing through communal areas.

Fig. 11 Plan diagram showing external connections from bedrooms.
Fig. 12 Plan diagram showing independent paths from the garage to each bedroom.
3. Internal/External Relationships

Alternative Configurations: External

The external design of the house includes a variety of landscape structures and external living areas.

Veranda/Deck
The south-facing length of the house is divided by internal elements such as the kitchen and study 'wings' and entry into four discrete deck areas. Of these, two are sheltered within the roof line as verandah spaces.

Spatial Function
The northeast fernery structure provides a visual boundary, in addition to the physical boundary of the low wall, to the car turning area. A triangular-shaped lawn is created between it and the pergola.

Multi-programming: External

The external spaces provided relate to the internal areas, linking internal activities to the outside.

External Living
The pergola area also includes a circulation path to the garage. The 'left over' space within this area is approximately the same size as the adjacent living/dining room. This partially sheltered outdoor room becomes an alternative living/dining space.
Courtyard House and Flat
Case Study Eight
Courtyard House and Flat

Margaret River, Western Australia
Morq Architects
2007
Single family detached house

Configuration: 2 bedroom and central courtyard, detached garage
Single storey

Size: 1300 m² site
170 m² house

Project Description
This building has three separate entries that access a doughnut-shaped plan. Kitchen, living and dining spaces directly face a central courtyard. The efficient plan uses the rooms as circulation with the courtyard as the device that separates the rooms. A large bedroom facing the fourth edge of the courtyard has the potential for becoming a living space in the future, shown as Stage 1. A second dwelling is provided at Stage 2, where the separate garage is altered to become a flat that shares the garden space between the buildings, effectively becoming another 'courtyard'.

The position of the bathrooms and three separate entries, as well as the large shape of the bedroom and its direct link to the courtyard, creates a suitable workspace. The building has a very high level of amenity and flexibility of use and future change.
1. Site, Siting and Shape

External Elements

Contextual Relationship
The internal courtyard within the footprint reduces the reliance on the quality of the immediate perimeter condition and context.

Site Relationship
The position of the garage, the attached flat at the front of the site, and the house to the rear creates shared and private outdoor space.

Fig. 1 Plan diagram showing perimeter and placement of outdoor space within courtyard.
Fig. 2 Plan diagram showing position of the flat and shared outdoor space.

Alternative Configurations:
Buildings on Sites

Courtyard Housing
The outdoor space is positioned within the building footprints. The second garden outdoor space can be shared with the flat in Stage 2.

Position on Site
The building is placed to the rear of the site, consolidating the open space into one large garden instead of smaller front and backyards.

Separate Building
The garage is separated from the house to allow independent location and orientation from the vehicular access.

Fig. 3 Site plan diagram showing alternative private and shared outdoor space.
Figs. 4, 5 Site plan diagram showing alternative position of buildings.
Individual/Collective Housing

Additional Dwelling
The staged project proposes the addition of a flat as an extension of the garage at the front of the house whereas it is usually placed at the rear. It shares a garden with the main house.

Fig 6. Site plan diagram of separate houses.

2. Internal Configurations

Alternative Configurations: Internal

Privacy
The courtyard is positioned within the footprint of the house, minimising its exposure to neighbouring properties.

Amenity
The adjacency of the courtyard to interior spaces provides a high level of amenity. Its glazed doors also allow each space to open to the courtyard.

Fig. 7 Plan diagram showing adjacency and access of rooms to courtyard.

Egress and Circulation

Room Borrowed for Circulation
The rooms surrounding the courtyard are also used for circulation rather than requiring a separate hallway.

Fig. 8 Plan diagram showing circulation.
2. Internal Configurations

Passive Flexibility

Work from Home
An independent entry and appropriate amenity provided by glazed doors to the courtyard creates the possibility for a suitable work environment.

The direct connection to a bathroom and the possibility to circulate through the courtyard, separates work and private areas of the dwelling.

Surplus Space
The second bedroom is larger than required and has a direct relationship to the courtyard. Its size and amenity means it could be used for other activities.

Access
Multiple entries create rooms that can be separated from the remaining house, allowing flexible use.

Mobility
The single level and flat outdoor spaces are appropriate for an ageing household.

Fig. 9 Plan showing suitable workspace. Fig. 10 Detail part plan showing surplus space. Fig. 11 Plan diagram showing multiple entries.

Multi-Programming: Interior

Circulation
Rooms are also used for circulation, negating the need for a separate hallway, which maximises the footprint.
Building Modification: Within Envelope

Subdivision
The large size of the bedroom, access to and amenity from the courtyard, and adjacency to separate bathrooms allows for the room to be subdivided. An additional bedroom can be created within the existing bedroom by subdividing it with an internal wall.

Fig. 12 Plan diagram showing subdivision of large bedroom.

Building Modification: Extension

Extension
The project has been staged to allow for further living space by adding two bedrooms; the existing bedrooms become extended living areas that surround the courtyard.

With the addition of a granny flat, a separate household occupies the site and shares the outdoor space.

Fig. 13 Site plan diagram showing staged additional spaces.
Fig. 14 Plan diagram showing extension of rooms and increased living area.
3. Internal/External Relationships

Alternative Configuration: External

Amenity, Solar Access and Shading
The courtyard is placed centrally so that solar gain can be achieved independent of orientation.

Orientation and Hierarchy
Three of the four facades have entry spaces and therefore reduce hierarchy of any particular facade. This allows for different orientations.

Adjacency
The location of the courtyard at the centre of the plan makes it available to all rooms.

Fig. 15 Plan diagram showing alternative solar orientation.
Fig. 16 View of deep entry space.

Multi-programing: External

Access and Circulation
The courtyard is used as an alternative circulation path between different parts of the house.

Fig. 17 Plan diagram showing multiple entries and secondary circulation.
Malagueira Housing
Case Study Nine
Malagueira Housing

Evora, Portugal
Alvaro Siza
1973–1977
Single family attached housing system

Configuration: Extendable courtyard attached housing system
44 2 storey dwellings
5 combinations of 2–5 bedrooms
1,200 houses in total

Size: 2.1 acre site, including parks
96m² footprint house

Project Description
Managed and funded by three separate housing cooperatives, this is a consolidated, low-rise, high-density social housing project with commercial facilities. The houses are grouped back to back in rows. At the end of each housing row are sites for small scale commercial and public facilities. These complement a larger central shopping centre and facilities such as a sports hall that have been added to the project as it has developed.

Malagueira Housing is a flexible housing system that uses several variations of a particular house type. Each type has three stages of development, which allow for the addition of one bedroom per stage. These additional spaces are permanent and accommodate functions such as bedroom or study areas. This system can accommodate different household types as well as potential workspaces.
Context Plan

Site Plan 1:10 000

Type A T3

House Plan Types

1 Entry
2 Bedroom
3 Kitchen
4 Bathroom

Type B T3

5 Living
6 Dining
7 Courtyard
8 Terrace

Type C T3

Type D T3

Type E T3

Axonometric of Type T3

Plan Type A T3
1. Site, Siting and Shape

Alternative Configurations: Building on Sites

Courtyard Housing
The Malagueira design is based on a walled courtyard house type arranged back to back in rows. Access roads run along the ends of housing rows and entry to each house is from a street facing the courtyard wall.

![Site plan diagram showing housing row consisting of back to back courtyard houses.](Fig. 1)

Services
A services conduit runs down the length of each housing row allowing access above ground to servicing infrastructure. The conduit is a raised ‘aqueduct’ in between housing blocks that also provides a sheltered pedestrian walkway.

![Site plan diagram showing services conduit.](Fig. 2)

Density
The variable individual dwellings share communal facilities.

Shared facility
At the end of each housing row, one vacant lot is allocated for communal facilities such as leisure space or shops.

![View of aqueduct.](Fig. 3)

Vacant lots for communal activities

![Site plan diagram showing vacant lots at the end of housing rows.](Fig. 4)
Unit Repetition
Malagueira is formed of five basic house types placed on identical lot areas, each with a series of variations. For each type, there are three stages of development – one room at each stage.

Fig. 5 Plan diagrams showing ground floor of five different house types in a three-bedroom configuration.

2. Internal Configurations

Building Extension: Addition

The variable system for each house type allows for highly flexible use of the dwelling, with the capacity to alter over time.

Capacity of Initial Building for Growth
Each of the five house types has a predefined series of extensions. These additions create a range of options that can be formed from each initial plan. For example, a two-bedroom house can be extended up to five bedrooms. The mechanisms which accommodate and facilitate the addition of new rooms and altered external spaces are the perimeter wall and central stair.

Fig. 6 Plan and axonometric diagrams showing possible extensions to a Type A house.
2. Internal Configurations

**Suitable Workspace**

Additional bedrooms can also be used for other programmes, such as workspaces.

**External Space**

A workspace occupying the third bedroom in a Type D house connects directly to the main courtyard.

**Separate Access**

Because the third bedroom lies between the initial house and the perimeter wall, a workspace occupying this room would have direct connection to the street. Openings to the courtyard could also provide direct access off the workspace.

*Fig. 7 Plan diagram showing potential access from workspace to internal courtyard and direct access to street.*

**Services**

The workspace has connections to kitchen and WC services. The addition of a screen at the edge of the living area would further separate dwelling and working activities.

*Fig. 8 Plan diagrams showing connections from workspace to services spaces.*

**Passive Flexibility**

A particular design quality of the Malgueira system is its support of alternative household configurations.

**Subdivision: Internal**

The stairway of a Type B house is located at the entry. As additional bedrooms are added, the house can be split into two semi-independent households, with the upstairs household using the third bedroom as a living space.

*Fig. 9 Plan diagram and axonometric showing use of the third bedroom as a living space and the configuration of the dwelling into semi-independent households.*
3. Internal/External Relationships

Alternative Configurations: External

Large Singular Shared, Articulated or Combination spaces.

The process of modification to the houses adds and transforms large shared external spaces into smaller, articulated spaces attached to particular rooms and activities. The system provides additional private and communal external spaces in conjunction with additional residents and/or activities.

Fig. 10 Plan diagrams showing external spaces transformed through Type A unit modifications.
Fukuoka Housing
Case Study Ten
Fukuoka Apartments

Fukuoka, Japan
Office for Metropolitan Architecture (OMA)
1991
Medium-rise apartment building

Configuration:
Block 1: 12
Block 2: 12 apartments
2 bedroom, 2 bedroom and extra room, 3 bedroom and extra room
Underground carpark, 4 commercial tenancy
3 storeys

Size:
1200m² per floor for each housing block
205m² for 3 bedroom apartment with spare room

Project Description
The building is one of seven housing projects built simultaneously in Fukuoka, Japan. Each project was designed by an internationally renowned architect, including Steven Holl, Mark Mack, Christian de Portzamparc, Oscar Tusquets, Osamu Ishiyama and Arata Isozaki. OMA’s project consisted of two dense medium-rise apartment buildings sited on either side of an access road. The apartments are split into three bands and are partly suspended above a communal concourse at ground level. The concourse provides access to individual apartments from the street and to an underground carpark. One of the significant features of the design is its use of a perimeter wall to provide privacy from the two neighbouring residential towers. Apartments in the rear and middle strips have a large ground floor courtyard, with the front strip of apartments located over a street-facing commercial tenancy.

This project addresses the relationship between individual and collective housing units. It features design issues such as unit repetition, shared facility, residential/commercial use and privacy/overlooking. Individual apartment units are configured to provide a variety of internal and external spaces within a small perimeter. The apartment design uses techniques of zoning and passive flexibility to accommodate different combinations of private and social activity.
Plans of Three-Bedroom Apartment

Ground Floor
1. Courtyard
2. Entry
3. Bedroom
4. WC
5. Bathroom
6. Dining
7. Spare Room
8. Kitchen
9. Living
10. Terrace
11. Balcony over

First Floor

Second Floor

Section a

Context Plan 1:5000

Ground Floor

First Floor

Second Floor

209
1. Site, Siting and Shape

Individual/Collective

The project utilises different combinations of repeating plan configurations in two ways: to provide variation in apartment types; and to retain a collective arrangement at concourse level.

Unit Repetition

There are two predominant apartment types in the block: Type A of two bedrooms; and Type B of three bedrooms plus spare room. Type A apartments are located in the centre of the block, Type B occupy the sides.

Apartments are formed of two repeating floor plan configurations used on the first and second levels. Apartments in the centre and rear bands and those occupying area over the commercial tenancies differ in type. Those at ground level are configured similarly to create uniformity at concourse level.

Fig. 1 Plan diagrams showing configuration of apartment and plan types on each floor.
Density

Shared Facility
The project has a number of shared facilities for residents.

Parking
There is an semi-underground carpark for residents under each building. Residents access this carpark via the ground level concourse.

Bicycle Storage
There are two bicycle storage facilities between the middle and rear bands of apartments.

Mutual Support Configurations

One of the primary elements of the project is a shared external concourse above the carpark. Rather than forming ‘dead’ space between apartments, the amenity and quality of this space is carefully considered to form a viable space for interaction between residents. Ongoing resident interaction is seen to assist in creating mutual support.

Circulation/Security
The concourse level provides access to individual apartments from the street and carpark. This shared access area provides greater security for residents.

Shelter/Amenity
The design of the block shelters the ground floor concourse area, while providing voids for natural light penetration.
2. Internal Configurations

Alternative Configurations: Internal

Individual apartment units contain design features that allow a variety of living spaces, which in turn enable different households to occupy them. Multiple external spaces and design features, such as the use of thresholds and level changes, support a degree of separation between spaces in an apartment with a small perimeter.

Zoning
Each Apartment is split into three distinct levels: ground floor entry/courtyard; first floor bedroom/bathroom; and second floor living/dining/terrace. Placement of bedrooms on the first floor allows the two primary open spaces – the courtyard and terrace – to be separated into two distinct locations and types:

Communal open space:
Second-floor living/terrace.

Private/separate open space:
Ground-floor courtyard.

Thresholds/Level Changes
The apartment design uses level changes to provide a greater degree of separation between adjoining areas.

Fig. 6 Plan diagram of ground and second floor showing location of open space.
Fig. 7 Cross-sectional diagrams showing connections between bedrooms and courtyard/living terrace zones.
Fig. 8 Plan diagram of ground floor showing stair from concourse to courtyard.
Fig. 9 Part-plan diagram of first floor showing stair between dressing and sleeping area of main bedroom.
Fig. 10 Part-plan diagram of second floor showing stair separating dining area and spare room.
Passive Flexibility

The apartment design also provides space that can be used as a study, alternate living area or guest bedroom.

Surplus Space
The three-bedroom apartments include a spare room off the dining area. It is the same size as the secondary bedroom and has views to the courtyard. Its adjacency to the dining area and its external aspect makes it suitable for use as workspace/secondary living area, or as a guest room.

Fig. 11 Plan diagram showing spare room adjacent to dining area.
Fig. 12 Sectional diagram showing connection of dining area and spare room.

Circulation Space
The circulation area between the dining and living rooms is an enlarged corridor with a glazed wall to the lightwell. Because of its size and external aspect, this circulation space can be utilised as an extended living area.

Fig. 13 Plan diagram showing circulation relationship between kitchen, living area, dining area and enlarged corridor.
Fig. 14 Section diagram showing visual connection between enlarged corridor and lightwell.
Fig. 15 View of circulation corridor looking towards living area.
3. Internal/External Relationships

Individual/Collective
The external spatial requirements of individual apartments within a dense residential block are addressed by the design. The qualitative aspects of these spaces are also considered, such as privacy and amenity.

Privacy/Light
The project had potential problems with overlooking from proposed apartment towers to the south. This was overcome by providing a screening perimeter wall. Secondly, the private terraces were protected from overlooking by increasing the angle of the adjacent roof to a double height. This protected the privacy of the terraces and maximised southern light penetration to the living and dining spaces.

Fig. 16 Sectional diagram showing perimeter wall and roof protecting interior and terrace from overlooking.
Fig. 17 Sectional diagram showing angled roof allowing light penetration to interior.

Service Spaces
High-density housing often precludes external spaces that provide service areas for individual households. In the Fukuoka project, service balconies are attached to internal service and circulation spaces allowing for activities such as drying clothes.

Fig. 18 Plan diagrams showing arrangement of service balconies.
**Alternative Configurations:**

**External**

This project provides a variety of external spaces for each apartment. They include:

**Internal Courtyard/Light Well**

Apartments to the middle and rear have courtyards adjacent to the first-floor entry. The courtyard forms a lightwell for the apartments and create an external aspect for all bedroom and living spaces.

**Elevated Terrace**

A terrace off the living area at the top floor of each apartment maximises sunlight and ventilation.

**Balcony**

Some apartments have balconies in addition to the standard arrangement.

*Fig. 19 Plan diagrams showing locations of external space.*
Stanga Housing
Case Study Eleven
Stanga Apartments

Rovinj, Croatia
Njiric and Njiric
2004
Medium-rise apartment building

Configuration:
- Block One: 14 apartments and 1 commercial tenancy
  1 and 2 bedroom
  3-4 storey
- Block Two: 24 apartments and 1 commercial tenancy

Size:
- 2800m² site
- 120m² typical 2 bedroom apartment

Project Description
Rovinj is a small coastal city on the Istrian Peninsula of Croatia, facing the Mediterranean Sea. This new housing development is close to the city centre among other medium rise buildings.

The historic city of Rovinj consists of dense low-rise buildings divided by narrow streets that provide pedestrian and vehicular access. This existing urban structure influences the project design: a group of independent dwellings linked and separated by narrow circulation paths. Between the two housing blocks is an open common area, a 'square' faced by two commercial tenancies incorporated into the blocks. Within the project are internal patios, which provide private open space to each unit. A variety of one and two bedroom apartments occupy the Ground and First floors, with one-bedroom mezzanine studio apartments dominating the Second floor.

Primarily designed as family dwellings, these apartments offer flexible arrangements that can support workspaces and various households. This flexibility is provided by the internal separation of apartments into two distinct zones. The first includes bedrooms, living spaces and external patios; the second is made up of service programs – kitchens, bathrooms, studies and storage.

View of building
Room facing patio
1. Site, Siting and Shape

Contextual Influences

Relationships to Existing Housing Types
The project is conceived as a housing project that differs from the perceived homogeneity of adjacent apartment buildings. As an alternative, the project draws on the urban relationship between buildings and street layouts in the historic city.

Fig. 1 Comparative plan diagrams showing historic city and project plan.

Individual/Collective Housing

Articulation of Part
Each apartment has one party wall and one wall facing a circulation path. This provides separation between individual apartments of each block and creates the sense of collected semi-detached housing.

Fig. 2 Plan diagram showing articulation of apartments with party walls and open wall combinations.

Access, Egress, Circulation

Access to individual apartments is via an internal courtyard. Voids are cut into upper level access courtyards to allow light to penetrate to ground floor.

Fig. 3 Plan diagram and image showing access courtyards.
Multi-programming

Exterior

External Space and Egress
Access courtyards incorporate wide segments that can be used as shaded public external spaces. Entries to individual apartments are grouped around access courtyards to activate them as social spaces.

Fig. 4 Plan diagram showing location of entries around access courtyards.

Vehicle Egress and Parking

Multi-use External
The vehicular access ramp between the two buildings forms a large open space. Its sloped sides use as a gathering space for residents and workers in the adjacent commercial spaces.

Fig. 5 Plan diagram showing access courtyards used as external spaces.

Density

Shared Facility
Two commercial tenancies are located adjacent to the square/ramp between the blocks. One contains an office, the other a café. Their location around the square provides a centralised gathering point and increases the vibrancy of the space. The café also provides amenity for residents.

Fig. 6 Plan and sectional diagram showing commercial tenancies.
2. Internal Configurations

Alternative Configurations: Internal

Zoning
The individual apartments are organised into two primary zones. This allows for temporary subdivision, flexible household types, and the accommodation of workspaces. Designated workspaces (study rooms), storage rooms, bathrooms, kitchens, laundries and entrance lobbies are grouped into a service zone, which is defined by a tiled floor throughout. The second habitable zone unites living, dining, bedroom and external living areas together.

Fig. 7 Plan diagrams showing zoning.
Suitable Workspace

Appropriate Size
One of the apartment types includes a large bedroom space that could be utilised as a workspace.

Levels of Internal Separation
The workspace can be accessed directly from the entrance lobby and is separated from the main bedroom by a stairway. The bathroom is placed in the services zone, disconnected from more private areas of the house and therefore easily accessible to residents or employees.

Storage
A storage room is placed opposite the bathroom within the services zone. This independence from private areas of the house allows it to be used as a storage or cloak room accessible to employees.

Flexible/Multi-programme
In addition to apartment zones of habitual and services areas, the apartment is also arranged in halves. The lobby/storage/workspace area on the ground floor connects via stairs to a level one dining/kitchen/patio area. The dining area can also be used as a lunchroom so the workspace can utilise one half of the apartment without encroaching on the private living and bedroom half.

*Fig. 8 Plan diagram showing size of workspace and separation from bedroom and bathroom.*

*Fig. 9 Plan diagram showing independence of bathroom and storage room and proximity to workspace.*

*Fig. 10 Plan diagrams showing division of workspace/private areas.*
2. Internal Configurations

Appropriate Amenity
The patio adjacent the kitchen provides external spatial amenity for employees. A second patio connecting directly to the main bedroom maintains private external space.

Fig. 11 Plan diagram showing private patio off main bedroom and employee use of social patio.

Shared Facility

Workspace
The designated workspace is placed in the services zone which it shares with occupants of the apartment. Its location adjacent to bedroom areas, or off the living area, increases its availability to all occupants.

Fig. 12 Plan diagram showing locations of designated workspaces and connections to living area and bedrooms.
3. Internal/External Relationships

Alternative Configurations: 
External

Type and Adjacency
External space within each apartment is provided by large patios. Smaller apartments have a single patio, connected to living/dining spaces. Larger apartments have two patios: one adjacent to the kitchen and grouped with the dining area; the other connected to the main bedroom. The second patio allows for occupation by diverse households and creates semi-independent spaces.

Fig. 13 Plan diagrams showing patio locations for two apartment types.

Actual Flexibility

Shutters
The internal and external aspect of patio spaces can be altered by opening or closing shutters. When closed, they increase space for the adjacent internal program. Opening the shutters allows for increased external use, such as outdoor dining.

Fig. 14 Plan diagrams showing modified use of patio space through opening/closing of shutters.
Case Study Twelve
Latapie House

Floriac, France
Lacaton and Vassal
1993
Single family detached house

Configuration: 2 bedroom house
2 storey

Size: 260m² site
185m² house

Project Description
The Latapie House is a highly flexible dwelling. The two primary elements of the house provide for different seasonal occupation in summer and winter and the centralised services facilitate flexible use of internal rooms. Only the services are fixed allowing for a maximum potential of uses of all spaces. The services are arranged as a core which organises different spaces. At ground level the living/dining and garage areas can extend into a large greenhouse structure that encloses the rear yard. Industrial building systems and an economic choice of materials and finishes are used to gain volume with a small budget.

View of street facade
View from rear yard
Site Plan 1:200

Perspective view from street, panels open

North Elevation with open facade

South Elevation with closed facade

Cross Section

Southwest Elevation

Ground Floor

First Floor

1 Entry
2 Garage/Dining
3 Bathroom
4 Laundry
5 Kitchen
6 Living/dining
7 Courtyard/Living/Dining
8 Possible Bedroom
9 Void
1. Site, Siting and Shape

Multi-programming
Internal

Enclosed Exterior
The dwelling is configured into two linked elements. A street-facing element contains all living, bedroom and service functions. A ‘greenhouse’ element to the rear operates as an enclosed yard, supporting multiple semi-external functions for living, dining and service.

Fig. 1 Site plan diagram showing two elements

Larger/Cheaper

Material Savings for Additional Volume
External cladding and internal lining materials used for the living and bedroom element of the house are economically selected and detailed. The reduced construction costs of these parts of the house allow for construction of the large enclosed yard element to the rear.

Fig. 2 Image and isometric diagram showing construction savings of dwelling borrowed to provide large rear element.
Construction Economies

Building System Appropriation
Greenhouse construction systems are used, providing savings for the rear enclosed yard element. The use of industrial systems is not new; they are often borrowed by architects for economical construction.

Fig. 3 Images showing previous dwelling built using greenhouse construction method and detail of Latapie house showing use of similar methods.

2. Internal Configurations

Alternative Configurations: Internal

Services Location
The bathroom, kitchen services and vertical circulation are grouped into a central core.

Fig. 4 Plan diagrams showing services core.

Passive Flexibility
The combination of the external enclosed courtyard and the services core provide great flexibility in how the dwelling can be used.

Serviced Spaces
The possible bedroom spaces on each side of the central services core are of equal size and amenity, allowing for flexible use by occupants.

Fig. 5 Plan diagrams showing bathroom and circulation access to bedrooms for flexible use.
2. Internal Configurations

Surplus Space
The enclosed courtyard space at the rear of the dwelling provides a surplus space for both internal and external activities. It allows extension, doubling, relocation or alteration to these activities.

Fig. 6 Plan diagram showing surplus space within enclosed yard element.

3. Internal/External Relationships

Spatial Definition
An area of lawn separates the surplus service space from the surplus living/dining spaces in the enclosed yard.

Fig. 7 Plan diagram showing lawn area defining spaces in enclosed yard.
ESD

Heating and Cooling
Both elements of the house can be opened substantially to ventilate heat from the enclosed yard. Alternately, solar loads can be distributed though the house to conserve heat in winter.

*Fig. 8 Sectional diagram of ventilation system.*
*Fig. 9 Principal facade showing openings.*
Furlan House
Case Study Thirteen
Furlan House

Ubatuba, Brazil
Paulo Mendes da Rocha
1973
Single family detached holiday house

Configuration: 3 bedroom house
Single storey

Size: 800 m² site
320 m² house

Project Description
This holiday house for Artemio Furlan is located on the beach in the town of Ubatuba near Sao Paulo in Brazil. The primary design intent was to provide an abundant level of external living spaces for the beach house, and to maximize the linkage between them and the indoor areas.

This house uses two basic elements – a bedroom block and a raised indoor/outdoor living platform – to create multi-functional external courtyard spaces and internal circulation paths. External walls composed of large doors in the raised living area maximize the relationship between internal and external space, allowing multiple combinations of indoor/outdoor living arrangements. All of the internal spaces of the house – the kitchen, bedrooms and bathrooms – have external entries, emphasising its informal nature.
1. Terrace
2. Living
3. Dining
4. Kitchen
5. Bedroom
6. Bathroom
7. Service Quarters
1. Site and Siting

Internal/External Relationships

Orientation
The mass of the building is located to produce three primary external spaces, each orientated to maximise sunlight.

Contextual Relationships

Edge Conditions
The site is located at the corner of two streets. The principal parts of the building – bedrooms and living area – are located away from the street, with the external courtyards providing a buffer to street activity.

Vehicle Egress and Parking

Multi-use External
The two courtyards, which are articulated by the boundary and external walls of the house, can also be used as off-street parking areas. Stone paving and the retention of existing trees increases amenity to these areas and reinforces its multi-use character.
Access and Circulation

Hierarchy
Primary and secondary access paths articulate internal spaces of the house. The primary paths connect multi-use courtyard/parking spaces to the main internal spaces. To the east, an entry door connects to the internal hall. The kitchen/dining area to the north is accessed directly from the courtyard/car park.

The secondary access path along the southern and western boundaries connects the bedrooms, bathrooms, and the external service space; it also links the courtyard/parking spaces.

Fig. 4 Plan diagrams showing primary and secondary access paths.

2. Internal Configurations

Alternative Configurations: Internal

The significant raised floor of the living space provides a variety of internal/external living configurations. The raised area also articulates circulation within the house.

Zoning
There are three zones within the house: bedrooms, bathrooms and service quarters which are grouped into a block along the southern boundary of the site; the kitchen and dining area, and the large raised internal/external living area which face north; and a variety of different internal/external spatial arrangements which are formed by the operable walls in the living space. The latter zone provides temporary, informal occupation compared with the more defined bedroom and kitchen/dining activities.

Fig. 5 Plan diagram showing zoning.
2. Internal Configurations

Thresholds/Changes in Level
The level change between the living area and the bedrooms creates a hallway that separates social and private areas of the house, without compromising the planned informality. The raised area also provides a suitable semi-enclosure to the external courtyard/carpark areas.

Fig. 6 Plan diagram showing hallway between bedrooms and raised living area.
Fig. 7 Cross-sectional diagrams showing semi-separated hallway and direct connection between service quarters and kitchen/dining area.

Services Location
Bathrooms are grouped and doubled up to support different combinations of private/social activity within the house.

Fig. 8 Plan diagram showing bathroom use supporting private/social occupation.
Fig. 9 Plan diagram showing bathrooms primarily supporting social occupation.
**Expectation/Provision**

**Storage**
Storage shelves are incorporated into the raised living area.

*Fig. 10 Cross-sectional diagram with storage shelf.*

**Passive Flexibility**

**Circulation**
The separation of the living area from the defined spaces of the kitchen and bathrooms/bedrooms is further enhanced by the connection to one of the external courtyard/car park spaces.

**Semi-detached**
The independent circulation within the raised living area separates it from other areas of the house, supporting its use as a large, undefined indoor/outdoor room.

*Fig. 11 Plan diagram showing independent circulation path within living zone.*

**Size**
The raised living area is large enough to support multiple uses.

*Fig. 12 Plan diagram showing multiple uses of living space supported by its size.*
3. Internal/External Relationships

Alternative Configurations: External

Egress and Circulation
Separate egress from each bedroom creates an independent external aspect and connection. This relationship also applies to the bathroom, allowing the space between boundary and house to be used as an external hallway.

Fig. 13 Plan diagram showing independent access to bedrooms from outside.
Fig. 14 View of external aspect from bedroom.
Fig. 15 Plan diagram showing use of space between boundary and house as external hallway.

Service Space
The external space adjacent to the service quarters and kitchen area is an external laundry area for washing and drying clothes.

Fig. 16 Plan diagram showing external service area.
Actual Flexibility

Doors as Walls
Sizes and combinations of internal and external spaces within the raised living area can be altered by opening and closing the large perimeter doors. These doors extend to the underside of the roof and can be used as walls.

Fig. 17 Plan diagrams showing alteration to living spaces by opening/closing perimeter doors.

Mechanisms for Flexibility

Doors
The perimeter walls to the raised living area are mostly large, paired timber doors, each split in half-panels and separately hinged. This creates several options for opening or closing the internal space to the outside. Maximum connection to the external living area is created when doors are fully open; a combination of wall and door openings allow for a variety of partial openings.

Fig. 18 Comparative views of raised living area with various combinations of open/closed doors.
Case Study Fourteen  
Nomi House

Osaka, Japan  
Tadao Ando  
1996  
Inter-generational family infill house

Configuration:  2 bedroom detached house  
2 storey

Size:  140m² site  
180m² house with courtyards

Project Description
The house occupies an extremely small site in a dense, inner-city Osaka neighbourhood. The design intent was to provide a high degree of private space within the small area to accommodate a young couple and their mother. Therefore, the house is designed as three separate houses, each with a private courtyard space. Each 'house' consists of one room and the external courtyard: one combination for the couple, one for the mother, and one for shared dining/living.  
Circulation to and from the bedrooms and the shared living/dining area is also separated. The entry and guest's access to the bathroom overlap these paths. The fourth area in the house is the elevated terrace, which is adjacent to the living/dining room. This terrace is accessed via one of the two circulation stairs along each side of the house.

This project demonstrates multi-generational living arrangements that are independent of each other despite the modest house size. They are created through unusual circulation paths that rely on small external courtyards to form private spaces, creating quality amenity throughout the house. The relationship of the bedrooms to the courtyards allows flexibility of use; one over-sized bedroom provides flexible surplus space.
1 Courtyard
2 Bedroom
3 Storage
4 Open to below
5 Terrace
6 Living/Dining
7 Bathroom

Sectional perspective of interior view to courtyard

Ground Floor Plan

First Floor Plan

Roof/Courtyard Plan

Section a
1. Site, Siting, and Shape

Smaller/Cheaper

Cost of Site
As land prices are costly in Japan’s urban centres, house sites are very small in comparison with Australian residential sites. The overall site for this project is just 110m². The project sacrifices the interior provision (number of bathrooms; room sizes) for exterior amenity.

Fig. 1 Plan diagrams showing proportion of open/internal space within small site.

Zero Lot Lines
The design of the house uses boundary walls to create external spaces and to support external circulation stairs, as well as acting as perimeter walls to interior spaces.

Fig. 2 Plan diagrams showing various uses of perimeter walls on boundary.

2. Internal Configurations

Individual/Collective Housing

In order to create privacy in a small house shared between three independent adults, three semi-separate houses are formed within the one house. In this way, the design draws on design techniques normally used in collective housing, rather than a private house.

Articulation of Part
The design articulates the house into three elements that are separated by circulation paths. There are two bedroom elements, one for the couple, the other for the mother. The third element is the shared living/dining area. All three elements have an attendant courtyard space.

Fig. 3 Plan diagrams showing the three combinations of rooms and courtyards.
Egress and Circulation

Room Borrowed for Circulation
Internal areas of the house are restricted by the inclusion of several courtyards. This economy of size precludes a guest bathroom. Instead, visitors access a bathroom adjacent to the couple’s bedroom via a separate circulation path. Rather than moving directly through the couple’s private sleeping area, visitors use the additional entry space borrowed from a corner of the couple’s room.

Passive Flexibility

Surplus Space
The couple’s bedroom is substantially larger than any of the other internal spaces of the house. The orientation of the room, with a long glazed wall that faces the courtyard, suggests that the bed be positioned along the boundary wall. This leaves half of the room to be used for another function. If used as a workspace, the less private programme helps mitigates the somewhat invasive ‘borrowing’ of the room for guest access to the bathroom.

Fig. 4 Plan diagrams showing view of rooms/courtyard when moving from living/dining area to couple’s bedroom.
Fig. 5 Plan diagram showing ‘service corridor’ between bedrooms and bathroom.
Fig. 6 Workspace use of surplus bedroom area as filter for borrowed circulation path.
3. Internal/External Relationships

Alternative Configurations: External

Egress and Circulation
The main circulation paths are designed to distinguish each element of the house separately, increasing privacy to bedrooms. This is enhanced by externalising circulation paths that would normally be inside the house. Shelter to the paths is provided by the extended eaves of the roof.

This relationship extends to include programs that would normally have adjacent circulation. The living/dining room and the external terrace have a small external circulation path between them. This allows simultaneous social activities to occur independently.

Fig. 7 Long section showing external areas protected by eaves.
Fig. 8 Plan diagram showing external paths between living/dining area and bedrooms, with shelter from roof over.
Fig. 9 Plan diagram showing small external hall between living/dining area and external living terrace.
External Elements

Courtyard
All three courtyards in the house are located on the ground floor.

Fig. 10 Plan diagram showing courtyards.

Raised Terrace
A large terrace is located above the couple’s bedroom and adjacent the living/dining room. It operates as an external living area.

Fig. 11 Plan diagram showing location of terrace and relationship to living/dining room.
Housing Prototypes
Case Study Fifteen
Prototype Houses

Atlantic City, USA
Brian Healy Architects
1996-7
Single and multiple family housing types, project

Configuration: Type A: 3 bedrooms, 2 storey detached house
Type B: 2 and 3 bedrooms 2 storey dual occupancy houses
Type C: 2 bedrooms, 2 storey detached house and 1 bedroom, 2 storey outbuilding

Size: 190 m² each site
160 m² Type A house
100 m² and 70 m² Type B houses
150 m² Type C house and 50 m² outbuilding

Project Description
This project proposes infill models for single and two family houses: a single family detached house, a back to back dual occupancy building and a detached house with a separate two storey building at the rear. All projects are predicated on the same lot size and have similar internal arrangements. The models demonstrate several approaches to dense, shared and collective housing.

A side passageway is instrumental to the design. It connects the street to a rear backyard space and alley way. The buildings can therefore open onto this side space with multiple access points, windows and circulation. Generally, the more communal areas of the plan are separated from the more private areas. A front room, featured in all the designs, could be a home office, living area or additional bedroom. In the Detached house plus outbuilding model, a separate dwelling can be accessed from the side passageway and shares a common courtyard with the main house.
1. Site, Siting and Shape

**Alternative Configurations: Buildings on Sites**

There are three types of housing in the housing prototype system:
- Type A: single detached 2 bedroom and flexible room
- Type B: dual occupancy, 3 bedroom dwelling/2 bedroom dwelling
- Type C: detached and outbuilding – 2 bedroom and 2 flexible rooms/ 1 bedroom house.

**Zero Lot Lines**

For each housing type, one wall has a zero lot line relationship with its neighbour. This creates a side lane on each lot to provide access to the rear from the front of the site. This lane allows the use of the front of the site to be different to the rear, and is utilised for all three housing types.

**Elevation**

All prototypes are raised from the street level around a metre. As the buildings are positioned up to the street’s edge with no setback, the elevation allows for some separation from the street.

**Contextual Influences**

The site has a laneway at the rear. This allows an alternative entry to the second dwelling and car parking access. The position of the Outbuilding at the rear has been influenced by the existence of the laneway.

Fig 1. Plan diagram showing zero lot line and side passageway.
Fig 2. Elevation showing relevated floor level from street.
Fig 3. Plan diagram showing adjacency of rear building to laneway.

**Density**

Multiple houses
In two of the three prototypes, two households can occupy the site independently.
2. Internal Configurations

Access and Egress

The use of the side lane allows circulation to the rear living area of the house to by-pass the front room or direct access to the rear separate dwelling in all prototypes.

Fig 4. Plan diagram showing separate access to the front entry, rear living areas and rear of the site.

Passive Flexibility

Work from Home
The flexible room at the front of the house in all prototypes has direct access to the bathroom, storage and the front entry. This allows it to be used independently from the rest of the house as a semi-independent dwelling or workspace.

Fig 5. Part plan diagram showing independent configuration of workspace room.

Visitors
The angled hall creates a generous space adjacent to the guest room that could be used to receive visitors. It narrows towards the rear living areas, becoming a domestic hall.

External Space
The workspace has a direct connection to the raised patio space at the front of the site.
2. Internal Configurations

Individual/Collective Housing

Private and shared Outdoor space:
Detached House and Outbuilding

The central courtyard between the detached house and the outbuilding is configured into 3 connected spaces:

- a screened patio area for the outbuilding,
- a shared lawn between the two dwellings, and
- a deck for the detached house off the living area

In this configuration the open spaces are grouped so as to create the maximum separation, but separated to allow for a private open space for each dwelling as well as a shared space which acts as a buffer between the two.

Fig 6. Plan diagram showing shared aspect to outdoor space and private outdoor areas.

Shared and Borrowed Amenity: Dual Occupancy

In the Dual Occupancy model, Type B, some of the courtyard and open spaces are positioned within the plan as opposed to at the rear or exclusively adjacent one dwelling so that their amenity can be shared.

Fig 7. Plan diagram showing shared aspect to central outdoor space.
3. Internal/External Relationships

Amenity

Setback
The setback of the building on one side to create a passageway ensures that windows can open along the length of the building. This also admits light into the centre of the plan and creates a private aspect for the dwelling.

Orientation
The plans can be flipped to suit the best solar orientation.

Fig 8. Plan diagram showing solar gain and ventilation into setback area.
Fig 9. Plan diagram showing alternative orientation.
Gifu Apartments
Case Study Sixteen
Gifu Kitagata Apartments

Kitagata, Japan
Kazuyo Sejima & Associates
1998
High-rise Apartment Building

Configuration: 2 bedroom, 10 Storey
Size: 584m² footprint
70-80m² apartment

Project Description
Developed as one project amongst a group of projects designed by female architects, this building provides accommodation for young women. In part, this project is the outcome of research undertaken by Sejima into typological variations in high-density housing. In particular, this project utilises a narrow plan in a high rise project, effectively halving what is usually a double loaded corridor type.

This project provides a high level of flexibility and amenity in a high density, high-rise type. In this way, the high-rise apartment building becomes 'domesticated'; individual apartments take on individualised shapes and have front and 'rear' entrances.

View of rear facade
North Elevation

1 Corridor
2 Dining Room
3 Terrace
4 Bedroom
5 Japanese Style Room
6 Verandah
7 Void

Context Plan

Typical Plan

Plan

First Floor

Ground Floor
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

High-Rise
This project uses the high-rise type to provide a high density of residences, with a narrow footprint which maximises the amenity for each unit. Each unit receives light from two sides, as opposed to the conventional double loaded corridor which provides light from one side only.

Fig 1. Plan diagram showing external visual and light amenity to both sides of unit.

Individual/ Collective Housing

Articulation of Part
The basic housing unit within the project consists of bedrooms, a Japanese style room, a bathroom and a double height living/dining room. A public circulation corridor runs down one side of the apartment. By varying the way in which the other rooms connect to the double height space, a variegated section is created that provides different apartment types and shapes.

Fig 2. Typical plan showing room layout
Fig 3. Long section showing different apartment configurations.
Building Extension: Addition

Capacity of Initial Building for Growth
The placement of the double height space in the middle of the apartment creates a potential for addition in two directions. One apartment unit can conceivably take part or all of a unit adjacent to this double height space to form a larger, interconnected dwelling.

Fig. 4 Section diagrams showing potential for expansion of an apartment in two directions.

Passive Flexibility

Circulation
Direct access to the circulation balcony allows flexibility of room use and different users.

Fig. 5 Plan diagrams showing flexibility with direct access from all rooms except bathroom.
2. Internal Configurations

Egress and Circulation

Program use of Circulation Space
To maximise bedroom space within a small apartment area, the internal hallway space is also used as the basin area for the bathroom.

Fig 6. Plan diagram showing use of circulation space for bathroom use.

3. Internal/External Relationships

External Elements

Terrace
A large terrace is provided for each unit that connects to the internal hall. This space is large enough to support a service use as well as external living use.

Fig 7. Plan diagram showing connections from internal spaces to terrace and terrace uses.
Fig 8. Image of terrace space.
Barnard House
Case Study Seventeen
Barnard House

Quelges, Portugal
Ricardo Bak Gordon
2007
Single Family Detached House

Configuration: 3 Bedroom with courtyards
Single storey

Size: 2.2 acre site
300 m² house and courtyards

Project Description
This building uses a grid system of interior rooms and courtyards within a square footprint. Each room has a direct relationship with a courtyard and an independent entry through glazed doors facing the courtyard. The circulation space is part of the rooms, with a secondary circulation through the courtyard spaces. The internal arrangement consists of square, rectangular and L shape spaces that can be reconfigured passively, or, where the bedrooms are defined by joinery walls, reconfigured by removing or changing those walls (actively). The location of bathrooms and independent entries, shape of the rooms and relationship with outdoor space creates a suitable workspace as well as a possibility to subdivide to create multiple dwellings within the existing envelope. Similarly, the interior could be extended by the enclosure of some courtyard space.

This house can be extended, subdivided and used flexibly due to its relationship with courtyards and subtly articulated open plan. The courtyards create multiple options to enter the house and provide a high level of amenity to each room.
Site Plan 1:2000

1 Courtyard
2 Entry
3 Bedroom
4 Bathroom
5 Kitchen
6 Dining
7 Living

Floor Plan

Perspective view

Section a
1. Site, Siting and Shape

External Elements

Contextual Relationship
The use of internal courtyards within the square footprint reduces the reliance on the quality of the immediate perimeter condition and context.

Economies
The internal courtyards remove the need for a backyard type outdoor space and therefore a smaller piece of land could be used, minimal to the dwelling footprint.

Alternative Configurations: Buildings on sites

Orientation
The use of the internal courtyard with glazed doors allows the plan to be rotated in any orientation and ensures that outdoor and interior spaces will receive daylight.

Density

Modular Repetition
The square footprint with the use of internal courtyards is suitable for repetition. The modular plan is suitable for subdivision. Both provide an increased density than commonly found in single family houses on a lot that relies on a backyard open space.

Combined and Borrowed Amenity
In a repeated pattern amenity can be borrowed from adjoining courtyards, and shared through back to back courtyards.

Fig 1. Plan diagram showing perimeter and placement of outdoor space within.
Fig 2. Image showing perimeter wall.
Fig 3. Plan diagram showing possibility to alter the orientation while retaining solar gain.
Fig 4. Plan diagram showing repeated footprint.
Fig 5. Detail Plan diagram showing relationship of courtyards and the potential shared and borrowed amenity.
2. Internal Configurations

Alternative Configurations: Internal

Privacy
The courtyards are separate from each other, providing several opportunities for outdoor space. They are also within the footprint of the house, and so sheltered by the pergola and building, minimising exposure to neighbouring properties.

Amenity
The adjacency of the courtyard spaces to each interior space provides a high level of amenity. The use of glazed doors also allows each space to open onto the courtyard.

Suitable Workspace
The independent entry, and appropriate amenity provided by glazed doors and relationship to an outdoor space creates a suitable work environment. The direct connection to a Bathroom and the possibility to circulate through the courtyard, separates workers from the 'private' areas of the dwelling.

Multi Households
The arrangement of one bedroom and bathroom separated by a door in the hallway, with its own access and outdoor space, allows for the semi-independent co-habitation of a second household.

Fig 7. Plan diagram showing direct link to courtyard from all spaces through glazed doors.

Fig 8. Detail Plan showing suitable workspace with separate entry, direct access to bathroom.

Fig 9. Plan diagram showing possible semi-independent household.
Passive Flexibility

Room Shape
The shape of the plan allows a passive articulation of room shapes: square, rectangle, or L shape. This allows different uses according to space requirements.

Access
Doors onto each courtyard space create multiple entries which allow rooms to be used flexibly separate from the remaining house.

Doors as Windows
The use of glazed doors as windows creates a high level of amenity and access to each room allowing a greater variety of uses than a typical bedroom space may facilitate.

Mobility
The single level and flat outdoor spaces are appropriate for an ageing household.

Fig 10: Plan diagram showing spatial modulation.
Fig 11. Image showing L shape living room.

Multi-programming
Internal

Circulation
Rooms are used as circulation, allowing full use of all spaces instead of separate hallways.

Fig 12: Plan diagram showing circulation shared with room.

Actual Flexibility

Joinery as walls
The use of joinery storage as walls, independent from the building’s structure, the simple grid plan and common quality of each room (identical doors as windows and amenity) creates the possibility to dismantle or move the joinery to create a larger or smaller room, or different configuration.

Fig 13. Plan diagram showing alternative configurations created by removing or moving the joinery walls.
Building Modification: Within Envelope

Addition/Infill
The infill of courtyards could increase the interior space as required without extending the footprint. The grid system, existence of doors into the courtyards, and use of rooms as circulation allows a simple enclosure of the roof and perimeter wall to effect the addition.

Subdivision
The modular plan, access to a courtyard from each space, access from a courtyard to each space and central location of bathrooms allows a simple subdivision using one internal wall to create multiple dwellings.

Fig 14. Plan diagram showing possible infill of courtyards.
Fig 15. Plan diagram showing possible subdivision of existing footprint into two separate dwellings.

Building Modification: Extension

Extension
The modular plan, courtyard system, simple roof shape and use of rooms as circulation allows for extension of the grid in any direction.

Fig 16. Plan diagram showing possible extension and addition to modular plan.
3. Internal/External Relationships

Alternative Configuration: External

Amenity, Solar Access and Shading
The courtyards are placed at each side of the building so that solar gain can be achieved independent of orientation.

The direct connection of each room to an outdoor space creates a high level of amenity. The position of the courtyards within the plan and the use of the building’s roof creates shade and shelter.

Orientation and Hierarchy
Each facade has an equal quality made up of a courtyard entry and glazed doors. This non-heirarchy of a single facade allows for different orientations.

Fig 17. Section diagram showing shading of internal courtyards.
Fig 18. Image showing shaded courtyard.

Multi-programming External

Access and Circulation
The courtyards are used as access points and an alternative circulation between different parts of the house.

Fig 19. Plan diagram showing multiple entries and secondary circulation.
Courtyard House
Case Study Eighteen
Courtyard House

Beijing, China
Atelier Feichang Jianzhu
2001
Inter-generational family house, project

Configuration:  4 bedroom and courtyard
                2 Storey

Size:         401 m² site
              427 m² house

Project Description
This contemporary version of a traditional Chinese courtyard house provides for several generations, or households, within a relatively small footprint. It combines small and large spaces with equal amenity to a central courtyard. All spaces face the interior courtyard and so have a high level of amenity and privacy from neighbouring properties. Garage and service spaces are located in a basement. The project contains four separate bedrooms each with their own bathroom. The serviced bedrooms are positioned apart from each other rather than zoned together. A kitchen and dining space, a large living room that could be used for separate activities, a study, exercise room and multi-function space are shared.

A unique quality of the project is its non-reliance on the shape or size of the perimeter. As a device, the courtyard shape and size could be altered to take into account different shaped or size lots while the remaining project remains relatively the same. The model could be repeated back to back, sharing the perimeter wall.

Alternative Configurations:
Buildings on Sites
Density
Individual/Collective Housing
Passive Flexibility
Multi-programming Internal
Building Modification: Within Envelope
Alternative Configurations: External
1  Courtyard
2  Entry
3  Bedroom
4  Bathroom
5  Kitchen
6  Dining
7  Living
8  Study
9  Exercise Room
10 Multi-function Room
11 Storage and Plant
12 Garage

Site Plan 1:750
Perspective view
Ground Floor
First Floor
Basement
Section a
1. Site, Siting and Shape

Alternative Configurations:
Buildings on Sites

Courtyard
The outdoor space is positioned in the centre of the plan. This provides a private space and an inward looking aspect from all rooms surrounding the courtyard.

Zero Lot Line
The use of the central courtyard allows the building to be built to its boundary, consolidating all space to the centre. Full use is made of the outdoor space and site extent.

Boundary Shape
The use of the central courtyard and the relatively generic square or rectangle shape of both the plan and courtyard, allow some flexibility in the shape of the site. Proportionally modified but very similar versions of the same plan can be adapted to different shaped sites.

Contextual Relationship
The use of internal courtyards within the square footprint reduces the reliance on the quality of the immediate perimeter condition and context.

Vehicle Access and Parking
The parking is located underground in the basement level. This frees the Ground Plan and is an efficient use of the footprint. The project also proposes underground road access – although the underground parking does not rely on this feature.

Fig 1: Plan diagram showing location of outdoor space in a central courtyard.
Fig 2: Plan diagram showing possible modification of plan within different perimeter shapes and sizes.
Fig 3: Plan diagram showing location of car parking and space it would otherwise use if located on the Ground Floor.
Fig 4: Section diagram showing location of car parking.
2. Internal Configurations

Density

Modular repetition
The square footprint with the use of internal courtyards is suitable for repetition. Both provide an increased density than commonly found in single family houses on a lot that rely on a backyard open space.

Fig 5. Plan diagram showing possible repeated footprint.

Individual/Collective Housing

Wing Shape Plan
The shape of the plan – a square ‘donut’ – creates four separate ‘wings’. There are four bedroom and bathroom independent ‘units’, while all other space is shared. Each ‘unit’ is positioned within a ‘separate’ wing. This position in plan allows some individual separation within a collective model.

Combined Amenity
The consolidation of the outdoor space in one central space increases the net amenity above that available to a smaller ‘unit’. The inclusion of other shared facilities such as an exercise room, study and a multi-function space also increase the amenity normally found in a smaller stand alone dwelling.

Fig 6. Plan diagram showing ‘wing’ arrangement.
Fig 7. Plan diagram showing direct independent bedroom and bathroom ‘Units’ and their location in each separate ‘wing’.
Fig 8. Plan detail of independent ‘Unit’.
Mutual Support
The project contains four separate bedrooms each with their own bathroom. The kitchen and dining space, a large living room, a study, exercise room, multi-function space and outdoor space are shared. The bedrooms are separated, located in each ‘wing’ and two are on the ground floor. This configuration supports multi-households: up to four singles or couples who have independent rooms and services but benefit from shared facilities and mutual support of co-habitation.

Mobility
The Ground Floor contains all necessary spaces and services including two of the four bedroom/bathroom combinations. There are several steps to the outdoor space which is otherwise level.

Health Based Recreation
The project includes a dedicated exercise room and a garden. Both can be used for health based recreation at home.

Suitable Workspace
The independent circulation through the courtyard, appropriate amenity provided by large glazed walls and relationship to an outdoor space creates a suitable work environment.

The direct connection to a bathroom and kitchen and the possibility to circulate through the courtyard, separates workers from the ‘private’ areas of the dwelling.

Fig 9. Plan diagram showing shared facilities.
Fig 10. Section diagram showing the flat outdoor space and minimal level change on the Ground Floor.
Fig 11. Plan diagram showing the alternative circulation between the workspace and services.
Passive Flexibility

Room Shape and Size
The shape of the plan allows a passive articulation of room shapes: square, rectangle, or L shape. This allows different uses according to space requirements. Also, the large size of the living space allows for flexible use for activities requiring a small or large space.

Wing Shape Plan
The shape of the plan – a square ‘donut’ – creates four separate ‘wings’. The shape separates spaces from each other allowing them to be used independently from one another. In this case the secondary circulation route can be used through the courtyard.

Access
Doors onto the courtyard space from each ‘wing’ create multiple entries which allow wings to be accessed separately from the remaining house.

Zoning - Dispersed
The plan does not zone private and public areas which commonly results in bedrooms being grouped together in a ‘private’ area. Rather, the bedrooms are separated from each other. They are also separate from the shared spaces using two methods: an articulated ‘box’ on the ground floor, and a second storey.

Fig 12. Plan diagram showing L shaped living space and room spatial modulation.
Fig 13. Plan diagram showing access from each ‘wing’ to the courtyard.
Fig 14. Plan diagram showing dispersed private areas within public areas.
Multi-programming

Internal

Circulation
Rooms are used as circulation, allowing full use of all spaces instead of separate hallways.

Fig 15. Plan diagram showing circulation borrowed from rooms.

Building Modification:
Within Envelope

Addition/Infill
The simple rectangular shapes of the rooms and the non-dedicated hallway allow for addition to the accommodation within the building envelope in a number of ways. Infill of parts of the courtyard by replicating the bedroom ‘box’ off the alternate wings, or/and the occupation of the high ceiling space with mezzanines.

Subdivision
The wing shape of the plan with equal access to the outdoor space, and separation of the bedrooms allows a simple subdivision using internal walls to create two to four separate dwellings.

Fig 16. Plan diagram showing possible infill of courtyard using articulated independent ‘unit’ accessed from main house and on alternate ‘wing’.
Fig 17. Section diagram showing possible use of high ceiling space.
Fig 18. Plan diagram showing possible subdivision of existing footprint into two separate dwellings using the existing entry.
3. Internal/External Relationships

Alternative Configuration: External

Solar Access
The central courtyard and glazed walls facing the courtyard ensures solar gain can be achieved independent of orientation.

Circulation
The courtyard acts as independent and secondary circulation to each 'wing'.

Amenity
The adjacency of the courtyard space to each interior space provides a high level of amenity. The inward looking aspect of each room towards the centre creates a high level of privacy from neighbouring properties.

Fig 19. Section diagram showing solar access to central courtyard and interior.
Fig 20. Plan diagram showing use of courtyard as secondary circulation route.
Fig 21. Plan diagram showing internal relationship with courtyard space.
Fig 22. Section diagram showing adjacency and aspect of interior to courtyard.
Alfonso Reyes Apartments
Case Study Nineteen
Alfonso Reyes Apartments

Mexico City, Mexico
Dellekamp Architects
2003

High-rise apartment block

Configuration: 7 Apartments, 2 - 3 bedrooms over 1 and 2 storey
Ground floor carpark and commercial tenancy
6 storeys

Size: 390m² site
total floor area 2000m²
1 x 2 bedroom 100m²
5 x 2 bedroom 130m²
1 x 3 bedroom 300m²

Project Description
This building is situated on a busy street in Mexico City, Mexico. It is a U shape building on a rectangular lot with an internal light court along its quieter northern side. The Ground Floor contains a commercial tenancy which extends to the First Floor, as well as garage and service spaces. The seven apartments are arranged over the four remaining storeys, where two are split over 2 storeys. Each apartment is simply planned and has a large combined kitchen, dining and living space, 2 bedrooms and bathrooms.

All apartments have a façade facing the internal light court void and windows, patios and stairs are arranged around the court. Each apartment has four individual facades created by the use of internal patios. The street facades have small strip clerestory windows and each apartment has at least one more glazed internal facade opening onto an internal patio which extends to the external façade. The patios have clear glass balustrades and separate each apartment, break up the building mass and provide access to apartments. They provide a more conventional type of outdoor space than often found in apartment buildings: inhabitable, shaded, covered and connected to living spaces. Each apartment is clad in a different material and so easily distinguishable. One of the significant features of the design is the use of the internal patio which provides a high level of privacy and amenity, a sense of individual within the collective, reduces the reliance on the context conditions, creates multiple potential accessways to each apartment thereby potential for adding or subdividing and ensures each apartment natural ventilation and solar access.
1. Patio
2. Entry
3. Bedroom
4. WC
5. Bathroom
6. Kitchen
7. Living and Dining
8. Light Court void
9. Apartment Type 5

Ground Floor
First Floor
Second Floor
Third Floor
Fourth Floor
Fifth Floor

Section a

Apartment Type 6 Plan
1. Site, Siting and Shape

External Elements

Combined Amenity
The U shape of the plan surrounds an internal shared light court that provides amenity to all apartments.

Contextual Relationship
The use of an internal light court, internal patios and clerestory windows in the street facades reduces the reliance on the quality of the immediate perimeter condition and context.

Fig 1. Site plan diagram showing U shape plan and internal light court. Section showing light court extending vertically and shared by all apartments.

Fig 2. Plan diagram showing relationship to internal light court and internal patios reducing reliance on perimeter.

Individual/Collective Housing

Apartment Arrangement
All apartments have a different configuration. The outdoor patio spaces are therefore positioned in varied areas, creating privacy between outdoor spaces.

Articulation of Part
The outdoor patio spaces separate each apartment breaking down the building mass as well as articulating each apartment. Use of different materials for each apartment further defines the individual within the collective.

Fig 3. Plan diagrams showing configuration of apartment layout and outdoor space position. Fig 4. Image showing articulation of individual apartment separated by the internal patio and use of different material.
Density

Shared Facility
There is a commercial tenancy on the Ground and First Floor. This also raises the dwellings from the busy street.

Multi-programming
External

External Space and Access
The internal patios also act as private access from the lift or stair to some apartments. This is in contrast to the common use of an internal hallway in apartment blocks, further improving amenity. It also provides an individual facade to the apartment upon approach as opposed to a single door.

2. Internal Configurations

Alternative Configurations: Internal

Privacy
The internal patios separate each apartment from each other, there are no shared walls which reduces noise transfer between apartments. The clerestory windows to the street shelter the noise and create privacy from the street. The position of the patios within the interior makes them more private outdoor spaces than conventional balconies.

Amenity
The adjacency of the patio along the Living space edge provides a high level of amenity where the living space can open up onto the patio.

Fig 5. Section diagram showing separation of apartments from the street by the commercial tenancy and services to the first two floors.
Fig 6. Plan diagram of Ground and First Floor showing location of commercial tenancy and services.
Fig 7. Plan diagram showing use of patio as entry hall and a facade upon approach.

Fig 8. Plan diagram showing direct link to open space from living space.
Passive Flexibility

The design of the apartments creates spaces that can be used as a workspace, the co-habitation of 2 households semi-independently, and spaces that can be made larger or smaller.

Separate ‘Building’
Apartment type seven has three separate ‘buildings’ linked by glazed hallways, and separated by the internal patios. The separation of activities created by the patio system allows spaces to become flexible, as different use of some parts of the dwelling will not disturb others.

Multi-household
The arrangement of several apartments plans and sections (1, 3, 7) supports the co-habitation of two semi-independent households. This is facilitated by the separation of one bedroom area from another, a bathroom for each bedroom, and the Living and Kitchen space located centrally.

Suitable Workspace
The use of large glazed walls and sliding doors opening onto a patio in Bedroom spaces provides the appropriate amenity for a working space used during the day time.

The direct connection to a Bathroom and the Kitchen also provides connected services separating workers from the ‘private’ areas of the dwelling.

Size
The combination of the Kitchen, Dining and Living Room spaces creates one large room which allows a variety of temporary, informal occupation compared with smaller separate rooms.

Fig 10. Plan diagrams showing separate ‘buildings’ linked by a glazed hallway and separated by the patio.
Fig 11 Part Plan diagrams showing suitable workspace set up through adjacencies and amenity.
Fig 12. Part Plan diagram showing combination of Living and Dining into one large space.
Actual Flexibility

Operable Walls
Bi-fold doors as walls in several apartments (1, 2, 4) between a smaller space and the Living space allow a variety of different internal spatial arrangements, including the use as a bedroom (separated) or extension of the living space (combined), or other type of activity such as a workspace.

The glazed floor to ceiling sliding doors facing the patios, as well as the shape and adjacency of the patio – a rectangle shape parallel to the Living space – create an extension of the living space when open.

Fig 13. Plan diagram showing extendable room.
Fig 14. Plan and Section diagram showing extendable living area into the patio space.
Fig 15. Image showing the floor to ceiling glazed sliding doors and their relationship to the patio.

Building Modification: Within Envelope

Addition
The arrangement of the plans and sections allows a simple connection through the patios to 'add' to and extend an existing apartment.

Subdivision
The arrangement of plan and sections conversely allows for the subdivision of several apartments into smaller apartments. Such a device may be employed as a form of income.

Fig 16. Plan diagram of second and third floor showing combinations of subdivision and addition.
3. Internal/External Relationships

Alternative Configuration: External

Amenity, Solar Access and Shading
The use of the patios to separate each apartment provides four exposed facades capable of receiving daylight and ventilation in all orientations. The floor to ceiling glazing of the internal facade, facing the patio, is shaded due to its internal position.

The position of the patio separates each apartment providing privacy between them. The placing of the patio within the plan, compared to an external balcony, provides a sheltered and private open space. The size and direct connection to the living space provides a more conventional, and usable, courtyard type open space.

Garage Amenity
Four garage spaces back onto the internal light court. This is a benefit of placing the garage at Ground level rather than underground. The adjacency to the light court creates a potential connection to an outdoor space, and if it were glazed, the flexible use of the garage as a workshop or workspace with amenity from the court as well as a separate entry.

Fig 17. Section diagram showing shading of internal patios.
Fig 18. Partial Plan diagram showing four facades.
Fig 19. Plan diagram showing relationship of Garage to Light Court.
Farfor Houses
Case Study Twenty
Farfor Houses

Portsea, Victoria
Grounds and Boyd
1968
Single family semi-detached houses

Configuration: 4 houses, 3 bedroom and garage
Single storey

Size: 2330m² site
244m² house

Project Description
In this project, four dwellings are organised as two semi-detached houses. The site has one street frontage and one crossover. The shared driveway occupies a considerable amount of the site and can accommodate visitor car parking, however its presence is subdued by its loose stone materiality. The houses are typical in plan, but are oriented differently and mirror each other. A shared garden separates each house and all have a private, un-roofed courtyard and a verandah. Each dwelling also has an internal roofed courtyard, that also acts as a hallway connecting bedrooms to living areas. The internal courtyard allows sunlight to enter all houses, despite their different orientations. Each house has a garage for two cars. The project was speculative, with the client, Mrs. I. W. Farfor retaining one of the houses.

This project demonstrates economical siting by placing four houses on a lot that would typically accommodate a single family detached house. The plan of individual houses supports the shared occupation of the site by providing private external space within each dwelling. The orientation of the houses and the use of landscaping further articulates shared open space between them. The internal configuration of the houses allows passive flexibility in the use of the bedrooms.
1 Entry
2 Living/Dining
3 Kitchen
4 Courtyard
5 Garage
6 Hall
7 Master Bedroom
8 Ensuite
9 Bathroom
10 Laundry
11 Bedroom
1. Site, Siting, and Shape

Alternative Configurations:
Buildings on Sites

Semi-detached Cluster
The houses have individual titles to the boundary of the building. This is simplified by the inclusion of the external space within the building envelope. The title of the remaining site is shared/strata.

Fig. 1 Site plan diagram showing individual title at house perimeter.
Fig. 2 Site plan diagram showing remaining site as shared/strata title.

Individual/Collective Housing

Access
Pedestrian and car access is shared via a single side driveway. The driveway is wider than a single-family domestic driveway, at around 5 metres. The house plans are rotated or mirrored to locate the front door and car access to garage in the appropriate location. Each house has an independent front door, and is accessible through the garage. Access to each house is separated: garages are never adjacent to each other so each house maintains an individual identity.

Car parking
The setback of the houses and plan of the driveway with areas for parking bay ‘turn-out’ space allows for guest car parking on site that does not constrain driveway access. This configuration accommodates 17 cars in total. From each car parking position, cars can be turned to drive out facing the road.

Fig. 3 Site plan diagram showing shared driveway.
Fig. 4 Site plan diagram showing individual garages.
Fig. 5 Detail site plan diagram showing vehicle turn-out.
External Elements

Spatial Function
The houses are separated by a shared garden that acts as a buffer zone between the two sets of houses.

Internal Courtyard
The inclusion of open space as an internal courtyard provides privacy and a controlled aspect for the interior. The surrounding space is shared. This housing typology is largely independent from its site boundary condition for external space.

Fig. 6 Site plan diagram showing shared garden separating sets of houses.
Fig. 7 Site plan diagram showing internal courtyards and shared open external space.

2. Internal Configurations

Building Modification: Within Envelope

Pedestrian and Vehicle Egress
The plan arrangement allows for houses to be rotated and mirrored along the axis of a shared wall.

Fig. 8 House plans showing mirrored plan form and entry path from garage and main house entry.

Alternative Configurations: Internal

Extent of Services
The location of bathrooms allows for some independence between the main bedroom and the two smaller ones. An extension could potentially occur in a modular way along the hallway.

Fig. 9 Part-plan showing bedroom spaces serviced by different bathrooms.
Fig. 10 Plan showing possible extension along half.
2. Internal Configurations

Passive Flexibility

Workspace
The non-domestic character of the hallway allows for an appropriate entry and access to a workspace. This space could be accommodated in the third bedroom, as it has a high amenity aspect into the semi-external hallway space. The location of the bathroom and kitchen could also serve the workspace, with little compromise of privacy. The hallway space acts like an extension of an external path. This is achieved through its width, materiality and semi-openness and modular placement within the plan.

Doors
The main bedroom has a large sliding door that opens onto the living space. The potential to create a large connection with the living space creates a possibility for the extension of the living space and multi-programming of the bedroom space.

Doors and Windows
The doors opening from the courtyard and garage to the hallway are glazed, providing light and aspect and an efficient wall opening.

Fig. 11 Plan diagram showing non-domestic hallway and connection of workspace to bathroom and kitchen.
Fig. 12 Plan diagram showing independent connection from workspace to entry and courtyard.
Fig. 13 Plan showing relationship between living/dining area and bedroom.
Fig. 14 Part-plan showing open sliding door between living/dining area and bedroom creating enlarged living space.
Fig. 15 View along hall toward entry, glazed doors to courtyard on right.
3. Internal/External Relationships

**Alternative Configurations:**

*External*

The internal courtyard and covered hallway provide a variety of private semi-external spaces.

Private Sheltered Open Space
The location of the open space allows sunlight to penetrate the plan in any orientation and therefore has the potential to rotate and mirror the plan. Each room can open onto a private open space.

*Fig. 16* Plan showing locations and types of external spaces within house boundary.

Multi-programming
The hallway is also a roofed garden. The bedrooms open onto this semi-internal space and therefore ignore the boundary condition. The space is an extension of the private open space, but is a sheltered alternative

*Fig. 17* Plan showing hall/roofed garden used for internal circulation from bedrooms.

The location of open space provided by the courtyard adjacent to the garage provides high amenity to the carport space, and can therefore be used as a habitable room.

*Fig. 18* Plan showing adjacency between courtyard and garage, and potential for garage to utilise the courtyard amenity for use as habitable room.
Pavilion House
Case Study Twenty One
Pavilion House

Melbourne, Victoria
Merchant Builders, Tract Landscape Architects and Terry Dorough
1974
Single family detached housing system

Configuration: Customised configuration of volumes
   Single storey

Size: 3.6 ha site
   200m² house

Project Description
The Merchant Builders, directed by David Yencken and John Ridge, were pioneers in developing alternative approaches to subdivision and housing design in Australia during the 1960’s and 70’s. Together with Landscape Designer Ellis Stones, Graeme Gunn and several other Architects they realised many influential developments that challenged the typical subdivision practice of suburban housing and designed housing that was responsive to Australian conditions. Three of these projects are included in here: Vermont Park, Elliston and Winter Park. Vermont Park, in an outer suburb of Melbourne, clusters houses around shared driveways in a shared landscaped setting by Tract Landscape Architects. The Pavilion House system was designed by Terry Dorough to be used at Vermont Park.

The Pavilion House consists of two separate volumes linked via an enclosed corridor. The functions of the house are configured across the two volumes. The larger pavilion contains the kitchen, dining, living and main bedroom areas. The smaller pavilion contains another bedroom, bathroom and living space. Though this division is intended for a family, with parents in the larger pavilion and children and family room in the smaller one, the system would suit a variety of users and different household types. The separate volumes provide a system to reconfigure a dwelling to maximise size, shape and conditions of the site.
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

Pair of Buildings
Three elements form the Pavilion house system and are organised as follows:

Pavilion 1
Main Bedroom, Living, Dining, Kitchen, Laundry, Bathroom and Study

Pavilion 2
Two Bedrooms, Bathroom and Family room, or second Living/Dining.

Linking Element
Glazed passageway or entry vestibule can include a stair to accommodate sloping site.

Fig. 1 Plan diagrams showing configuration of elements within Pavilion House system.

Orientation
The position of the linking element can be altered, allowing flexibility in the orientation of pavilions. This flexibility also accommodates different site shapes.

Figs. 2, 3 Plan diagram showing orientation of pavilions to suit site shape.
Contextual Influences

Edge Conditions
The flexibility in orientating and connecting the pavilions can be utilised to suit the edge conditions of the site, responding to negative or favourable conditions.

Fig. 4 Plan diagram showing alternative configuration of the dwelling to suit site edge condition.

Building Extension: Addition

Modular Addition
The pavilion system can be extended, allowing for subsequent pavilions to be added. This system could be suitable for multi-household dwellings or for accommodating other activities, such as workspaces.

Fig. 5 Plan diagram showing a four pavilion combined dwelling.

Construction Economies

Structural Simplicity and Economy
The pavilions use the same construction system and the shape is also economical. Variation of the external spaces is provided by the combination of the pavilions, rather than by altering the perimeter of a single dwelling.
2. Internal Configurations

Passive Flexibility

Separate Building
The separation of activities created by the pavilion system allows spaces to be used flexibly; different uses can occur within the dwelling without disturbing others. Typically, the larger pavilion accommodates core domestic functions and the smaller one houses other activities.

Fig. 6 Plan diagrams showing core activities located in larger pavilion with smaller pavilion containing flexible spaces.
3. Internal/External Relationships

Alternative Configurations: External

Large Singular Shared or Combination Spaces

The flexibility of the pavilion system allows multiple external spaces to be created in two ways. External spaces can be formed between the pavilions themselves or between the pavilions and site edges. These combinations can be tailored to suit site size and dwelling configuration.

*Fig. 7* Plan diagrams showing articulation of external spaces on different sites.
Growth House
**Case Study Twenty Two**

**Growth House**

Melbourne, Victoria  
Cocks and Carmichael  
1974

Modular single family detached housing system

**Configuration:** Customised configuration of modules  
Single storey

**Size:** 180m² house plan variation A

---

**Project Description**

The Growth House consists of square modules that incorporate function and circulation space. The basic configuration of the Growth House provides three separate zones that are linked via shared spaces. These zones are the main bedroom; living, kitchen and meals area; and two smaller bedrooms. Each area has dedicated external space.

The project uses a modular system of spaces and functions to provide economical construction and planning flexibility. The modules are designed to be reconfigured appropriate to site and internal uses of the dwelling. In addition to the internal variation, the planning system provides multiple external courtyard spaces.
1. Entry
2. Bathroom
3. Ensuite
4. Bedroom
5. Kitchen
6. Laundry
7. Living/dining
8. Courtyard

Plan variation A

Plan variation B
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

Modular System
For construction efficiency and ease of internal planning, a modular system is adopted. The system groups activities and links these groups to other modules, with courtyards inbetween. Consequently the house depends less on boundary and site conditions for the provision of external space.

Orientation
The multiple courtyards penetrate deep into the plan and allow for solar gain from multiple directions. This allows the house to positioned in any orientation.

Fig. 1 Plan diagram of house showing courtyards created by configuration of modules which also allow for flexibility of orientation while maintaining solar gain.

Density

Land Economy
The system is suitable for use in small, zero lot line and/or infill sites because it creates external spaces within the overall envelope of the dwelling.

Fig. 2 Plan diagram showing application of Growth House on a zero lot line site.

Contextual Influences

Edge Conditions
The configuration of courtyard modules can be altered for particular site conditions. The dwelling can be configured to maximise a favoured site condition or reduce the impact of negative conditions.

Fig. 3 Plan diagram showing house modules reconfigured in response to site condition.
2. Internal Configurations

Construction Economies

Timber Frame
The planning module is sized to suit standard timber lengths. This reduces the construction costs whilst allowing variation in the house perimeter.

Alternative Configurations: Internal

Spatial Modulation
Each of the modules can support a single activity. Connected activities, such as living and dining, can be accommodated in a larger shared area by combining modules.

Suitable Workspace
Many of the modules could be used as suitable workspaces as they have independent entries, a high level of amenity from the adjacent courtyard and can be separated from the rest of the dwelling.

Fig. 4 Plan diagram showing singular activity modules and combined activity module groups.
Fig. 5 Plan diagram showing suitable workspace.
2. Internal Configurations

Building Modification: Extension

Adding modules allows the house to be extended in a variety of ways.

Addition
Adding modules axially creates opportunities for semi-separate households within the overall envelope, or can simply provide greater separation between bedroom zones.

Infill
Infilled modules can suit smaller sites and consolidate external spaces. Infilled modules also generates larger grouped spaces.

Fig. 6 Plan diagrams showing different methods to extend the dwelling.
3. Internal/External Relationships

Alternative Configurations: External

General Amenity
The distribution of courtyards throughout the house provides each room with amenity to external spaces. In some cases, rooms have multiple connections, combining views with directly accessible courtyards.

Access and Egress
The distribution of courtyards allows for different access and egress points.

*Fig. 7 Plan diagram showing connections between internal spaces and courtyards.*
Case Study Twenty Three
Cooloongatta Road Villas

Melbourne, Victoria
Bernard Joyce and Associates
1965
Attached villa units

Configuration: 4 attached 2 bedroom units and courtyards
Single storey

Size: 900m² site
90m² each unit

Project Description
Bernard Joyce and Associates developed many residential plans and proposals for Melbourne developers during the 1960s and '70s. The site and house plans are characteristic of the practice's work, where the plan is arranged around a central courtyard. This development on a corner site has car access from the exposed long road side and the plan could be repeated according to the lot size. Each unit has a carport that connects spatially to the courtyard and entry court, creating one combined open space and providing an aspect for the main rooms of the house.

The interior is flexible: one bedroom can be made larger for shared use, or made smaller to enlarge the living room. Boundary walls of each unit form the internal courtyard wall of its neighbouring unit, creating independent dwellings with high amenity and privacy.
Perspective View of Houses

Site Plan

Typical Unit Plan

1. Entry
2. Carport
3. Courtyard
4. Living/Dining
5. Kitchen
6. Laundry/Bathroom
7. Bedroom
8. Service Court
1. Site, Siting, Shape

**Individual/Collective**

Unit Repetition
Each unit is L-shaped, which provides a courtyard for each unit. Most of the internal spaces have views and access to the external space.

*Fig. 1 Plan diagram of L-shaped unit showing courtyard and aspect from internal spaces.*

**Density**

Land Economy
The unit plan can be repeated to create a number of units on a typical suburban housing lot. The courtyard spaces of each unit are framed by the neighbouring wall, protecting individual external space while allowing dense development.

*Fig. 2 Site plan diagram showing additional external space at front of site.*

**Shared Facility**
The economical size of the individual unit allows a large shared external space to occupy one end of the site.

*Fig. 3 Site plan diagram showing additional external space at front of site.*

**Alternative Configurations: Buildings on Sites**

**Terrace**
Units are orientated along the street, which allows them to be arranged in a terrace formation. Individual pedestrian and vehicular access is created for each dwelling.

*Fig. 4 Site plan diagram showing terrace formation with individual entries.*
2. Internal Configurations

**Suitable Workspace**

The internal configuration of the dwelling and its relationships to external space supports the use of the living area as a workspace.

**Separate Access**

The living area has separate external access allowing visitors to the workspace.

*Fig. 5 Plan diagram showing alternate entry for workspace.*

**Services**

Employees using the workspace have direct access to the kitchen and to the courtyard. Bathroom facilities are located close to the workspace. The large windows to the courtyard provide high amenity to the workspace area.

*Fig. 6 Plan diagram showing connections from the workspace to the courtyard, kitchen and bathroom facilities.*

**Building Modification: Within Envelope**

**Reconfigured Interior**

Joinery units are used to divide spaces. These units have the potential to be repositioned, altering the internal configuration of the dwelling. Different configurations can suit alternative household arrangements of living, work and bedroom spaces.

*Fig. 7 Plan diagram showing repositioned joinery unit that provides rear living space and front workspace.*

*Fig. 8 Plan diagram showing joinery unit deleted to connect living area to study.*
3. Internal/External Relationships

Vehicle Egress and Parking

External Configuration
The carport connects directly to the internal courtyard. This combination effectively increases the size of the courtyard space.

Fig. 9 Plan diagram showing inclusion of carport to enlarge courtyard space.

External Elements

Service
An external strip of service courtyards are placed to the rear of the units and connect directly to the internal laundry area.

Fig. 10 Plan diagram showing location of external service area and connection to laundry.
Case Study Twenty Four
Commonwealth Games Houses

Perth, Western Australia
Cameron Chisholm and Nicol
1961
Single family detached house

Configuration: 4 bedroom and courtyard
Single storey

Size: 190m² house

Project Description
This house was designed for the Athletes’ Village of the 1962 Commonwealth Games in Perth, Western Australia and is repeated in a variety of arrangements across different sites. The compact plan accommodates four bedrooms arranged around a central courtyard with a wide internal hallway. Screen walls are used to form private external spaces that have a direct relationship to the room adjacent.

This project has a high level of programmatic flexibility, with bedrooms that could alternatively accommodate workspaces. The plan frames external spaces and could be mirrored and rotated to suit the orientation of the lot and street access, without any loss of external amenity.
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

The shape of the plan allows flexible site arrangement while maintaining private external spaces.

Courtyard House
The house is U-shaped, which provides a central, private courtyard. This privacy is further enhanced by the supporting wall of the carport.

Orientation
The overlapping and cornering of the wing walls, together with the central courtyard, allows the building to be reorientated depending on aspect or solar amenity. The square inscribed by the extent of the house and the wing walls suits a variety of sites.

Articulated/Distributed External Space
The wing walls assist in framing the internal courtyard. They also articulate and position external spaces around the perimeter of the dwelling, further enhancing its ability to be reorientated.

Fig. 1 Site plan diagram showing U shape of house and private courtyard.

Fig. 2 Plan diagrams showing the internal and perimeter external spaces with different orientations of the dwelling.

Fig. 3 Plan diagram showing the distribution and articulation of external spaces around the perimeter of the house.
2. Internal Configurations

Suitable Workspace

The fourth bedroom can operate as a workspace. Its position and visual connection to other internal spaces would make it inappropriate for a workspace with visitors or employees.

Separate Access

The workspace is located at the end of a circulation corridor that removes it from the social and private areas of the house. It also has a potential external entry from the courtyard that is independent from other entry points to the house.

Fig. 5 Plan diagram showing separation of workspace from other areas of the dwelling and independent external entry point.

Appropriate Amenity

The workspace overlooks two courtyards, and physically connects to the central courtyard. This provides a high level of amenity appropriate to a daytime use space.

Fig. 6 Plan diagram showing location and connections to external courtyard spaces from workspace.
3. Internal/External Relationships

**Alternative Configurations:**

**External**

Nature of External Space and Relationship to Adjacent Room
The perimeter courtyard spaces have particular combinations of social, private or service use derived from their relationship to the adjacent rooms of the dwelling.

Fig. 7 Plan diagram showing perimeter courtyard types and their relationships to internal areas.

**Landscape**

Spatial Definition
The perimeter courtyard areas use planting to complete their definition. Landscape elements provide visual and spatial separation from other areas of the site and from neighbouring areas.

Fig. 8 Plan diagram showing definition provided to courtyard areas by additional landscape elements.
Cheddar Road Houses
Case Study Twenty Five
Cheddar Road Units

Melbourne, Victoria
Ashton Raggatt McDougall
1984
Attached units within detached houses

Configuration: 6 detached houses, 18 units, 1 bedroom
Single storey

Size: 1500m² site
70m² each unit

Project Description
This project was developed as elderly persons housing for the Ministry of Housing. It occupies a thin strip of land created by an easement along the rear of the site. Comprised of six separate detached ‘houses’, what appears to be a single, separate family house is made up of two–three separate units. Each unit has its own entry and private external space as well as some shared external spaces linked by an external footpath. Although the ‘houses’ are designed and detailed to be sympathetic to their suburban context, they are painted white, introducing a unique identity to the development.

The Cheddar Road houses create the appearance of a large traditional house with corresponding density and open space. The grouping creates a relationship between each of the three units that encourages social interaction, which is reinforced by the site planning that creates a private shared access road. The road also forms a landscape buffer between the traffic noise of Cheddar Road and the dwellings. Each house has two typical plans, repeated, mirrored and staggered to form a unique footprint. Internally, the units are planned to create zoned areas without physical division.
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

This project reconfigures a single detached dwelling to accommodate multiple, independent households.

Villa Units

Composed of six detached buildings, and appearing as single family detached houses, each house contains three individual dwellings. The houses are repeated, but placed at different angles on the site. This creates a point of difference between each building and shifts the aspect to avoid direct overlooking towards a neighbour.

Fig. 1 Site plan diagram showing individual 'houses' and orientations.

Individual/Collective Housing

The project maximises aspects of collective housing, such as economy of land use and shared facility, whilst maintaining levels of privacy and individual articulation.

Land Size Economy

The grouping of the units into a house form increases the density of dwellings. Effectively, they are three-bedroom dwellings of three separate households.

Fig. 2 Plan diagram showing individual units within each 'house'.

Vehicle Access

Cars gain access to the houses via a private shared road off Cheddar Road. With the nature strip, the road acts as a buffer to Cheddar Road and accommodates car parking for the units. The access road breaks down the scale and direct relationship to the main road.

Fig. 3 Site Plan diagram showing access road and nature strip as buffer.

Fig. 4 Plan diagram showing parking configuration.
Articulation of Part to Whole
The units are physically grouped into one building but have individually articulated entries.

Fig. 5 Detail site plan diagram showing individual entry and access.

Construction Economies
Design and site planning create economies in construction while providing variety to the housing and increasing external amenity.

Repetition
The project comprises of two house types that can be mirrored and rotated to create a diverse arrangement by combining these two configurations. This reduces documentation time and expense and encourages modular construction systems.

Traditional trade culture
The buildings use traditional craft-based materials and techniques, including concrete slab, brick walls and tile roofs. The familiar materials and construction methods would reduce time and expense of construction.

Car parking off site
A significant proportion of land is often required for car parking. The provision for car parking off the dwelling lots creates a land-use economy that prioritises housing.

Fig. 6 Repeating unit plan configurations within house types.

Fig. 7 Plans showing diverse arrangement of two house types.
1. Site, Siting and Shape

Egress and Circulation

The design utilises the narrow site shape to form front entrances.

Street frontage

Houses and units are sited side by side, allowing every dwelling to have a street entry and frontage. This results from the narrow lot with a wide street frontage.

Security

Similarly, the location of the entry in full view of the street is considered more secure than entries positioned at the rear or side of the house/unit.

Alternative Configurations: Exterior

External spaces combine communal and individual elements, balancing interaction and privacy.

Proximity and Mutual Support

The physical proximity created by grouping units into a single building encourages interaction and mutual support. The small scale of the groupings creates a direct relationship between dwellings and de-institutionalises the project.

Spatial Interaction

The location of the car parking, footpaths and shared open space is designed to encourage interaction between residents.

Levels of Separation

The level of separation attempts to encourage interaction without enforcing it. Each unit has individual entries and private open spaces.
Contextual Influences

Formal Relationships to Existing Building Types
The design borrows the form of neighbouring detached single family housing for a collective housing project. The overall visual bulk of the project is reduced by designing separate buildings at the same scale as those around them.

Fig. 12 Site plan diagrams comparing visual effect of detached versus consolidated forms.

2. Internal Configurations

Passive Flexibility

Spatial Zoning
The internal division of the unit provides for variety of dwelling spaces as ‘zones’ within a small area. The interior partition wall is angled, enclosing the bedroom and bathroom, while creating space for a dining table and living room.

Fig. 13 Spatial zoning of individual unit plan.

Mobility

Doors, Steps, Widths
All doors are designed to accommodate wheelchair access. Internally, sliding doors are used, which provide more access space than swing doors. The dwellings are of single storey with minimal thresholds that could be ramped. The units are planned to eliminate hallways and access widths are more generous than usual.
3. Internal/External Relationships

Alternative Configurations: External

The design of the units provides numerous visual and physical connections to external spaces while protecting internal privacy.

General Amenity
The units are planned to have high levels of general amenity. Each space has a large window with an aspect to the garden. The exteriors have generous direct access via sliding glazed doors.

Windows as Doors
Living spaces are entered by a glazed sliding door that also acts as a window.

Privacy
The arrangement in plan of the units, both through altered placement and skewed plan means that no windows directly face each another as is often the case in this building type. High levels of visual privacy are created although residences are in close proximity.

Fig. 14 House plan showing relationship between window and room.
Fig. 15 Detail site plan showing staggered and skewed plan arrangement.
Elliston Subdivision and Houses
Case Twenty Six
Elliston Subdivision and Houses

Melbourne, Victoria
Merchant Builders, Ellis Stones, Graeme Gunn and McGlashin Everist
Date
Single family detached houses, shared open space

Configuration: Detached house on a single lot
Single storey

Size:
16 ha site
215m² Courtyard house (McGlashan)
156m² Detached house (Gunn)

Project Description
The project, named after the landscape designer Ellis Stones, consists of approximately seventy houses, designed by four different architectural practices: Graeme Gunn, McGlashan Everist, Jackson & Walker and Charles Duncan. The inherited subdivision plan curtailed any substantial alterations by Merchant Builders. However, in addition to providing housing models, some site design initiatives were achieved. This design borrows from the adjacent parkland to develop an alternative subdivision model. Increased density is coupled with the introduction of a shared rear access to the park. The first realisation of this is shown in detail here. This access route gives the houses a further private entry and also encourages interaction between residents. The housing models compliment and support the subdivision by creating strong connections to external areas, contained private courtyards that allow for denser subdivision and therefore the allocating of open space in the access lane and a range of footprint shapes (rectangular or square).
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

Subdivision
The subdivision did not include private lots at the end of the streets, which provided strong connections between housing and the parkland.

Density
The subdivision planning and subsequent modification by Merchant Builders responds to the adjacent parkland. Landscaped connections were made through the sharing of private open space at the rear of lots resulting in an increase in amenity and a reduction in site size.

Shared Facility: Garden, Open and Recreational Space
Though not provided by the subdivision the adjacent parkland is strategically addressed as an additional shared facility for residents.

Borrowed Amenity
Reduction in individual lot sizes and private external courtyard spaces rather than large backyards are offset by the parkland amenity.

Configurations of Mutual Support: Circulation
A space at the rear of the properties provides shared access to the parkland. This second entry point to lots also creates a place of activation and interaction between residents, providing opportunities for mutual support.
Alternative Configurations: Buildings on Sites

Integrated House and Site Design
Two dwelling types were provided that responded differently to site boundaries and shapes and provide different configurations of internal and external spaces.

Courtyard House
This rectangular shape plan has minimal interaction with the boundary. The primary external space in centrally placed in the plan.

Detached House
This square shape plan distributes the external spaces using a combination of courtyard and setback niches to distribute the open space.

Fig. 4 Plan diagrams of different dwelling types showing relationships to sites boundaries.
2. Internal Configurations

**Passive Flexibility**

**Plan Configurations and Connections**

**Courtyard House**

The rectangular plan with a centrally placed courtyard separates areas whilst maintaining connection to the external spaces. This arrangement supports the flexible use of bedroom spaces as alternative living areas, separate household or workspaces.

*Fig. 5 Plan diagram showing flexible use of spaces in courtyard house.*

**Building Extension: Addition**

**Detached House**

The dead-end hallway in the detached house allows for the simple addition of a fifth bedroom.

*Fig. 6 Plan diagram showing addition of bedroom to end of hall.*

3. Internal/External Relationships

**Alternative Configurations: Buildings on Sites**

**Distributed External Space**

The relationship of the plan shape to the site boundary creates a series of courtyards distributed around the perimeter of the dwelling. Each room is provided with an external outlook.

**Orientation**

The compact plan shape and distribution of the courtyards allows for rotation of the plan depending on solar orientation of individual lots.

*Fig. 7 Plan diagram showing distribution of external spaces and connection to internal spaces.*
Kempsey House
Case Study Twenty Seven
Kempsey House

Kempsey, New South Wales
Glenn Murcutt
1976
Single family detached house

Configuration: 2 bedroom and verandahs
Single storey

Size: Farm site
120m² house and 70 m² verandas

Project Description
Situated on an isolated site on the northern coast of New South Wales, the Kempsey house employs robust construction techniques typical of a rural shed. The house was required to be of low maintenance and to have capacity to be relocated. Cross-ventilation is used extensively to capitalise on coastal breezes. The design of the dwelling utilises two semi-independent volumes to provide spaces for flexible use and for various social and private zones within the house. The split plan creates two independent external spaces and provides a model that could be reconfigured and reoriented on different sites or for different household configurations.
1 Entry
2 Screened verandah
3 Verandah
4 Living/dining
5 Kitchen
6 Bedroom
7 Bathroom
1. Site, Siting, and Shape

Alternative Configurations: Buildings on Sites

Pair of Buildings
Though not intended as a flexible paired housing system, the use of a central corridor to connect the two house volumes allows for the possibility of alternative household arrangements via a central entry. These could be altered to suit different site conditions and household configurations.

Fig. 1 Site plan diagrams showing alternative configurations of house volumes.

Orientation
The external area is divided into two verandas arranged at opposite ends of the house. This allows one veranda to receive more sunlight while the opposite one is shaded. It also ensures that solar aspect is achieved regardless of orientation.

Fig. 2 Site plan diagram showing two variations of sun and shade quality of veranda.
2. Internal Configurations

Alternative Configurations: Internal

Zoning
The sleeping and living activities are grouped into separate zones that each occupy a pavilion.

Fig. 3 Plan diagram showing grouped activities that zone each pavilion.

Passive Flexibility

Services Extent
Each pavilion has a bathroom facility, which allows for a significant degree of independence between them. This allows the second bedroom to accommodate use as a workspace; it is supported by services in two directions but is separate from living and bedroom areas.

Fig. 4 Plan diagram showing conversion of bedroom 2 to workspace, which connects to bathroom facilities and kitchen via veranda.

Building Modification: Addition

Capacity for Growth in Initial Building
The bathroom adjacent to the kitchen can support an additional bedroom extension. This extension could be added to either end of the dwelling and could facilitate two semi-independent households. (In 1980, the dwelling was extended using this method.)

Fig. 5 Plan diagram showing additional bedroom. Fig. 6 Plan diagram showing further addition to create two semi-independent households.
2. Internal Configurations

ESD

Heating and Cooling Systems
The house plan allows significant cross-ventilation cooling. Both pavilions are raised above the ground, allowing free air circulation underneath. Almost all of the latitudinal walls incorporate operable louvres which allow the control of cross-ventilation of cool north-easterly sea breezes. The solid panels of the longitudinal walls deflect the hot westerly winds.

The zoned plan allows for heating of areas only as required.

Fig. 7 Plan and section diagram showing cross-ventilation to dwelling.

3. Internal/External Relationships

Alternative Configurations: External

Relationship to Adjacent Room
The position of the verandahs at the end of each pavilion allow internal spaces access to external spaces both along and across the dwelling.

Fig. 8 Plan diagrams showing multiple access to external spaces.
Winter Park Subdivision and Houses
Case Study Twenty Eight
Winter Park Subdivision and Houses

Melbourne, Victoria
Merchant Builders (Architect Rob White), Ellis Stones and Graeme Gunn
1970-74
Single family detached houses, shared open spaces, Cluster subdivision

Configuration: 3 and 4 bedroom and courtyard
Single storey

Size: 2.43ha site
125m² typical each house

Project Description
Winter Park is located in Doncaster, a middle-ring suburb in Melbourne of predominantly single family, detached houses on large lots. Twenty detached houses are arranged across a site where twenty individual subdivisions would typically occur. Open space is amalgamated through efficiencies gained by shared driveways and small private courtyards in lieu of large backyards. The landscape design by Ellis Stones was considered equally and complimentary to the housing and siting.

The shared space creates an open park-like continuous landscape setting providing a high level of amenity. The houses are grouped (‘clustered’) in four sets of five around the shared driveways. The driveways provided paving suitable for pedestrian access, play area and vehicle access. In all, there are five house types: Studio house, the Two-Storey house, the Terrace house, the Courtyard house, and the Cellar house; the latter two are shown here.

View from shared open space
1. Courtyard
2. Entry
3. Master Bedroom
4. Bedroom
5. Living/Dining
6. Family
7. Kitchen
8. Laundry
9. Store
1. Site, Siting and Shape

Alternative Configurations:
Buildings on Sites

Cluster
The site accommodates the same number of houses as a typical subdivision of the same area. However, the grouping of external spaces in a shared parkland setting creates greater amenity for the dwellings.

Orientation
The four clusters of five houses each can exist alone or be repeated and oriented to suit the site. The design of the houses themselves allow for orientation in several ways. Each house has a private open space and a service court. The disconnection of the garage from the house enables the various orientations to occur.

Site Modification

Staged Subdivision
The independence of each cluster allows the development to occur in stages. It also reduces the scale of the site into smaller areas, which avoids the feel of a larger development, particularly when the project is incomplete.
Vehicle Egress and Parking

Multi-use External
The houses are clustered around a shared driveway. These driveways service each cluster and reduce traffic and driveways, which in turn allows use of these spaces by pedestrians and children.

Material Articulation
The brick paving used for these driveways offers amenity to pedestrians and for play activity.

Fig. 4 Site plan diagram showing driveway areas.
Fig. 5 Image showing brick paving surface to driveways.

Egress and Circulation

Social Interactive Space
The communal open space is in the centre of the site. This position provides privacy, a ‘buffer’ between the clusters as well as convenient access to/from all houses. The site is permeable in an east–west direction for pedestrians.

Fig. 6 Site plan diagram showing pedestrian thoroughfare across the central communal open space and direct access from adjacent dwellings.
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

Courtyard House
The courtyard house type at Winter Park has an 'L' shape and is sited to provide external aspects from all habitable rooms.

Fig. 7 Plan diagram showing aspect from rooms to courtyard spaces.

Orientation
The living space of the 'L' shape occupies the whole width of the house and receives light from both sides. This in turn allows the house to be reoriented without significant solar loss to this primary area.

Fig. 8 Site plan diagrams showing sunlight penetration to living space in several orientations.
2. Internal Configurations

Passive Flexibility

Zoning

The use of zoning provides two ways in which passive flexibility can be used in the house.

1. Bands
   The distribution of services along the length of the house, the distributed bedrooms and the central placement of the kitchen, allows the house to operate as two semi-independent households sharing this kitchen facility.

2. Ends
   By placing the majority of bedrooms at one end of the house, adjacent to the family room, a domestic part of the house is formed. The bottom end of living, dining master bedroom spaces can then be used as a large workspace with independent entry.

*Fig. 9 & 10 Plan diagrams showing the creation of flexible dwelling spaces through zoning.*
2. Internal Configurations

Building Extension: Addition

Capacity of Initial Building for Growth
The hallways at each end of the dwelling and the distribution of services along its length allow extension to occur at each end.

Fig. 11 Plan diagram showing extension of ends to dwelling.

Building extension to provide bedroom

Building extension to provide workspace
Adaptable House
Case Study Twenty Nine
Adaptable House

Melbourne, Victoria
Shane Murray, Diego Ramirez-Lovering, Graham Crist
2008
Single family detached house

Configuration: 2–3 bedroom with multi-purpose space
Single storey

Size: 375 m² site
150 m² house

Project Description
Designed for a typical subdivision site, this rectangular planned house contains two bedrooms and a third space that could be used as either a bedroom, workspace or a second household. The flexible uses for this room are supported by an independent entry and kitchenette, the large room size and its adjacency to a bathroom. In addition, careful thought has been given to the aspect, materiality and amenity of the carport to create a high quality space that can be used for various sheltered outdoor activities. The passive solar orientation and an adaptable building envelope of the design suit different orientations.

This project was designed according to common Australian construction processes to demonstrate several design principles while addressing affordable housing. It comprises a simple arrangement that can be adapted for various uses without physical alteration through careful spatial planning, arrangement and adjacencies.
1. Site, Siting and Shape

Alternative Configurations: Buildings on Sites

Position on site
The building footprint is positioned to one side, as opposed to the centre of the site, with the larger setback facing north. This allows for an outdoor space connected to the living area. This strategy can also be seen in the Furlan House.

Outdoor space
There are three outdoor spaces: an exposed outdoor area including rainwater tank, clothes line, vegetable garden and terrace; a shaded north-facing area connected to the living space; and a sheltered space shared with the carport and connected to the front garden. The provision of multiple outdoor spaces allows for varied use by different households and in varying weather conditions.

Fig. 1 Plan diagram locating building on site.
Fig. 2 Plan diagram showing outdoor spaces.
Fig. 3 Image showing aspect of carport to garden and shared use as outdoor space.
2. Internal Configurations

Individual and Collective Housing

Zoning
The plan is zoned to create two separate areas: the rear with two bedrooms, bathroom and living room; and the front with one large room and a bathroom. The separate zones enable co-habitation of two households.

Separate Entry
Each zone has its own entry allowing households to be independent.

Serviced Space
The front zone has a small kitchenette for independent food preparation.

Adjacency
The adjacency of the bathroom to the front zone allows for shared use without alteration.

Mutual Support
The grouping of separate serviced spaces allows for co-habitation of two households that could mutually benefit and support each other while maintaining some independence. This concept is also seen in the Nomi House.

Alternative Configurations: Internal

Work from Home
The plan arrangement allows for a workspace. The large front room has its own entry, bathroom and a high level of amenity for daytime use.
2. Internal Configurations

Passive Flexibility

Serviced Space
The large front room has independent entry, adjacency to a bathroom and a high level of amenity, allowing for independent use from the main house.

Size of Room
The increased size of the room extends its use beyond a bedroom. This condition can also be seen in the Nomi House.

Adjacency and Openings
The carport is connected to the side outdoor space and front garden by large openings. This adjacency transforms the carport into a pergola type space suitable for shared outdoor use.

Amenity
Daylight enters the carport space through the roof, raising its amenity for other uses. This condition can also be found in the Farfor Houses.

Materiality
Brick paving extends into the carport space providing a high quality floor material suitable for other uses other than car parking. This can also be seen in the Winter Park Subdivision.

Fig. 7 Part-plan showing surplus space of multi purpose room.
Fig. 8 Part-plan showing adjacency of outdoor space to carport space and open sides.
Fig. 9 Part-plan showing clear roof admitting daylight to carport.
3. Internal/External Relationships

Alternative Configuration: External

Orientation
The project is of lightweight materials, allowing for simple substitution or repositioning of windows according to site orientation.

Fig. 10 Plan diagram showing different plan orientation and alternative window arrangement.

Multi-programming External

Vehicle parking
The carport is shared for other outdoor uses. This is facilitated by its aspect to the garden area, materiality, size and high amenity. This concept is also realised in the Farfor Houses.

ESD
Solar gain and shading
The orientation of the living room glazing admits northern sun into the living areas, yet is shaded by the pergola to minimise summer heat gain. This can also be seen in the Pavilion House.

Fig. 11 Plan diagram showing solar gain and shading by pergola.
Multi-family House
Case Study Thirty
Multi-family House

Wye River, Victoria
Baracco+Wright Architects
2006
Multi-family detached house, unbuilt

Configuration: 3 bedroom, 2 kitchen
Elevated, single storey

Size: 1600 m² site
150 m² house

Project Description
This house was designed as holiday accommodation for three separate couples, one with children. It allows each to have one separate space and private bathroom, with shared kitchen and living space. All rooms are united under one roof but separated by an internal deck with a transparent roof that operates as a hallway with open ends. The concept of the open hallway was primary to the program of a holiday house, which would be used during the day and should therefore have a high level of amenity. It is three metres wide at its maximum, allowing for alternative use as a room.

This project is a model for a single-storey house that has independent and shared facilities. It re-interprets design concepts seen in Individual/Collective case studies where rooms can be separated or united allowing for different levels of privacy. It also refers to Passive Flexibility case studies such as the multiple use of spaces due to independent access, and the use of doors as walls with particular consideration for door sizes and room types serviced by openings.
1. Site, Siting and Shape

Alternative Configurations:
Buildings on Sites

Elevated Building
The building is elevated above ground, in response to a fragile and steep ground plane. The elevation creates an undercroft space that can be used.

Vehicle Access and Parking
The undercroft of the building is used as a car parking sheltered space. The open undercroft allows for vehicle access from any direction. The use of the space beneath the first floor for a sheltered car park is also seen in the Latapie House.

Outdoor space
The three outdoor spaces are all located within the footprint of the building: a deck in the undercroft; a semi-enclosed deck as ‘hallway’; and a rooftop deck. The multiple outdoor spaces allow for use by different households and in varying weather conditions.

Fig. 1 Sectional diagram showing building elevation.
Fig 2. Sectional diagram showing use of undercroft space for car parking.

External Elements

Economies
The project uses vertical space economically, including the use of the undercroft space for car parking and outdoor space, and the use of the roof for outdoor space. The footprint of the house could closely fit to the lot size.

Fig. 3 Sectional diagram showing outdoor space.
Fig. 4 Plan diagram showing outdoor space within footprint and possible lot size.
Fig. 5 Plan diagram showing location of outdoor roof space within footprint.
2. Internal Configurations

Individual/Collective Housing

Separate Building/Fractured Whole
The multi-family house applies the concept of the Fractured Whole, where the deck separates the rooms into distinct buildings. The whole is achieved by a common floor and roof. Physically separate serviced spaces are provided within the singular block giving the project a collective sensibility. This can also be seen in the Mt Eliza House and the Stanga Housing project.

Serviced Space
Each separate room is serviced by its own bathroom; one has its own kitchenette. This allows some independence between rooms.

Mutual Support
The grouping of separate serviced spaces allows for the co-habitation of two or three separate households with a shared kitchen. This maintains independence as well as mutual benefit and support for each.

Fig. 6 Plan diagram showing articulation of separate serviced rooms.
Fig. 7 Sectional diagram showing separation of rooms by open deck and shared floor and roof.

Alternative Configurations: Internal

Privacy
The internal deck separates each serviced room. There are no shared walls which reduces noise transfer between rooms.

Work from home
The arrangement is suitable for use as a workspace. The large rooms have their own entry, bathroom and a high level of amenity for daytime use.

Fig. 8 Part-plan showing serviced room, independent entry and access to kitchen suitable for workspace.
2. Internal Configurations

Passive Flexibility

Circulation
The circulation is also a useable outdoor space that is wider than a conventional hallway, open at the ends and with a transparent roof. This condition can be seen in the Farfor Houses and Alfonso Reyes Apartments.

Doors as Windows
Access doors to the rooms are also windows.

Serviced Space
The allocation of a bathroom, independent entry and high level of amenity to each room allows for them to be used independently from the whole for a variety of uses.

Adjacency
The living space can be extended by opening sliding doors to the deck adjacent. This condition can be seen in the Pavilion House.

Building Modification: Within Envelope

Infill
The building could be extended within the existing envelope by infilling the undercroft space, or an addition to the rooftop. The internal deck could also be infilled, joining two rooms to make two independent dwellings each with a living room and kitchen.

Fig. 9 Plan showing serviced space.
Fig. 10 Part-plan showing outdoor deck adjacent to living room and kitchen, creating an extension of the space.

Fig. 11 Section diagram showing possible infill/addition within envelope.
Fig. 12 Plan diagram showing possible connection of two rooms to create two separate dwellings.
3. Internal/External Relationships

Alternative Configuration: External

Amenity, Solar Access and Shading
The separation of rooms by the deck provides four exposed facades capable of receiving daylight and ventilation in all orientations.

The position of the deck within the plan, compared to an external balcony, provides a sheltered and private open space. This condition can be found in the Alfonso Reyes Apartments.

Orientation
The transparent roof deck/hallway admits light deep into the plan and allows for each room to receive daylight in any orientation.

Fig. 13 Plan diagram showing four exposed facades receiving solar access and ventilation. Fig. 14 Sectional diagram showing solar access deep into plan through transparent roof deck.

Multi-programming External

External Space and Access
Access to the rooms is via a roof deck that acts as a hallway. It is open at each end and is wide enough to be used for other activities, being three metres at its widest point. This condition can also be seen in the Farfor Houses.

Fig. 15 Plan diagram showing multi-use outdoor deck as hallway.
4.0 Conclusion

The Ageing of Aquarius project started off as a design-based research project that aimed to propose design-based solutions to the issues facing the baby boom cohort in retirement. The method developed to these ends were the matrix and case study analysis. I argued that the outcome of this was the validation of the architect as the knower of an architectural knowledge base. I reflected in this thesis how designerly thinking was present in these methods and the value of this type of thinking. I demonstrated designerly thinking by explaining how the same concept was present in different physical iterations as well as explaining how it occurred in some of my own design work. I reflected on the nature of architectural knowledge, what it is architects know and how they know it. This reflection was broadened and applied to the explanation of the development of the method for articulation and capture of knowledge. I argue that the articulation of the knowledge base has contributed to the development of my own architectural practice by discussing what is known now that was not known before. I demonstrated the transformative nature of architectural knowledge by providing evidence of the way knowledge shifts and transforms into new knowledge through the design process.

The evaluation of this thesis should consider the multiple and somewhat woven contributions. Some of these are afforded in the case studies themselves: the articulation of embodied knowledge within designs represented graphically through drawings and diagrams and explained through text in the case studies captures and communicates knowledge and thereby validating the knower (in many cases myself) and contributes a method for knowledge capture. However, it is the reflection on the matrix process and case study method that bring the contributions to the surface to document what is now known: nature of architectural knowledge, development of a design-based research method, enhanced ability to inquire, development of my own architectural practice, validation of knowledge base and architect as knower, and demonstration of designerly thinking through reflection on contribution to my own work.

In the case study analysis I have documented the 'what' that I 'see' and 'know' when I undertake the case study process. In so doing, the ability to 'project' claimed while making a leap from a set of issues (as identified in the Ageing of Aquarius project) to connecting design solutions – as a
key part of the research method – is also validated. A further argument has been made for the value of architectural knowledge and *designerly thinking* by placing the architect in a leading position much earlier in the process in so much that underlying relationships not apparent are identified by the architect. This is not evident without the exegesis of the case study.

In regards to this last point, it is well documented that innovation depends on the nature of the interaction between elements of a system of knowledge creation rather than stand-alone elements (Winch 1998). This could be thought of as the creative recombination and transformation of knowledge to create new knowledge in each new iteration as well as the application of design-based research method to problems not necessarily the obvious domain of design.

The analysis of case studies and the linking of design knowledge with specific non-design issues demonstrate the ability of design to be a flexible research tool beyond traditional design. I argue that it is this very flexible type of thinking that is applicable to problem solving techniques outside the discipline of Architecture.

The ability to understand, identify and link design concepts with non-design issues relies on a built-up knowledge of design that cannot necessarily be fully described. It is difficult to demonstrate in detail the dynamic link made in the matrix between non-design issues and design solutions – only to say that this relies on architectural experience and places the research specifically within the architecture discipline. Similarly, the extraction of embodied knowledge within the case study process can never be exhaustive and new aspects of this knowledge will be revealed in each iteration of the analysis. However by articulating this process through a number of modes a much more detailed insight into the process is made available as possible and makes the knowledge available for extension. Duffy and Hutton recognise the importance of such an attempt:

> ... in what we expect to be an increasingly knowledge-based society...there is an urgent need for architects to reaffirm the intellectual basis of their profession, to align it with other rapidly-developing disciplines to make sure that the design of the built environment takes its proper place in a society based increasingly upon the development and transmission of all kinds of knowledge."44

---

This thesis validates a contemporary role for architecture as described above through the application of architect’s particular thinking to effect design-based solutions to a variety of issues. The methods developed focus on the effective application of those already in use by the discipline and their body of knowledge, described here by Heylighen et al.: “Increasingly both government and industry see today’s problem less as a need to generate more knowledge than of making effective and equitable use of what is already available.”45

The very flexible way that designers think, producing highly sensitive iterations and responses, is exposed here and its value implicit with the consensus that the general direction of information science is taking us away from predefined cataloguing and towards heuristic search engines.46

The articulation of architectural knowledge through the case study recognises and emphasises the substantial knowledge embodied, but rarely articulated, in existing design. Heylighen et al (2005, 255) argue that strengthening the knowledge distribution in architecture should involve knowledge flows from academia to practice and practice to academia. This thesis spans the three streams of teaching, research and practice. The method, outcomes and application of the research rely equally on all three. This occurred through the development of design-based research method, application of the analysed knowledge to my own architectural practice which I attribute to a more accurate understanding as a result of the articulation process carried out in the case studies that enabled me to transform the knowledge with ‘control’. The method of inquiry is not normally undertaken in such detail within the architecture practice. The development of a systematic method enhances the (architect’s) ability to inquire (Downton 2003, 96) and identifies the potential for further research into methods of development of the architectural brief as well as an approach and method to teaching design.

In the proceedings of a conference on the notion of a design-based PhD, Glanville and Kormoss (2005) propose a criteria of evaluation: the close integration of specifically architectural design tools, methods and techniques through which architectural knowledge can be developed, formalized, articulated and communicated and that... research should create new knowledge.47 In Part 2 I discussed how the research method satisfies this evaluation by the innovative combination of disciplines where the modes of architecture are applied and new knowledge is created.


47. Glanville and Kormoss, “Summary: Theme 3 Validation”, in The Unthinkable Doctorate, proceedings of the colloquium at Sint-Lucas Brussels 14–16 April 2005, p. 401
through the development of processes and tools to capture and articulate embodied design knowledge thereby contributing to the practice and pedagogy of architecture.

In the Introduction I claimed that the benefits of studying and revealing architectural knowledge are multiple; development of techniques for revealing tacit knowledge and therefore the validation of a disciplinary knowledge base, development of design research processes of how to design and how to inquire, and development of architectural practice and education.

On this last aspect, I believe an important consequence for further research of this thesis would be the reflection on architectural education techniques. As discussed, precedent study is a central method of learning the 'how' architecture works, but not the 'how' to do it (which is through the 'doing' of design). Methods of knowledge capture would benefit the understanding of the 'how' it works, or, 'what' is happening. The most obvious application would be to adopt the case study method, being overlaid diagrams and text descriptions, employed in this thesis, in the classroom.

Further opportunities to develop methods for teaching remain. In applying these observations in my own teaching practice, over the past year I have begun to use what I refer to as 'context' led teaching. For example, in order to teach 'sustainable architecture' I start with a case study that is unpacked for all the ways it acts sustainably, where all the 'concepts' are understood for their relationships as an alternative to teaching a stand alone sustainable 'idea' that is then applied to a design. The use of context based teaching enables the nuance and connections between the interacting parameters to be understood. It is the very complex and intertwined nature of architectural design that requires this approach.

Having undergone some 7 years of formal architectural education and many more of practice, I had never thought of architecture in the terms set out here and neither had it been explained to me in this way. When I did eventually come across the literature but also conciously enacted the processes I describe here, a light went on in my mind!
Categories and concepts

Each case study is categorised into three main sections. These categories define three ways that most of the design concepts are achieved through plan and section adjacencies.

1. Site, Siting and Shape: how the site, the way the building is positioned on the site and its shape facilitate flexibility.

2. Internal Configurations: how the position of rooms in the overall plan, their size, proportion and adjacency to other rooms and entries for example, facilitate flexibility.

3. Internal External Relationships: how the interior and exterior are arranged such as position and adjacency of outdoor space/courtyards and carparking, windows and entries facilitate flexibility.

Within each section sub-categories are used to describe the design concepts. They are used across all three of the main categories wherever they occur.

Sub categories

Alternative Configurations: Internal
Arrangement of interior space such as position of bathroom or hallway that facilitate flexibility.

Buildings on Sites
Arrangements and shapes of the building on its site that allow flexible use.

Contextual Influences
Neighbouring or local conditions that can influence flexible use.

Density
Arrangements that achieve multiple dwelling solutions that also facilitate flexibility of use and a high amenity.
Larger Cheaper
Arrangements that achieve flexible use through volume

Construction Economies
Arrangements that use prefabricated techniques or off-the-shelf systems to achieve construction economies.

External Elements
Elements of the exterior space that facilitate flexibility.

Site Modification
Arrangements and shape of the site that facilitate change.

Individual/Collective Housing
The way that individual dwellings are arranged into a collective grouping

Multiprogramming External
Design concepts that facilitate the use of external space in multiple ways.

Multiprogramming Interior
Design concepts that facilitate the use of internal space in multiple ways.

Passive Flexibility
Arrangements that allow for use to be changed without physical modification of the building.

Actual Flexibility
Design concepts that allow for use to be changed by physical moving of built elements e.g: sliding doors.

Building Modification: Within Envelope
Arrangements that allow for the use to be changed by modifying the design within the original building through simple techniques e.g.: division of a room by a wall.

Building Extension: Addition
Arrangements that allow for the use to be changed by physically adding to the original building.
Egress and Circulation
Arrangements of egress and circulation that facilitate flexible uses within sections of or the overall house.

Vehicle Access and Parking
The way that car access and parking arrangement facilitate flexible uses.

Shared Facilities
Arrangements that employ shared facilities to achieve a flexibility of use.

Suitable Workspace
Arrangements that can be used as a workplace when not originally designed for that purpose.

Mobility
Aspects of a design that address design for mobility.

Health-based Recreation
Aspects of a design that address health based recreation.

Mutual Support Configurations
Arrangements that facilitate interaction between dwellings.

Expectation and Provision
Arrangements that increase the flexibility of use by providing more than what would usually be expected e.g. a bedroom that is larger than would be expected.

ESD
Aspects of a design that employ Environmentally Sustainable Design, improving amenity and flexibility of use.

Landscape
The way that a landscape contributes to the amenity and flexible use.
Image Credits

Photographs credited in order they appear
Napier Street Townhouses: Patrick Bingham Hall
Wynnstay Street Townhouses: Peter Clarke
Mt Eliza House: John Gollings
Queens Park Townhouses: Anthony Browell
Where House: 01 Richard Waldendorp, 02 Robert Frith
Poll House: 01&03 Jacqueline Stevenson, 02 & 04 John Gollings
Ivan Calnin House: unknown
Courtyard House and Flat: Andrea Quagliola
Malaguerira Housing: Ekain Jimenez Valencia
Fukuoka Apartments: Image courtesy of the Office for Metropolitan Architecture (OMA)
Stanga Apartments: 01 Damil Kalogjera, 02 & 03 Helena Njiric
Latapie House: Philippe Ruault
Furlan House: Unknown
Nomi House: Mitsuo Matsuoka
Prototype Houses: Brian Healey
Gifu Kitagata Apartments: Silencium http://www.flickr.com/photos
Barnard House:: Leonardo Finotti
Courtyard House: Atelier Feichang Jianzhu
Alfonso Reyes Apartments: 01, 03 & 04 Oscar Necoechea, 02 & 05 Lara Becerra
Farfor Houses: Mark Strizic
Pavilion Houses: Matt Ellis
Growth House: Cocks & Carmichael Architects
Coolangatta Road Villas: Aaron Pocock
Commonwealth Games Housing: courtesy Cameron Chisolm Nicol
Cheddar Road Units: courtesy Ashton Raggatt McDougall
Elliston Subdivision and Houses: Unknown
Kempsey House: Courtesy Glenn Murcutt
Winterpark Subdivision and Houses: Louise Wright
Adaptable House: courtesy Shane Murray
Multi-family House: Baracco + Wright Architects
Rose House: Aaron Pocock
Fitzroy Community School Creative Space: Derek Swalwell
and the neo-‘patterns’ in:
References


Angéil, M. Inchoate. An Experiment in Architectural Education, Eth/Actar, Zurich, 2003

Architectural Design Research, Vol 1, No. 1 2005, Association of Architecture Schools of Australasia


Barbazette, J. "Instant Case Studies: How to design, adapt and use case studies in training", Pfeiffer, San Francisco, 2004


Cavallin, H., Heylighen A., and Martin M.W. "How to Teach and Archive Tacit Design Knowledge", in Design Intelligence, Issue June 23, 2005

Chermayeff, Serge & Christopher Alexander, Community and Privacy: Toward a New Architecture of Humanism, Doubleday/Anchor, Garden City, New York, 1963


Cross, N., "Designerly Ways of Knowing: design discipline versus design science", in Pizzocaro, S., Arruda, A and De Moraes, D. (Ed) *Design plus research, Proceedings of the Politecnico di Milano Conference May 18-20, 2000*.


Glanville and Kormoss, "Summary: Theme 3 Validation", in *The Unthinkable Doctorate*, proceedings of the colloquium at Sint-Lucas Brussels 14-16 April 2005.


Architects, Edited by Assoc. Professor Shane Murray, Melbourne: RMIT University Press, 2002, unpaginated

Murray, S. Architectural Design and Discourse, PhD, RMIT University, 2004

OASE journal, The Diagram, No. 48 1998


Rowe, P., Design Thinking, Cambridge, MA. The MIT Press 1987, pp.1-250


Schneider, F. (Ed), Floor Plan Manual, Housing, Birkhauser, 2004


Shim, Han Sik, Roth, Gene L. "Sharing Tacit Knowledge Among Expert Teaching Professors and Mentees: Considerations for career and technical education teacher educators", Journal of Industrial Teacher Education, Volume 44 Number 4 2008, pp 5-28


Usher, R. and Bryant, L. Adult Education as Theory, Practice and Research, London: Routledge. 1989


van Schaik, L. Mastering architecture, becoming a creative innovator in practice, Wiley & Sons, Chichester, 2005

