Japanese Garden Houses:

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Strategies for creating an interface with nature in
New Zealand's urban dwellings.
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Erin Shillington

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New Zealand's urban dwellings.

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Abstract

New Zealanders have a proud tradition of living close to nature (clean and green). This high interface with nature in traditional New Zealand dwellings is referred to as the “quarter-acre dream” by Mitchell (1972). However, the recent intensification of New Zealand cities has resulted in higher-density, multi-unit dwellings that have little interface with nature. As Auckland alone is expected to require an additional 400,000 homes within the next 30 years, a medium-density housing model that has a high nature-dwelling interface is potentially useful in reducing urban sprawl.

In contrast, many Japanese houses are effectively integrated with nature. The number of case studies available through books, journals and on websites suggests that it is possible to group these dwellings under the heading “garden houses”. For the purpose of this research, the term “Japanese Garden House” refers to Japanese houses in which the garden is an integral part of the architecture, as opposed to a separate spatial entity.

New Zealand walk-up apartments are analysed to show how this New Zealand housing model relates to nature in addition to revealing typical design elements. Thereafter, the adaptation of the Japanese Garden House for the New Zealand context is proposed as a mechanism to further connect urban dwellings with nature, thus increasing the interface between nature and inhabited space. The significant benefits this mechanism provides, including a positive effect on psychological and physiological wellbeing, are discussed. In order to adapt the features of Japanese Garden Houses to the New Zealand context, a detailed analysis of Japanese Garden Houses is undertaken to reveal design principles and strategies that characterise this type of dwelling. The analysis is limited to houses built in the last 15 years.

An investigation, through design, is carried out to determine whether the Japanese Garden House models could be used to reconnect walk-up apartments with nature. The investigation is tested on a typical Auckland site. In a case study design, principles and strategies discovered through analysis of Japanese Garden Houses are applied and, adapted to fit walk-up apartments and the New Zealand context. The outcome is a valuable new New Zealand housing model and a set of guidelines presented as a matrix including key principles, strategies and a menu of solutions with the potential to be applied more broadly by other architects, developers and city councils.

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Introduction

New Zealand dwellings have traditionally benefitted from a high interface with nature – often referred to as “the quarter-acre dream” (Mitchell, 1972). A high interface between nature and dwelling is highly coveted in New Zealand culture. However, a shift from low-density, detached, single-family housing to various types of medium-density housing is occurring - particularly in Auckland. Auckland alone is expected to require an additional 400,000 homes within the next 30 years. Detached houses on quarter-acre sections have been unsustainable in cities such as Auckland for many years. To address this emerging conflict, a medium-density housing model that has a high nature-dwelling interface could be useful for intensifying Auckland suburban centres and ultimately reducing urban sprawl.

Despite highly dense cities, many contemporary Japanese houses are effectively integrated with nature. The number of case studies available through books, journals and on websites suggests that it is possible to group these dwellings under the heading “garden houses”. For the purpose of this research, the term “Japanese Garden House” (JGH) will refer to houses in which the garden is an integral part of the architecture, as opposed to a separate spatial entity.

The adaptation of the JGH for the New Zealand context is proposed as a mechanism to reconnect urban dwellings with nature, thus increasing the interface between nature and inhabited space. This may provide significant advantages because the interface between dwellings and nature has been shown to have a positive effect on psychological and physiological wellbeing. For instance, views of nature can reduce stress, anxiety and muscle tension (Edwards & Torcellini, 2002, p.4).

New Zealand walk-up apartments are analysed to show how they relate to nature, and to identify design aspects that characterise this housing type. Issues and strengths are also identified. In order to adapt the features of JGHs to the New Zealand context, a detailed analysis of JGHs is undertaken to reveal potentially useful design principles and strategies that characterise this dwelling type. This analysis is limited to 50 houses constructed within the last 15 years for the general analysis, and five houses for the more detailed studies.

An investigation, through design, is carried out to determine whether JGH models could be used to reconnect walk-up apartments with nature. This investigation is tested on a typical Auckland site. Principles and strategies discovered through analysis of JGH are applied and adapted to fit walk-up apartments and the New Zealand context. The outcome is a useful new New Zealand housing model and a set of guidelines presented as a matrix including key principles, strategies and a menu of solutions with the potential to be applied more broadly by other architects, developers and city councils.

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Chapter One:

Background [Literature Review]

“I often think about the luxury we have in New Zealand to live so closely with nature. As urban environments densify and become more sustainable, redefining this critical relationship becomes an interesting challenge”

- Duncan, S. (2011). as cited in Architecture New Zealand (2) , 36. (C. Bruhn,Ed.)

Chapter one: Background and literature review

Fig. 1.01: Traditional New Zealand dwelling patterns - single detached houses surrounded by large, landscaped sites from 1860-1880 @ 1:1000.

Source: Image by author (*Adapted from Auckland Libraries. (2011).*)

Traditionally, New Zealanders dwell in single-storey, single-family, detached houses – preferably sited on quarter acre sections. Mitchell (1972) refers to this tradition as “the quarter-acre dream” while many authors, including Gatley (2000) and Bennett (2010) argue that this is considered the ideal form of dwelling in New Zealand (p. 66; p.27). The popularity of the quarter-acre dream is a result of the benefits inhabitants incur from this dwelling type. For instance, a high nature-dwelling interface is incurred from the large, and typically planted, sections. Harvey, Perkins and Thorns (1999) even claim that a strong connection between garden (nature) and home - still prevalent in New Zealand today - was formed from this tradition (p.133) (Fig 1.1; 1.2). Large sites also separate individual dwellings from one another, and the street, generating a high level of privacy within the dwellings. A large site ensures that neighbouring dwellings do not block sunlight and therefore, dwellings receive natural light, while the detached nature of the dwellings evokes a sense that each dwelling is unique. In summation, the quarter-acre dream is considered the New Zealand ‘ideal’ as a result of its high interface with nature, sense of privacy, ample natural light and sense of identity.

Gatley (2000) argues that the quarter-acre dream of detached houses on large sites contributes to urban sprawl (p. 74). Auckland is expected to require an additional 400,000 dwellings by 2040 to accommodate the predicted population growth (Auckland Council, 2012, p.137). Indeed, if the 400,000 required dwellings are built as detached houses on quarter-acre sections, Auckland will need to dedicate 405km² of land to new housing. This would escalate urban sprawl and significantly increase Aucklanders’ reliance on fuel-based transport (Dixon & Dupuis, 2003, p.353). In turn, it will jeopardise the Auckland Council’s goal of becoming a sustainable city of the future and impact on New Zealand’s ‘clean and green’ image. Therefore, Cullen (2005) argues alternative higher density housing models need to be considered to meet Auckland’s future housing needs (p.1-3).

Multi-unit dwellings have widely been accepted as a strategy to reduce urban sprawl as they allow higher density occupancy than detached dwellings (Dixon & Dupuid, 2003, p.354). Various types of multi-unit dwellings have been introduced to New Zealand over time. However, many of these dwelling types are poorly received. Different authors claim that the unpopularity of multi-unit dwellings is caused by different factors. Honey (2004) and Collins (2008) claim that multi-unit dwellings are unfamiliar to New Zealanders as they are relatively uncommon here, thus making them unpopular amongst New Zealanders (p.58; p.56).

On the other hand, Grant (1989) and Warne (2011) argue that multi-unit dwellings, such as ‘sausage flats’, are disliked because they are perceived to lack privacy, are monotonous and have little or no interface with nature (p.7; p.10). The issues identified by Grant and Warne directly counteract benefits incurred from detached houses on quarter-acre sections and therefore, counter the New Zealand ‘ideal’. Daniels (2008) and Carroll, Witten and Kearns (2011) add that apartment living can also leave occupants feeling isolated with a loss of the sense of community that the traditional street evokes (p. 130-132; p. 355-356).

Despite negative attitudes towards multi-unit dwellings in New Zealand, the Auckland Council (2012) has recognised that in order for Auckland to become a sustainable city of the future, intensification of key Auckland suburbs is necessary to stem urban sprawl. Perhaps, as “Auckland Transport Blog” (2012) argues, the problem is the “missing middle density.” Good quality, medium-density housing – such as walk-up apartments - has the potential for greater acceptance than high-rise apartments, while providing the necessary amount of intensification.

In addition to New Zealand’s cultural agenda for enhancing nature-dwelling interfaces, an interface with nature also provides inhabitants with many psychological and physiological benefits (Smith, Gaston, Warren & Thompson, 2005, p.236). Views of nature can have the physiological benefit of reducing muscle tension and increasing relaxation (Edwards & Torcellini, 2002). Kaplan (2001) builds on Ulrich’s (1981) argument that nature can aid in stress reduction, reporting experiments that reveal that apartment dwellers with natural outlooks are not only more satisfied in life, but also have lower stress and anxiety levels than those with urban views (p.528-529). According to Edwards and Torcellini (2002) access to, and views of, nature are particularly important for those who live and work in urban areas (p.4). Although parks and green spaces may mitigate the effects of urban densification, interfaces with nature are limited within the city - which can preclude apartment dwellers from enjoying natural outlooks and access to nature.

Bennet and Isaacs (2009) relate these arguments to the Auckland context. They claim that natural light and ventilation, benefits incurred from a dwelling-garden interface, are often deficient in urban Auckland dwellings, as neighbouring buildings can block natural light and natural ventilation can be compromised by noise and traffic pollution. They assert that

Fig. 1.02: Traditional New Zealand dwelling patterns - single detached houses surrounded by large, landscaped sites from 1960-2012.
Source: Image by author (*Adapted from Auckland Council, 2013*).

artificial systems, employed to compensate for a lack of natural systems, cannot replicate the psychological and physical benefits of natural light (p.60-61). Natural light positively affects mood, morale and energy levels and can also reduce the risk of disorders such as SAD (seasonal affective disorder) that may occur from a lack of sunlight (Danilenko & Levitan, 2012, p.279). Physiologically, “the major control centres of the body are directly stimulated and regulated by light “ (Edwards & Torcellini, 2002, p.4). Deficiencies in natural light may result in decreased physical health and even some deficiency diseases -such as bone disorders because of inadequate vitamin D conversion (Holick, 2011, p.74). The psychological and physical benefits from natural light underpin the importance of appropriate urban intervention to maintain and enhance the health of Auckland’s urban dwellers.

Japan, a country in the Pacific like New Zealand, has faced and dealt with much higher population densities than New Zealand. Reaching a population of 37.6 million in 2010, Tokyo is currently the world’s biggest “mega-city” (Bagan & Yamagata, 2012. p.210). Yet many urban Japanese houses have high nature-dwelling interfaces despite being based on small sites in dense areas. Many of these houses can be described as ‘Japanese Garden Houses’. Other contemporary authors refer to houses of this description using different terminology. Pollock (2005) labels these houses as “The Indoor-Outdoor House” (p. 57) while Hildner (2011) identifies them as “The Garden as Part of The Architecture” (p. 144). This, along with a number of case studies available through books, journals and on websites suggests that it is possible to group these dwellings under the heading “garden houses”.

As there currently does not appear to be one, succinct, descriptive, well-known and agreed upon term for the house type, the term ‘Japanese Garden House’ (JGH) is adopted for this research to refer to Japanese houses where the garden is an integral part of the architecture – as opposed to a separate spatial entity.

Nitschke (2002) claims “in Japan the garden has traditionally always been a part of the architecture and the architecture a part of the garden” (p. 26-27). This develops Engel’s (1964) argument that, traditionally, the Japanese considered gardens as a necessity – with even poor Japanese families having a garden (p. 264). Engel (1964) believes that this perception of garden as a necessity contrasts the traditional Western approach to garden. He supports this contention, arguing that Western gardens have always been separate from the house they surround or are adjacent to. Although gardens could be

viewed from some of the interior, the Western garden was never “more than a detached space” (p. 264). Pollock (2005) furthers Engel’s argument stating that Western houses and gardens are often built at separate stages of the construction process – whereas Japanese gardens and houses are usually designed and built in unison (p. 59).

Engel (1964) and Pollock (2005) claim that the high interface between Japanese house and garden is also related to traditional, spiritual beliefs (p. 256; p.59). Japanese traditionally largely belong to the Zen sect of Buddhism and believe that nature and man are one (Engel, 1964. p.258). This sense of oneness with nature is usually expressed through a high interface between dwelling and nature. Traditional Japanese houses achieve this through sliding partitions between dwelling and garden. The sliding partitions can be opened, thus eliminating the boundary between interior and garden. Another strategy is the inclusion of a series of small courtyard gardens called *Tsuboniwa* (small garden). *Tsuboniwa* were often employed when external gardens were impractical or impossible. The *Tsuboniwa* has particular dimensions and is never part of the circulation (Pollock, 2005).

Hildner (2011) adds that Japanese believe in the ephemerality of life – “everything must die” (p. 127). Therefore, a garden allows Japanese to relate their own temporary nature to the temporariness of the garden and architecture. The strong spiritual relationship between nature and humans is a contributing factor to the high interface between traditional Japanese dwellings and their gardens. Pollock (2005) argues that the spiritual beliefs concerning human interface with nature, along with practical reasons, is still causal to the integration of garden and house in contemporary JGHs (p. 57). Daniels (2008) claims that traditional Japanese gardens were often intended to be viewed rather than occupied however, contemporary gardens are moving away from this tradition and becoming places of activity (119).

In addition to traditional spiritual beliefs, gardens are often integrated within the architecture in Japan for pragmatic reasons. Many of Japan’s cities are densely populated. Japan’s population density reached 336.5 per km² (United Nations Statistics Division, 2012) in comparison to New Zealand’s population density of 15.8 per km² in 2009 (United Nations Statistics Division, 2012). Many Japanese sites are small (Daniels, 2008, p.121) expensive and built up on three sides. Space is further limited by rigorous height restrictions that prevent buildings blocking other buildings’ sunlight (Hildner, 2011, p.11).

Where space is scarce and a perimeter garden impossible, gardens are often integrated within the interior of the dwelling (Pollock, 2005, p.60). Internal gardens have additional benefits of providing natural light and ventilation into the home (Mizuno, 2002, pp.vii-ix). This is particularly useful in houses with limited access to light and air at the perimeters, as internal gardens can let natural light and air into the depths. Many urban areas in New Zealand cannot accommodate detached houses with gardens, so in this situation the JGH has the potential to be a useful precedent. Likewise, in building types such as apartments, where it can be difficult to introduce light and air into all areas, internal gardens could be effectively employed to improve these qualities. The enclosed and introverted nature of many JGHs suggests that they may be potentially useful for translation into higher density housing as they do not rely on adjacent sites for an interface with nature, light or air.

Japanese houses have a short lifespan - an average life span of 25 years (Hildner, 2011, p.8) (Koolhaas, 2011). Furthermore, Japanese believe that houses should be built to capture ‘the moment’ and when that ‘moment’ has passed, the house is demolished (Hildner, 2011, p.8). For instance, a house may be designed for a family comprising two parents and two children. Once the children have moved out, the house would be demolished and redesigned as a house for two people. According to Hildner (2011) contemporary Japanese houses are often introverted as there is little point in designing in response to the current context when neighbouring houses have such a short life span (p.13). This is one contributing factor towards the trend in internal gardens.

Japanese notions of privacy also contribute to the internalisation of gardens. A high threshold between street and home is evident in Japan (Daniels, 2008, p.133). As a result, enclosed gardens are more private - away from the view of the street. Gardens can also provide alternative sources of light (Mizuno, 2002, p.vii-ix) so that exterior windows can be minimised to increase privacy.

Although most New Zealanders do not share the same spiritual or cultural beliefs as Japanese, it is proposed that JGHs could provide useful precedents in reconnecting New Zealand urban dwellings with nature, as both Japanese and New Zealanders have a close affiliation with nature. Therefore, the research proposition explores the premise ‘the potential of Japanese Garden Houses to provide a precedent for new strategies and principles for architects to enhance the nature-dwelling interface in walk-up apartments on a typical Auckland site’.

Chapter Two:

Analysis of New Zealand Walk-Up Apartments

Chapter two: Analysis of New Zealand walk-up apartments

Fig. 2.01: Medium density housing types considered for analysis as shown on a density continuum.
Source: Image by author.

Fig. 2.02: The u-shaped stair configuration included in many New Zealand WUAs.
Source: Image by author.

Fig. 2.03: The straight-run stair configuration included in many New Zealand WUAs.
Source: Author's drawing

Purpose of analysis:

According to Auckland Council (2012) medium-density housing is appropriate for suburban intensification, whilst high-density dwelling types should be reserved for the central business district (CBD). Therefore, various medium-density housing types are considered as potential mechanisms to test the research proposition (Fig. 2.01). Walk-up apartments are selected, as the Walk-up apartment is a useful model for a first generation of suburban intensification because it is a low-rise, medium-density housing type, with cost and sustainability benefits (e.g; elevators are not required).

The analysis of New Zealand Walk-up apartments has two main purposes. First, to understand design characteristics of the Walk-up apartment type and any design issues revealed in the literature review that need to be addressed. This allows a variant of a Walk-up apartment to be designed as a mechanism to test the design proposition (Chapter four). Second, to identify the current nature-dwelling interface that is addressed using design strategies developed from the JGH analysis in the case study design. Contemporary walk-up apartments, built within the last 15 years, located in New Zealand's three main centres (Auckland, Christchurch and Wellington) are analysed. The apartments analysed are architecturally designed and published in professional journals, such as [Architecture New Zealand](#), or on architecture firms' websites, and so assumed to be good examples of walk-ups. As a result of this selection method, considered architecture is being examined as opposed to vernacular patterns. Analysing exemplary models has the advantage that design intentions and characteristics are clearly readable. This is useful as the primary goal of the analysis is to determine design characteristics, so that a walk-up apartment can be designed (Chapter four). However, exemplary models are less likely to raise many of the issues discussed in multi-unit dwellings literature (Chapter one).

Characteristics of New Zealand walk-up apartments:

'Walk-up apartment' is originally an American term whilst it is observed that New Zealand and British literature usually refer to Walk-up apartments as 'flats'. New Zealand literature historically groups most low-rise apartments under this heading, although in contemporary writing they are now referred to as "multi-unit dwellings" along with all housing types that are not single, detached houses (Statistics New Zealand, 2012).

As these commonly used New Zealand terms are ambiguous and include other housing types in their definition, the term ‘walk-up apartment’ (WUA) is employed in this thesis for clarity.

WUAs do not include elevators. Rather, they are limited to three or four storeys and are built with communal staircase(s) (JASMAX, 2011, p.76-78). This is verified through analysis of New Zealand WUA – none of which include an elevator. Yet, the analysis counters Plunz’s (1990) claim that WUA often feature multiple staircases (p.133) as it reveals that units are often clustered around multiple vertical cores so that occupants of units do not have a choice of vertical access routes. This minimises the size of horizontal circulation routes. Although fewer staircases may increase social interaction, as occupants are more likely to experience chance encounters with their neighbours, their omission means that, in many cases, additional fire escapes must be provided.

The current building code stipulates that dwellings that are four or more storeys must include a form of mechanical vertical egress. In addition, dwellings of two or three storeys require an elevator if more than 50 occupants occupy the upper floors (The Department of Building and Housing, 2011). Therefore, the omission of elevators in New Zealand WUAs results in WUAs being restricted in density and size. Nonetheless, it is still plausible to design WUAs in New Zealand that comply with the building code without the inclusion of an elevator.

The configurations of communal staircases in New Zealand WUAs vary. The most common configurations are the u-shaped staircase (Fig. 2.02) and the straight-run staircase (Fig. 2.03) with a landing. Both of these arrangements provide a landing between each level, allowing occupants to rest or other users to bypass them. Both stair formations are compact – yet each configuration is suited to different conditions. The u-shaped stair is shorter than the straight-run and so is useful in shorter, wider circulation spaces (Fig. 2.04) or, as illustrated in the Wakefield apartments (Architecture Workshop, 2002), where the staircase is positioned at the end of the circulation space allowing the staircase to span the entire width of the corridor. The straight-run – longer and narrower in character- is well suited for long, narrow spaces. This is evident in the Tamaki project (Crosson Clarke & Carnachan Architects, n.d.) where the corridor is not wide enough for a u-shaped stair and the straight-run is employed (Fig. 2.05).

Fig. 2.04: Examples of New Zealand WUAs including a communal u-stair configuration @ 1:200. The Star block apartments feature a variation on the u-stair. Left to Right: Te Ara Hou, Wakefield apartments, Star block apartments
Source: Image by author (Adapted from Novak & Middleton, 2009; Architecture Workshop (2002); Housing New Zealand Corporation, 2005).

Fig. 2.05: Examples of New Zealand WUAs including a communal straight-run stair @ 1:200. Left to Right: Tamaki project (n.d.) Tattoo Apartments (n.d.)
Source: Image by author. (Adapted from Crosson Clarke Carnachan Architects, n.d.; Archaus Architects, circa. 2010).

Individual units are connected to the communal staircase by a horizontal circulation space. These spaces tend to be linear and small (Fig. 2.06). In many of the examples analysed, there is little space for residents to pause and engage with one other – limiting opportunity for social interaction and illustrating Daniels’ (2008) and Carroll, Witten and Kearns’ (2011) claim that apartment residents can lack a sense of community. The number of units per corridor varies from two to 18 (although 18 is an extreme example) with a majority connecting to three units.

Many of these circulation spaces are internal and enclosed. Internal communal circulation space allows units to be arranged on either side of the circulation space ensuring each apartment benefits from at least one external outlook. Some of the examples analysed include windows at either end of the circulation space to introduce natural light into the space (Fig. 2.07). Exceptions to the enclosed and internal communal circulation space are Wakefield Apartments (Architecture Workshop, 2002) and Te Ara Hou (Novak & Middleton, 2009). While the u-shaped communal staircase of Wakefield Apartments and Te Ara Hou is enclosed, the horizontal circulation space is an open-air deck. As a result, some of the apartments overlook and receive natural light from the circulation space. As only three apartments are connected to the circulation space, these outlooks are relatively private (Fig. 2.08).

Fig. 2.06: Small, linear communal circulation spaces in New Zealand WUAs do not encourage social interaction.
 Left to Right: Tattoo Apartments, Wakefield apartments, Star block apartments, Tamaki project, Te Ara Ho @ 1:200.
 Source: Image by author. (Adapted from Archaus Architects, circa 2010; Architecture Workshop, 2002; Housing New Zealand Corporation, 2005; Crosson Clarke Carnachan Architects, n.d; Novak & Middleton, 2009).

Fig. 2.07: Natural light is introduced into the communal circulation spaces in many New Zealand WUAs. Yellow is used to illustrate the distribution of natural light (White denoting the most natural light and dark yellow the least).

Left to Right: Tattoo Apartments, Wakefield apartments, Star block apartments, Tamaki project, Te Ara Hou @ 1:200.

Source: Image by author. (Adapted from Archaus Architects, circa. 2010; Architecture Workshop, 2002; Housing New Zealand Corporation, 2005; Crosson Clarke Carnachan Architects, n.d; Novak & Middleton, 2009).

Fig. 2.08: Some units overlook the communal circulation space. View-shafts from the unit into the communal area are highlighted in green.

Left to Right: Wakefield apartments, Te Ara Hou

Source: Image by author (Adapted from Architecture Workshop, 2002; Novak & Middleton, 2009).

Fig. 2.09: The internal configuration of New Zealand walk-ups is divided into an open plan living space, service area and cellular bedrooms. Left to Right: Tattoo Apartments, Wakefield apartments, Star block apartments, Tamaki project, Te Ara Hou @ 1:200.

Source: Image by author (Adapted from Archaus Architects, circa. 2010.; Architecture Workshop, 2002; Housing New Zealand Corporation, 2005; Crosson Clarke Carnachan Architects, n.d; Novak & Middleton, 2009).

Many of the units analysed have a similar internal arrangement - separated into two parts with an open plan living space on one side of a service core and cellular bedroom spaces on the other (Fig. 2.09). This typical planning strategy separates the private, cellular areas from the more public living spaces, whilst open planning allows for flexibility in furniture placement. Typically, private outdoor areas are adjacent to open plan living spaces. Therefore, views of outdoor spaces can be enjoyed from the living spaces -reiterating Engel's (1964) claim that the Western garden is typically designed as a separate space to be viewed from the interior (p.264). The open plan nature of these units means that more living spaces are exposed to outdoor views than would be possible if the living spaces were cellular. Glazing is also used to visually connect outdoor space with the interior. Where individual units span several storeys, bedrooms and bathrooms tend to be vertically separated from kitchens and open plan living spaces. Services are also usually stacked vertically or horizontally. This is practical and conventional practice as it lowers cost and is more efficient.

The majority of the apartments analysed feature a small, private garden space in the form of a balcony or deck with minimal or no planting amenity (Fig. 2.10). Although this is low maintenance, the lack of planting lowers the nature-dwelling interface, as the garden is simply an outdoor space. In contrast, apartments spread over large sites, such as Tamaki project (Crosson Clarke Carnachan Architects, n.d.) and Te Ara Hou (Novak & Middleton, 2009) feature portions of communal garden space (Fig. 2.11). The inclusion of communal garden space encourages social interaction between residents, minimising negative effects imbued from a lack of social interaction that Carroll, Witten and Kearns (2011) associate with apartments. These communal spaces tend to be landscaped as sections of grass and are not usually assigned specific uses- such as playgrounds or community vegetable gardens - so it is questionable how often these spaces are used. However, it is evident from the analysis that communal garden spaces are only included in designs based on large sites. These larger developments are also often sited adjacent to greenspaces and sites that provide wider views that are external to site boundaries.

Fig. 2.10: Most units features a small, and often unplanted, private garden area (highlighted in green).
 Left to Right: Tattoo Apartments, Wakefield apartments, Star block apartments, Tamaki project, Te Ara Hou @1:200.
 Source: Image by author (Adapted from Archaus Architects, circa. 2010; Architecture Workshop, 2002; Housing New Zealand Corporation, 2005; Crosson Clarke Carnachan Architects, n.d; Novak & Middleton, 2009).

Fig. 2.11: Communal garden spaces are provided by New Zealand WUAs spread over large sites @ 1:1000.
 Left to right: Tamaki Project, Te Ara Hou.
 Source: Image by author (Adapted from Crosson Clarke Carnachan Architects, n.d; Novak & Middleton, 2009).

Private outdoor areas are the only natural source of light for WUA based on smaller sites – such as Tattoo Apartments (Archaus Architects, circa. 2010) - and many apartments feature only one light source in each space (Fig. 2.12). Richmond (2012) argues that this is not ideal as it can cast shadows and cause glare (p.30). Many of the WUAs analysed that included multiple aspects are sited on large sites. Forsyth (2003) argues that these may not be as high density as they appear as they are spread over a large area and so can be inefficient (p.4). Building apartments on smaller sites with close neighbours on two or three sides presents challenges to providing natural light.

The analysis reveals that the WUA tend to be highly repetitive (Fig. 2.13). Although uniformity can reduce construction costs, the linear repetition of Tattoo Apartment units (Archaus Architects, circa. 2010) results in design monotony. Other examples rotate and reflect a typical unit multiple times, to create the illusion of variety from an external perspective. Multiple extrapolations are limited to developments on large sites where space is not confined. Lack of variety verifies Grant's (1989) and Warne's (2011) claim that large apartment developments are frequently monotonous. The lack of variety also means that residents will be less socially diverse, as units usually have the same number of bedrooms and would likely be within a similar price bracket. Maliene and Malys (2009) argue that the housing market comprises households of different sizes, ages and incomes. Therefore, developments should accommodate this varied market in order to be sustainable (p.428-429). Schosauer (2000) argues that a variety in unit sizes, and therefore prices, increases resident diversity, creating a vibrant and more successful community development (p.322).

The design repetition for units extends to associated garden spaces. As a result, garden spaces are not oriented in response to sunlight, but rather are placed wherever space allows. Gardens are also often adjacent or stacked – compromising privacy of the spaces. Where a screen in Tattoo Apartments (Archaus Architects, circa. 2010) separates outdoor spaces, the spaces are abutted against each other, compromising privacy.

Fig. 2.12: The distribution of natural light in each unit (white denoting the most natural light and dark yellow the least).
 Left to Right: Tattoo apartments, Wakefield apartments, Star block apartments, Tamaki project, Te Ara Hou @ 1:200.
 Source: Image by author (*Adapted from Archaus Architects, circa. 2010; ArchitectureWorkshop, 2002; Housing New Zealand Corporation, 2005; Crosson Clarke Carnachan Architects, n.d; Novak & Middleton, 2009*).

Fig. 2.13: New Zealand WUAs are highly repetitive. A typical unit is repeated, reflected or rotated to form a holistic design.

Left to right: Tattoo Apartments, Wakefield apartments, Star block apartments, Tamaki project, Te Ara Hou @ 1:500.

Source: Image by author (Adapted from Archaus Architects, circa. 2010.; ArchitectureWorkshop, 2003; Housing New Zealand Corporation, 2005; Crosson Clarke Carnachan Architects, n.d; Novak & Middleton, 2009).

Variants

Analysis of the WUAs reveals that some of the apartments are variants on the traditional WUA. Wakefield Apartments (Architecture Workshop, 2002) is an example of a successful variant of the WUA type. These apartments are a set of WUAs sited on the roof of an existing building. Holden (2004) describes this new way of intensification as “contributing to the city’s greater liveability, vibrancy and sustainability” (p.54). This variant of the WUA is currently common in Wellington (Holden, 2004, p. 54). While an elevator is taken to the top of the existing building, a communal staircase links the existing building to the WUAs. As the staircase is communal and a shared horizontal access zone connects the apartments, the apartments are deemed WUAs sited on top of an elevator building.

In short, WUAs illustrate common issues revealed in the literature review that could be utilised and improved by thoughtful design. As a result, WUAs appear to be suitable as a model for a first-generation adaptation of the JGH to a higher density design.

Furthermore, Wakefield apartments (Architecture Workshop, 2002) and WUAs based on large sites or sites adjacent to greenspaces appear to have relatively high dwelling-nature interfaces. These apartments are able to include more windows facing onto communal garden spaces. However, apartments based on large sites and apartments adjacent to green spaces are less useful for intensification planning, as large sites in existing Auckland suburbs are rare. Therefore, this research is focused on apartments built on smaller, suburban sites – such as Tattoo Apartments (Archhaus Architects, circa. 2010). Not only are these apartments more useful for intensification, but they also present a more challenging nature-dwelling interface. This needs to be addressed if the, WUA is to be a useful model for intensification on typical sites in suburban Auckland.

Chapter Three:

Analysis of Japanese Garden Houses

Chapter three: Analysis of Japanese garden houses

Purpose of analysis:

The analysis of Japanese Garden Houses (JGHs) has two purposes. The first is to determine design characteristics of JGHs in order to better understand the JGH as a type – as it is not fully defined in literature. Secondly, design principles embodied by JGHs, and strategies used to achieve these principles, are investigated so that they may be usefully applied to the case study design (Chapter four).

In order to determine the design characteristics of JGHs, 50 precedents (where the garden is visibly integrated with the architecture) are gathered from a wide range of sources. Sources include books, journals and websites. Using a wide range of sources ensures that a broad sample of JGHs is included in the analysis. Selection of precedents is limited to houses constructed within the last 15 years in Japan.

Geist's (1983) categorisation of arcades provides a useful precedent for identifying design principles and strategies for a building type. Whilst arcades and JGHs are fundamentally different, Geist's method of drawing and grouping precedents so that common characteristics can be identified is a useful method of analysis. Therefore, a plan and section of each precedent is drawn and the garden highlighted. Drawing each precedent in the same format and scale as well as highlighting the garden allows for visual comparison of the precedents. Thereafter, precedents with similar characteristics are grouped into categories. Where a house includes multiple gardens the most dominant garden is considered. The groupings of the precedents are as follows:

-Spatial structure (plans) of JGH (Fig. 3.01- 3.05)

-Spatial structure (sections) of JGH (Fig. 3.06-3.09)

-Relationship between garden and circulation (Fig. 3.10-3.12)

-Garden roof treatments (Fig. 3.13-3.16)

As characteristics can be examined endlessly, the grouping is limited to four categories that explore the spatial relationships between garden and house. The emphasis on spatial

relationships in this phase of analysis is consistent with the definition of the JGH – where the garden is an integral part of the architecture - and consequently, verifies this definition. Specifically, these four categories reveal the horizontal and vertical relationship between interior and garden and how the garden interacts with or interrupts the circulation of the space. The study of roof treatments reveals whether the gardens are top-lit or if the gardens need to be positioned on the building perimeter for lighting because the roof is opaque. In this way, these categories illustrate the spatial relationships between the garden and house sufficiently to enable an understanding of the characteristics of JGHs. By approaching the subject at a fairly general level, the effective transference to New Zealand walk-ups is more feasible.

Spatial Structure (plans) of JGHs:

Fig. 3.01: Spatial structure (plans) of JGHs @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Spatial Structure (plans) of JGHs:

Fig. 3.02: Spatial structure (plans) of JGHs @ 1:500.
Source: Image by author. (Adapted from - See appendix a.)

Spatial Structure (plans) of JGHs:

Fig. 3.03: Spatial structure (plans) of JGHs @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Spatial Structure (plans) of JGHs:

Fig. 3.04: Spatial structure (plans) of JGHs @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Spatial Structure:

Fig. 3.05: Spatial structure (plans) of JGHs @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Vertical Spatial Structure:

Ground Floor

Middle Floor

Top Floor

Multiple Floors

Roof

Vertical Spatial Structure:

Ground Floor

Middle Floor

Top Floor

Multiple Floors

Roof

Fig. 3.07: Spatial structure (sections) of JGHs @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Vertical Spatial Structure:

Vertical Spatial Structure:

Fig. 3.09: Spatial structure (sections) of JGHs @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Circulation:

Fig 3.10:
Relationship
between garden
and circulation @
1:500.
Source: Image by
author (*Adapted
from - See appendix
a.*).

Circulation:

Fig. 3.11: Relationship between garden and circulation @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Circulation:

Fig. 3.12: Relationship between garden and circulation @ 1:500
Source: Image by author (Adapted from - See appendix a.).

Roof Treatments:

Fig. 3.13: Garden roof treatments @ 1:500.
Source: Image by author (Adapted from - See appendix a.).

Roof Treatments:

Solid

Glazed

Structure

Open

Roof Garden

Fig. 3.14: Garden roof treatments @1:500.
Source: Image by author (Adapted from - See appendix a.).

Roof Treatments:

Solid

Glazed

Structure

Open

Roof Garden

Fig. 3.15: Garden roof treatments @1:500.
Source: Image by author (Adapted from - See appendix a.).

Roof Treatments:

Solid

Glazed

Structure

Open

Roof Garden

Design principles

In addition to identifying spatial characteristics of JGHs, the analysis also reveals design principles embodied by the JGH precedents. The principles employed include:

A high interface with nature

A high interface with nature is evident in the 50 JGH precedents analysed. This principle is also a palpable part of the quarter-acre dream and thus, highly coveted by New Zealanders. A high nature-dwelling interface also responds to Grant (1989) and Warne's (2011) claim that multi-unit dwellings often lack an interface with nature.

Quality natural light

A benefit of the inclusion of a garden is that gardens can provide natural light for the dwelling as a result of vegetation's need for natural light. Natural light is also an important quality of the quarter-acre dream and Bennet and Isaacs (2009) argue that natural light is often deficient in Auckland urban dwellings (p.60-61).

Privacy

Literature and precedent analysis reveal that JGHs are highly privatised from the street. Comparably, detached houses on quarter-acre sites also incur a high level of privacy from neighbours and the street, usually through setbacks, planting and fences. In contrast, residents in New Zealand multi-unit dwellings complain of a lack of privacy.

The principles outlined above are highly coveted by New Zealanders as these principles, embodied by the JGH, are also components of the quarter-acre dream. In addition, the principles are potentially useful for New Zealand architectural practice as they are often absent in New Zealand medium density dwellings (Grant, 1989; Warne 2011). Therefore, the aforementioned principles are applied to the design case study so that their application to the New Zealand and medium density context can be tested (Chapter four).

Design strategies

In order to successfully implement the design principles outlined above, specific design strategies are employed by the architects of JGHs. The design strategies manifested in JGHs are investigated in the following section in order to reveal strategies that can be translated to suit a New Zealand, higher density context. The success of these strategies is measured against how successfully they achieve the principles (Chapter four). Therefore, five JGH precedents, selected from a range of the categories outlined above, are used to illustrate specific design strategies that achieve the aforementioned principles. Strategies used in the design case study (Chapter four) are as follows:

1. Integration of garden and architecture

An integration of garden and architecture is evident in all the precedents analysed in response to the principle of a high interface with nature. This is manifested through the spatial composition of garden and architecture. The five precedents used to illustrate the design strategies employ a range of spatial compositions to integrate garden and architecture. The House in Koamicho, designed by Suppose Design Office (2008-2009), includes multiple gardens connecting interior spaces to one another in a linear pattern (Fig. 3.14). These gardens double as circulation space - and so are integrated with the function of the house (circulation) in addition to visually. Because each interior room is adjacent to a garden the house incurs a high nature-dwelling interface, as every room has access to and views of, a garden space.

In contrast, The Hansha Reflection House (Studio SKLIM, 2011) and Ogaki House (Katsutoshi Sasaki & Associates, 2010) feature u-shaped interiors that wrap around rectangular, perimeter gardens (Fig. 3.15). The interiors of these houses are introspective on the gardens creating a high nature-dwelling interface. The garden of Ogaki House is much smaller in relation to the floor plate than the garden of the Hansha Reflection House, and so does not impact the internal planning to a great extent. To compensate for the smaller garden, Ogaki House includes two additional, smaller gardens. By introducing three separate gardens throughout the design, a high nature-dwelling interface is achieved by the architects of Ogaki House as, like the House in Koamicho (Suppose Design Office, 2008-2009), the living spaces and bedrooms each have a visual, and sometimes accessible, connection with nature.

Fig. 3.17: The House in Koamicho, with gardens highlighted in green, integrates gardens and architecture in a linear pattern @ 1:200.
Source: Image by author. (Adapted from Suppose Design Office, 2008-2009)

Fig. 3.18: Gardens are highlighted in green to illustrate the u-shaped interiors wrapping around the gardens.
Left to right: Hansha Reflection House, Ogaki House @ 1:200.
Source: Image by author (Adapted from Studio SKLIM, 2011; Katsutoshi Sasaki & Associates, 2010).

Fig. 3.19: Moriyama House, with gardens highlighted in green, illustrates the u-shaped garden wrapping around the open plan interior @ 1:200.
Source: Image by author (*Adapted from Suppose Design Office, 2011*).

Fig. 3.20: Kondo house, with gardens highlighted in green, illustrates the spatial relationship between the internal garden and architecture @ 1:200.
Source: Image by author (*Adapted from Makiko Tsukada Architects, 2008*).

In an inverse form to The Hansha Reflection House (Studio SKLIM, 2011) and Ogaki House (Katsutoshi Sasaki & Associates, 2010) Moriyama House (Suppose Design Office, 2011) is composed of a u-shaped perimeter garden that wraps around the rectangular, open plan living space (Fig. 3.16). Like the House in Koamicho (Suppose Design Office, 2008-2009) the garden also doubles as circulation space, integrating the garden with an interior function. The living space is surrounded on three sides by the garden, and so experiences a high integration, and interface, with nature.

Kondo House (Makiko Tsukada Architects, 2008) is the only precedent out of the five to include a completely internal garden. This creates opportunity for the interior to be integrated with all four sides of the garden. Indeed, the open plan interior of Kondo House visually connects with a majority of the garden (Fig. 3.17).

The five gardens analysed are all double height spaces integrating both the ground and first floor with nature (Fig. 3.18). The gardens are accessible via the ground floor through sliding doors that allow the garden to be closed off from or integrated into the interior. This resonates with the sliding doors of traditional Japanese houses and is pragmatic, as elements, such as rain or wind, can be kept out of the interior by closing the doors. The first floor connection between the houses and the gardens is predominantly visual. The exception to this is the House in Koamicho (Suppose Design Office, 2008-2009) where bridges across the garden spaces permit garden access along the first floor.

As a result of the integration of garden and interior, the five gardens include similar vegetation. All feature gardens planted with small trees and sometimes small shrubs. These plants are only planted on the ground floor – reducing drainage and maintenance issues. Although the vegetation is similar, the ground treatment varies across the precedents. The ground at House in Koamicho (Suppose Design Office, 2008-2009) Ogaki House (Katsutoshi Sasaki & Associates, 2010) and Moriyama House (Suppose Design Office, 2011) is treated with gravel – relating to traditional Japanese stone gardens (Fig. 3.19). The Hansha Reflection House (Studio SKLIM, 2011) is a variation of this and employs gravel and grass. Although this may incur further maintenance, the grass increases the sense of outdoor space. In contrast, the garden of the Kondo House (Makiko Tsukada Architects, 2008) is tiled. A hole in the centre of the tiles enables a single tree to grow. While it is low maintenance, this garden space is far less versatile than the gardens treated with gravel – where plant configurations can be altered.

Through the spatial structure and visual and accessible connections between interior and gardens, JGHs are successfully integrated with the gardens. The integration of garden and architecture creates a high nature-dwelling interface thus, relating to the first principle outlined above. This strategy is particularly useful as it directly addresses the research proposition.

Fig. 3.21: Gardens are highlighted green to illustrate the vertical spatial layout of the gardens. Each of these JGHs includes a double height garden. Top - bottom: House in Koamicho, Hansha reflection house, Ogaki house, Moriyama house, Kondo house @ 1:200. Source: Image by author. (Adapted from Suppose Design Office, 2008-2009; Studio SKLIM, 2011; Katsutoshi Sasaki & Associates, 2010; Suppose Design Office, 2011; Makiko Tsukada Architects, 2008)

Fig. 3.22: Ground treatments are presented in this figure to illustrate the materiality of the gardens - which are predominantly gravel. Top - bottom: House in Koamicho, Hansha reflection house, Ogaki house, Moriyama house, Kondo house @ 1:200. Source: Image by author. (Adapted from Suppose Design Office, 2008-2009; Studio SKLIM, 2011; Katsutoshi Sasaki & Associates, 2010; Suppose Design Office, 2011; Makiko Tsukada Architects, 2008)

Fig. 3.23: Yellow is used to illustrate how the gardens act as a natural light sources for the houses.
 Top - bottom: House in Koamicho, Hansha reflection house, Ogaki house, Moriyama house, Kondo house @ 1:200.
 Source: Image by author. (Adapted from Suppose Design Office, 2008-2009; Studio SKLIM, 2011; Katsutoshi Sasaki & Associates, 2010; Suppose Design Office, 2011; Makiko Tsukada Architects, 2008)

2. Garden as a light source

In order for plants to survive, gardens must receive natural light and so gardens double as a light source for JGHs. Indeed, gardens are treated as the primary light source for each of the five precedent houses. This is advantageous, as the private gardens do not introduce noise or pollution from the street. Nor do they impact on privacy. Thus using the garden as a primary light source gives JGHs a private outlook onto nature - resonating with principles of quality natural light, a high interface between dwelling and nature and privacy (Fig. 3.20).

Different design mechanisms are employed by the five precedents to introduce natural light into the gardens themselves, and thus, allow vegetation to grow. The House in Koamicho (Suppose Design Office, 2008-2009) Hansha Reflection House (Studio SKLIM, 2011) and Ogaki House (Katsutoshi Sasaki & Associates, 2010) receive light from glazed perimeter walls (Fig. 3.21). In addition, the five gardens collect natural light from either an open or glazed ceiling (Fig. 3.22). The introduction of natural light into the gardens provides an additional benefit for JGHs as gardens provide light for the interior. Thus, garden spaces are the primary light sources for the houses analysed.

In order to maximise the amount of light gardens can provide, the interior walls of the gardens of the Ogaki (Katsutoshi Sasaki & Associates, 2010) Moriyama (Suppose Design Office, 2011) and Kondo Houses (Makiko Tsukada Architects, 2008) are fully glazed while the Hansha Reflection House (Studio SKLIM, 2011) visually connects the interior and garden through a series of windows. This creates the impression that the garden is an outdoor space that the house overlooks. While the employment of windows creates a different aesthetic to curtain glazing, both these methods successfully use the garden as a source of light whilst visually connecting gardens with interiors.

Light is able to reach the ground floor of the JGHs as the precedents are limited in height. The first floor bridges of the House in Koamicho are constructed out of steel mesh so that light may permeate. This strategy is transferable to limited height walk-up apartments.

By using the garden as a source of light, the principles of quality natural light, a high interface between nature and dwelling and privacy are effectively achieved. This strategy is useful for sites that do not have a natural outlook and walk-up apartments as the provision of integrated gardens internalises the architecture.

Fig. 3.24: The gardens manifested in the House in Koamicho and Ogaki house are naturally lit by glazed perimeter walls @ 1:200.
Source: Image by author (Adapted from Suppose Design Office, 2008-2009; Katsutoshi Sasaki & Associates, 2010).

Fig. 3.25: Gardens receive natural light from either a glazed or open ceiling in the five precedents.
Top - bottom: House in Koamicho, Hansha reflection house, Ogaki house, Moriyama house, Kondo house @ 1:200.
Source: Image by author (Adapted from Suppose Design Office, 2008-2009; Studio SKLIM, 2011; Katsutoshi Sasaki & Associates, 2010; Suppose Design Office, 2011; Makiko Tsukada Architects, 2008).

Fig. 3.26: Hansha reflection house, Kondo house and Moriyama house utilise several external windows as secondary light sources @ 1:200.
Source: Image by author (*Studio SKLIM, 2011; Makiko Tsukada Architects, 2008; Suppose Design Office, 2011*).

3. Multiple light sources

The Hansha reflection house (Studio SKLIM, 2011) Kondo house (Makiko Tsukada Architects, 2008) and Moriyama house (Suppose Design Office, 2011) accommodate several external windows as secondary light sources (Fig. 3.23). These are used either to provide light to spaces that are not connected to gardens, or to provide multiple light sources in a space. The Moriyama house is the only house to include at least one window in every external wall. As gardens provide an outlook these windows are often used purely for additional light and not for outlook, encompassing spaces with natural light from a variety of directions. Indeed, the external windows of the House in Koamicho (Suppose Design Office, 2008-2009) and Hansha reflection house each provide an outlook to the neighbouring house's blank façade. Richmond (2012) argues that having multiple light sources improves the quality of light within a space as they evenly illuminate the space, reducing glare and shadows. The House in Koamicho successfully dispenses with external windows as each space obtains sufficient natural light from gardens adjacent to each interior space.

By including windows into the garden rather than curtain walls, the garden of Hansha reflection house (Studio SKLIM, 2011) creates the illusion of multiple light sources as light enters the interior from three directions. This effect is lost in the houses where the garden is fully glazed, as aesthetically, these appear to be one light source. Therefore, through less glazing, the garden of the Hansha reflection house provides a greater variety of light.

The strategy of multiple light sources responds to the principle of quality natural light and is translated into the case study design in Chapter four.

4. Introducing Natural Light without creating views into the house

Daniels (2008) asserts that social interaction with non-family members does not usually occur in the Japanese home and so, Japanese houses are very private from the street (p.117-118). Daniels adds that this is based on the tradition of having high, solid fences enclosing Japanese sites (p.118). In keeping with this tradition, the analysis reveals that the houses are highly private from the street and the neighbouring houses. Indeed, the only penetration in the street façade for the House in Koamicho (Suppose Design Office, 2008-2009) and Moriyama house (Suppose Design Office, 2011) is the front door (Fig. 3.24).

Although the Hansha reflection house (Studio SKLIM, 2011) Ogaki house (Katsutoshi Sasaki & Associates, 2010) and Kondo house (Makiko Tsukada Architects, 2008) are private from the street, windows on the street façades are included to introduce natural light into the houses. These windows are designed to ensure that natural light is introduced without creating views into the house. Hansha reflection house and Ogaki house contain windows in the street facades, set back from the built edge. This creates a physical distance between passers by and the windows, increasing the sense of privacy. The windows of these houses are also positioned above head height, so passers-by are unable to see into the house from the street. Similarly, Kondo house includes windows in the street façade that are not at eye level. The windows are set at ground level, so are too low for passers-by to see into (Fig. 3.25)

In addition, Ogaki (Katsutoshi Sasaki & Associates, 2010) and Kondo house (Makiko Tsukada Architects, 2008) include translucent screens (to screen the perimeter garden at Ogaki house and to screen the front door at Kondo house). These translucent screens allow light to permeate the houses without enabling passers-by to see in (Fig. 3.26). Indeed, Daniels (2008) claims that translucent glass set in conventional window frames are common in Japan (p.124-125). This is not evident in the JGH precedents analysed, as the translucent screens are not set in conventional window frames.

Shutters that allow the interior to be concealed or opened to the street accompany street-facing windows in the Kondo house (Makiko Tsukada Architects, 2008) (Fig. 3.26). This provides the occupants with versatility and the option to sacrifice privacy for extra light when required.

By minimising the number and size of windows, including shutters, positioning windows above or below eye level, employing setbacks and using the garden as the primary source of light, natural light is introduced into JGHs without compromising the high level of privacy between house and street inherent in Japanese houses.

This design strategy supports the principles of quality natural light and privacy. It is a particularly useful design strategy as it gives architects the opportunity to introduce natural light from sources that can be closed off from public view if required. This increases the feasibility of the strategy of multiple light sources as it widens the choice of light sources for architects.

Fig. 3.27: Moriyama house and House in Koamicho each feature a single facade penetration- highlighted in yellow.

Source: Image by author (*Suppose Design Office, 2011; Suppose Design, 2008-2009*).

Fig. 3.28: Hansha reflection house and Kondo house - windows above or below eye level - highlighted in yellow. This increases the privacy within the homes.

Source: Image by author (*Adapted from Studio SKLIM, 2011; Makiko Tsukada Architects, 2008*).

Fig. 3.29: Ogaki house and Kondo house include translucent screens (yellow) and shutters (pale yellow) in order to introduce natural light into the houses without compromising privacy.

Source: Image by author. (*Adapted from Katsutoshi Sasaki & Associates, 2010; Makiko Tsukada Architects 2008*)

5. Thresholds between interior and exterior

The highly private JGHs do not include many penetrations on the street facades, creating little interface with the street, so a series of thresholds are included to avoid an abrupt transition from street to house. The five JGHs investigated are all setback from the street edge. This setback physically separates the front door from the street creating a threshold - so occupants must consciously step off the street and onto the JGH's site (Fig. 3.27).

The House in Koamicho (Suppose Design Office, 2008-2009) Hansha reflection house (Studio SKLIM, 2011) Kondo house (Makiko Tsukada Architects, 2008) and Moriyama house (Suppose Design Office, 2011) include a level change from the ground and into the house. The House in Koamicho, Hansha reflection house and Moriyama house are accessed via steps while a ramp connects the Kondo house to ground level. This level change acts as a second threshold as occupants must consciously climb a set of stairs, or a ramp, to reach the front door.

A small entrance hall is included in each of the five precedents analysed (Fig. 3.29). This resounds with traditional Japanese dwellings. In Japanese culture, like some New Zealand cultures, shoes are removed before entering the house. The entrance hall provides a space for this ritual to occur and so fulfils its role as a threshold through screening from the rest of the house, and through its accommodation of this ritual. The entrance hall also increases the privacy of the house, as guests can be entertained in the entrance hall without entering the private realm of the house.

Therefore, the provision of thresholds in JGHs responds to the principle of privacy. This strategy is potentially useful for walk-up apartments where thresholds between the street and communal circulation (in addition to thresholds between communal circulation space and interiors) can be instigated to improve the sense of privacy in the design. The application of this strategy is tested in Chapter four.

Chapter three conclusions:

The principles discussed throughout chapter three cannot be addressed in isolation. Rather, each principle either contradicts or complements another. Often, research focuses on complementary principles, as it can be difficult to effectively solve contradicting principles. Indeed, Housing New Zealand Corporation (2005) notes that strategies used to solve a lack of sunlight tend to contradict issues of privacy yet, strategies of how to achieve both sunlight and privacy are not provided (p. 12). Therefore, in Chapter three complementary and contradictory principles have deliberately been discussed. For instance; The introduction of natural light without creating views into the house is a strategy that effectively addresses the contradictory principles of quality natural light and privacy. By employing translucent screens or positioning glazing above or below eye level, natural light can be introduced into the dwellings while still maintaining a sense of privacy. Interestingly, this strategy cannot address one principle without fulfilling the other demonstrating that the principles are interrelated.

In contrast, an interface with nature complements the principle of quality natural light. The strategy of the garden as a light source illustrates this as, by using the garden as a source of light, an interface with nature is established in addition to quality natural light. The complementary or contradictory relationships of the principles discussed in Chapter three results in single strategies that may achieve multiple principles. This adds richness to design, as strategies are more specific and novel than counterparts designed to address one principle.

In many cases, it appears that the gardens provide a solution to the three principles. Gardens are manifested in various strategies to create quality natural light, a high interface with nature and enable a sense of privacy within the house. Thus, the garden is an element that is used to address all three principles.

Principles embodied by the JGH precedents will be carried through into the case study design (Chapter four) through the adaptation of the design strategies employed by JGHs that are evaluated above. The design strategies are adapted for WUA on a typical Auckland site with the aspiration that the integration of garden and architecture in tandem with the implementation of the strategies will provide as much success as they have in the JGH precedents.

- — Street.
- Setback from street.
- Level change.
- Entrance hall.

Fig. 3.30: JGHs are very private from the street. Thresholds are used to separate the private spaces from the public space @ 1:200.
 Source: Image by author (Adapted from Suppose Design Office, 2008-2009; Studio SKLIM, 2011; Katsutoshi Sasaki & Associates, 2010; Suppose Design Office, 2011; Makiko Tsukada Architects, 2008).

Chapter Four:

Design Case Study

Chapter four: Case study design

Fig. 4.01: Long, narrow sites are typical in Mt Albert @ 1:10,000.
Source: Image by author (Adapted from Google, 2012).

Fig. 4.02: Many sites in Mt Albert are either sub-divided or developed into 'sausage flats'. This organic intensification re-iterates the need for intensification in this suburb @ 1:1500.
Source: Image by author (Adapted from Google, 2012).

Introduction

Chapter four discusses a case study design undertaken to test some of the design principles and strategies discussed in Chapter three. The design is of a WUA on a typical, yet confined, suburban Auckland site. The chapter discusses the site selection method before evaluating the case study design.

Site

A specific site is chosen to demonstrate that the design adheres to realistic constraints. Auckland is selected as the location of the case study as it is anticipated to continue to have New Zealand's highest population growth (Auckland Council, 2012). It is articulated in the council's growth plan that high-density dwellings are planned to intensify the CBD while medium density dwellings are reserved for suburban centres (Auckland Council, 2012). Suburban centres marked for intensification are listed in the Auckland Growth plan and thus, are examined as potential areas for the design site. As the case study design is not intended to be social housing or high-end housing, a middle socio-economic area is identified. To ensure this, the decile ratings of high schools in suburbs marked for intensification were examined as deciles reflect the socio-economic position of the community around the school (Valentine, 2012). Suburbs with schools outside of 4-7 decile range were discarded as a decile of 4-7 is considered average. For suburbs fulfilling this criterion, a 2km radius was drawn to determine whether the school was within walking distance of a shopping centre. This was important as one of the main advantages of apartments is convenience, so, the attribute was deemed to be an effective indicator of intensification enablers. Other indicators examined included access to public transport, proximity to public buildings, such as churches and libraries, and accessibility to communal spaces, such as sports grounds. This narrowed potential suburbs to three. The proximity of these suburbs to the CBD was then mapped, revealing that Mt Albert was the closest, and therefore most appropriate, suburban centre for investigation for this thesis.

A 'typical' site was then selected for further investigation using the following methodology. Aerial analysis of Mt Albert showed that long, narrow sites were very typical for this suburb (Fig. 4.01). Further investigation revealed that the Mt Albert area had experienced organic intensification, where many long narrow sites were either

sub-divided or developed into ‘sausage flats’ (Fig. 4.02). This supports the contention that ‘typical’ sites in this area require new methods of intensification. Aerial photographs were scoured for potential sites, and undeveloped sites in particular, but these are rare. The second priority is single, detached houses, as it would be less disruptive (and less costly) to displace one family than several, and it would be more feasible to purchase single dwellings for development purposes. A site, currently accommodating a single detached house, with a width-to-depth ratio of 1:4, was selected for the purposes of this thesis. This long narrow site was selected as a design could easily be adapted to less constrained sites. Fig. 4.03 shows the selected site, its existing structure and the usual way of developing the site while Fig. 4.04 shows the site within the neighbouring context.

Fig. 4.03: The selected site, its existing structure and the usual way of developing the site @ 1500.

Source: Image by author (*Adapted from Google, 2012*).

Fig. 4.04: The site within the neighbouring context @ 1:10,000.

Source: Image by author (*Adapted from Google, 2012*).

Fig. 4.05: Gardens are cut into the building mass on an angle to ensure that the gardens are oriented North. As a result, units benefit from either an Eastern or Western aspect @ 1:500.
Source: Image by author.

Case Study Design:

The following section uses design as a mechanism to test the design principles and strategies identified as particularly useful for the New Zealand context, outlined in Chapter three. The following section is organised into three parts. The first part describes the design and strategies not pertinent to the research but necessary for a cohesive design suited to the Auckland context. These strategies are not derived from JGH models. The second part evaluates design strategies adopted from JGHs (Chapter 3). It articulates how they relate to New Zealand WUAs and the JGH principles, and illustrates their translation into case study design. To avoid repetition, this section is organised into design strategies, as each strategy may relate to multiple principles. The third part includes guidelines comprising successful strategies and examples of how these can be manifested for future application by other professionals. A discussion concerning the research process concludes the research.

General design approaches (Not derived from JGH Models):

Gardens oriented towards the sun

Many of the gardens included in New Zealand WUAs are not oriented towards the sun (Chapter two). Orienting the gardens North maximises the amount of natural light the gardens receive while encouraging vegetation to grow. Therefore, private gardens are cut into the building mass on diagonals to ensure that gardens are oriented towards North (Fig. 4.05). To emphasise the diagonal composition of the boundary walls, the service cores, interior partition walls and screens between gardens are all on an orthogonal grid (Fig. 4.06). Fig. 4.07 illustrates a comparative sun study of how this method improves upon other garden compositions.

The Northern orientation of the gardens has a positive effect on the unit orientations. In order to face the gardens, units are oriented East and/ or West. Therefore, South-facing units, that would receive little sunlight, are excluded from the design. The problematic effects of low-angle, afternoon sun on the Western facades is prevented through the provision of large overhangs. While the Northern orientation of the gardens is successful on the selected site, it is likely that additional research is required to adapt this strategy for sites with a predominantly East or West orientation.

Gardens are also extruded diagonally in section towards the northern light source (Fig. 4.08) minimising the triangle of shadow that conventional light shafts create. The apartment boundary walls themselves are vertical - as this is cost effective, user-friendly and maximizes usable floor area. By designing a cost-effective option the design is intended to be useful as a precedent to others, and through thoughtful design expresses the most effective orientation towards the sun.

Adjacent Gardens

Gardens are arranged adjacent to one another in order to create maximum- light shafts (Fig. 4.08). Individual gardens spread around the complex run the risk of not receiving adequate sunlight. By grouping gardens together, larger light shafts are provided, increasing the amount of natural light that can reach the garden depths. Indeed, some of the JGH precedents limit the garden spaces to fewer, larger gardens that may be more useful and provide more light.

Fig. 4.06: Unit perimeter walls are cut into the building mass on an angle, while other partitions are orthogonal to emphasise the diagonal orientation of the gardens @ 1:500.
Source: Image by author.

Fig. 4.07: Comparative sun study of an alternative development model, sausage flats and the case study design. While all three models perform well on a summer afternoon, the case study design casts the least shadows onto the neighbouring property on a summer morning. The case study design also provides larger amounts of sun on a winters afternoon.

Left to right: Summer afternoon, summer morning and on a winter afternoon.

Source: Image by author.

Fig. 4.08: Gardens are extruded diagonally to ensure the gardens are oriented North in order to receive maximum sunlight. Gardens are adjacent to create large light shafts allowing maximum sun penetration @ 1:250.

Source: Image by author.

- Playground
- BBQ seating area
- Vegetable gardens

Fig. 4.09: Communal space locator plan @ 1:1000.
Source: Image by author.

Fig. 4.10: A playground is included at the front of the site as an amenity to the case study design and the wider community.
Source: Image by author.

Communal garden space

Communal garden space is provided in response to Carroll, Witten and Kearns' (2011) argument that apartment dwellers often suffer from a lack of a sense of community (Fig. 4.09). This differs from the JGH precedents that are singular houses and so private from the street. The inclusion of communal space is believed to be an important adaptation for the New Zealand context as well as for multi-unit dwellings. Safety within the complex can be increased by the provision of communal spaces as they encourage residents to utilise, and passively survey, public areas. In addition, communal areas also encourage the New Zealand 'backyard BBQ' where neighbours may commune.

Different types of communal garden spaces are provided. Assigning defined functions to communal spaces encourages residents to use them. The range in functions accommodated is intended to appeal to a variety of age groups and people, encouraging and supporting resident diversity.

Communal garden spaces include a playground located at the front of the site (Fig. 4.10). As the playground is adjacent to the vehicular access route, a speed bump has been placed at the entrance to the vehicle ramp to encourage vehicles to travel at slow speeds. The driveway is also screened from the playground so that children are unable to run onto the driveway. The street front location of the playground encourages neighbouring residents to use the playground together with complex residents. Therefore, the playground is an amenity to surrounding sites and the design provides for its community.

The second communal space is a covered deck with seating areas and communal barbeque facilities (Fig. 4.11). This encourages residents to hold informal community gatherings and provides extra space if residents have guests.

Pockets of communal vegetable gardens encourage social interaction as well as healthy eating (Fig. 4.12). The playground, seated area and vegetable gardens provide three different types of garden that may appeal to a range of residents. Importantly, all of these gardens encourage social interaction and mitigate the effects of loneliness that multi-unit dwellings can imbue.

The communal spaces are spread throughout the complex to encourage social interaction along the circulation route in a similar way to a traditional residential street, creating a network of nodes that encourage different social interactions rather than being focused on a single area. Communal garden spaces are easily distinguished from private spaces, and are also distinguished from one another by their orientation. Private gardens run north to south while communal spaces run east to west.

Fig. 4.11: A covered barbecue and seating area is provided to encourage social gatherings and community activities. The roof acts as a shade in summer and shelters inhabitants from the rain and wind so that the space can be utilised in a range of weather conditions.
Source: Image by author.

Fig. 4.12: Pockets of vegetable gardens are included to encourage social interaction between inhabitants. This also encourages residents to directly engage with nature while encouraging healthy eating.
Source: Image by author.

Fig. 4.13.:Communal circulation routes including access to each unit. Left to right: Ground floor and second floor @ 1:500.
Source: Image by author.

Communal Circulation and access

Little precedent for communal access is provided by JGHs - as the precedents are private houses. Similarly, New Zealand WUAs tend to include small, linear communal circulation spaces that do not promote social interaction. In contrast, the communal access of the case study design follows a varied, meandering route rather than being linear (Fig. 4.13). Although this is less efficient than a linear route, it provides more interest, particularly for residents in the rear apartments, without significant increase in cost. As the site is very long, a linear access route would have been long and narrow - unpleasant for occupants.

The varied access route also allows composition of unit blocks, creating a front, middle and rear area (Fig. 4.14). These can be designed to vary in cost, as traditionally, front units are more expensive. This helps to attract a variety of residents from across a broader socio-economic spectrum – constituting a more complete community. The variation in garden and unit size is also designed to attract a range of residents. As a result, issues such as crime and vandalism that often occur in lower cost housing complexes and issues such as exclusivity and unaffordability that occur in high cost-housing projects are negated.

The current New Zealand building code stipulates that three-storey dwellings, such as the case study design, that house more than 50 residents on the upper floors require an elevator - or alternative mechanical vertical egress. At maximum capacity of two occupants per room the case study design can host 47 occupants on the upper floors. Not only does the maximum occupancy comply with the building code, but the actual number of occupants is expected to be much lower - as it is not expected that every dwelling will be occupied at full capacity.

Approximately one third of the units included in the design case study are single storey units located on the ground floor while approximately two thirds of the units are accessible via the ground floor. This promotes accessibility as a majority of the complex is universally accessible. Duplexes accessible from the groundfloor are able to be retrofitted with stairlifts if necessary while the proposed stepping stones from walkway to unit can be retrofitted with ramps for wheelchair access. Furthermore, the family sized units have been composed on the upper floors - where people are more likely to be able-bodied and fitter - while the smaller units, that are more likely to be occupied by the elderly and or people with mobility difficulties, are positioned on the ground floor.

Fig. 4.14: The communal circulation creates a distinct front, middle and rear creating a range of garden and unit sizes to encourage resident diversity @ 1:500.
Source: Image by author.

Fig. 4.15: Repeated service core reduces the overall cost of the development without imbuing a sense of monotony @ 1:500.
Source: Image by author.

Fig. 4.16: Stacked services reduce cost and minimise plumbing issues.
Source: Image by author.

Fig. 4.17: Each block is composed of three interlocking units of different sizes and numbers of bedrooms to encourage diversity.

@ 1:500

Source: Image by author.

Repeated service core – stacked services

In order to create variety – without creating it endlessly – repetition is employed.

The service core is repeated and reflected in every block to allow variety within living and garden zones to occur without creating unnecessarily expensive and unrealistic iterations (Fig. 4.15). Designing a repeating service core greatly reduces cost without creating monotony. To further reduce cost and minimise the potential for leaks, the service core has also been designed to stack vertically (Fig. 4.16).

Typical units

Three ‘typical’ units have been designed to form blocks in combination (Fig. 4.17-4.20). Variations of these blocks are arranged throughout the site comprising a holistic design. Unit one has one bedroom, is composed of the standard service core and is divided down the centre into the bedroom and living spaces (Fig. 4.21-4.24). Unit two has two bedrooms and living spaces. The kitchen and bathroom are arranged on the ground floor, with bedrooms and second bathroom arranged on a mezzanine connected by a straight-run stair (Fig. 4.25-4.28). Unit three is the largest unit comprising three bedrooms. Like Unit two, the bedrooms and second bathroom are separated vertically from the living spaces on a second level. This unit also includes two garden spaces – one connecting to the living spaces while the second is adjacent to the master bedroom on the upper floor. The inclusion of more garden spaces is in response to the higher number of bedrooms and associated greater resident concentration (Fig. 4.29-4.32).

All three unit-types feature open-plan living spaces to increase the visual connection with garden spaces. The design is based on the JGHs that also employ an open plan interior to capitalise on garden views.

Ground floor

First floor

Second floor

Fig. 4.18 Each block is comprised of three interlocking units @ 1:100.
Source: Image by author.

Fig. 4.19: Section perspective of the three interlocking units.
Source: Image by author.

Fig. 4.20: Sectional perspective of a typical block.
Source: Image by author.

Fig. 4.21:Unit one plan (Ground floor).
Source: Image by author.

Fig. 4.22:Unit one isometric.
Source: Image by author.

Fig. 4.23: View of Unit one from the garden.
Source: Image by author.

Fig. 4.24: View of the garden from Unit one.
Source: Image by author.

Fig. 4.25:Unit two plans (Ground and first) @ 1:100.
Source: Image by author.

Fig. 4.26:Unit two isometric.
Source: Image by author.

Fig. 4.27: View of Unit two from the garden.
Source: Image by author.

Fig. 4.28 View of garden from Unit two.
Source: Image by author.

Fig. 4.29: Unit three plans (First and second) @1:100.
Source: Image by author.

Fig. 4.30: Unit three isometric.
Source: Image by author.

Fig. 4.31: View of Unit three from garden.
Source: Image by author.

Fig. 4.32: View of garden from Unit three.
Source: Image by author.

Fig. 4.33: Basement parking @ 1:500.
Source: Image by author.

Parking

Kjellstrom and Hinde (2007) argue that Auckland is a highly vehicle-dependant city (p.104). As a result, car parks must be included if the design is to be considered suitable for the Auckland context. The Auckland District Plan specifies that parking should not dominate the front of the site, for aesthetic reasons, wherever possible (District Plan, 7b. p8). Therefore, basement parking is employed to adhere to the district plan and to make the most effective use of the ground floor for gardens and units, and thus improve circulation space (Fig. 4.33).

The additional cost of basement parking is rationalised by the increased density of the design. The use of basement parking allows ample space for extra car parks to be provided for residents' guests. The provision of additional car parks minimises potential congestion from cars using the street for parking and provides a secure, protected environment for residents' vehicles. Should vehicular usage decrease in the future, this space could offer additional storage opportunities for residents.

Pedestrian access to and from the site is clearly separated from vehicular access both physically and visually. This is safer and more aesthetically pleasing than a shared entrance to the site. The separation of vehicle and pedestrian access is in keeping with the Auckland District Plan (District Plan. 7b. p.20) (Fig. 4.34).

The basement car park composition is informed by the building structure. Often, the building design and structure is based on the structure of the carpark. However, in this case car park efficiency is compromised for architectural quality of the dwelling units, which is more likely to enhance resident satisfaction.

A high stud height is employed in the basement car park to allow for the planting of trees on the ground floor. However, some large trees would need to be strategically positioned so as not to encroach on the basement parking.

— Vehicle entry
— Pedestrian entry

Fig. 4.34: Separate vehicle and pedestrian entrances @ 1:500.
Source: Image by author.

Density and context.

Through compact design, multi-storey development, higher site coverage and underground parking, 18 times the original site density is achieved. This is a relatively high density for WUAs. However, by concentrating density onto a few WUAs per suburban block, a medium density suburban centre can be achieved with minimal displacement of existing houses. As a result, more land can remain as detached dwellings or be transformed into community amenities. By replacing between 30%- 50% of single, detached houses with a development based on the case study design, density can be increased from 6.25 units per hectare to 38 - 59.38 units per hectare. This is in keeping with New Zealand definitions of medium density - Turner et al. (2004) defines medium density as 30-66 dwellings per hectare (p. 22). If the New Zealand quarter-acre dream is to be interpreted to literally, strategies used in the case study design have the potential to increase density from one unit per quarter acre to 3.42-5.5 units per quarter acre. The dramatic increase in density that the case study design demonstrates to be achievable is a promising solution to Auckland's housing shortage and provides a novel way to intensify existing Auckland suburban centres with minimal displacement of existing communities. The development of design principles from JGH precedents in response to existing issues in New Zealand WUAs has resulted in a case study design that could achieve higher density in a uniquely New Zealand manner.

Increased density has often been negatively received by New Zealanders in the past. However, Forsyth (2003) argues that there is a difference between perceived density and actual density. Developments that are unattractive, have little interface with nature and cause parking problems on the street are perceived by the public as being denser than they actually are, and are consequently poorly received (p.4). Forsyth concludes that by addressing these issues with design solutions, the perception of inappropriate density can be reduced and the likelihood that residents will enjoy the development can be increased.

The case study design responds to the issues Forsyth (2003) outlines and the design aesthetic is intended to be contemporary and unobtrusive. The design also has a high interface with nature- evident from the street in the form of a communal, grassed garden, the trellises supporting ivy panels and glimpses of buildings and tree tops from the street. Potential parking problems are mitigated by ample basement parking that provides an additional level of security and reduces the visual pollution resulting from

large numbers of parked cars (Fig. 4.35). With less cars parked on the street, the potential to develop walking and cycling tracks is also enhanced, promoting the potential for community development.

Fig. 4.35: The perception of the density of the case study design is reduced through the contemporary aesthetic, inclusion of visible vegetation and the elimination of above-ground parking.
Source: Image by author.

Fig. 4.36: The street elevation is in keeping with the scale of the surrounding trees.
Source: Image by author.

As the design is only three storeys in height, it adheres to the Auckland District Plan's (2012) maximum height for the site's zone, and fits appropriately into a residential context. The three-storey design complements the scale of the large trees present in the neighbourhood. This establishes a satisfactory scale relationship - particularly as the street elevation includes vegetation that softens the scale of the development while aesthetically connecting the design to the surrounding vegetation (Fig. 4.36).

The bulk of the complex is effectively broken up by the centralised communal access that splits the façade into two distinct blocks. The large setback of one block contributes to this breaking up of the mass of the complex through difference in roof height design. This complies with the Auckland District Plan (2012), which emphasises the need to break down the massing of larger developments in residential areas. It fits in with the neighbouring context and, with integrated gardens, provides an appropriately human scale (Fig. 4.37).

Forsyth (2003) claims that

“many of the most charming environments in the world have buildings with small setbacks, high building coverage, and relatively small distances between buildings.” (p.4).

The case study design is based on this contention and so is built up to the site boundaries for maximum building coverage (Fig. 4.38). Setbacks from boundaries can result in unpleasant and unsafe, alley spaces. This challenges the current Auckland District Plan (2012) that requires buildings to be setback from site boundaries. Boundary setbacks can prevent detached houses from overlooking one another and minimise the spread of house fires. Although the case study design takes care not to impose on neighbouring sites, as it does not rely on neighbouring sites for ventilation or light (and therefore, does not include glazing overlooking neighbouring properties), the scale of the development built up to the boundary may have negative aesthetic implications for the neighbouring properties. This potential flaw in the design case study could be remedied through further investigation, or through tessellation of the design when a neighbouring property becomes available for development (Fig. 4.39). A significant advantage of the case study design is that the development does allow for intensification to occur on neighbouring sites without serious loss of amenity for the units -as the case study design does not rely on neighbouring sites for an interface with nature, light or privacy.

Fig. 4.37: Massing is broken into two volumes minimising the appearance of density from the street.
Source: Image by author.

Fig. 4.38: Roof plan- the design is built to the site boundaries @ 1:2000.
Source: Image by author.

Fig. 4.39: An example of how the case study design could be tessellated @ 1:1000.
Source: Image by author.

Cost effectiveness

Although cost effectiveness is not a primary principle drawn from JGHs it was considered to be important as many design issues can be solved with a substantial budget. Cullen (2005) and more recent authors argue that Auckland faces a lack of affordable housing and that this issue will become exaggerated in the future (p.1). Indeed, this issue has occupied a significant space in local media of late (Keon, 2012; Morgan, 2012). Appropriate, affordable and liveable densification is likely to be part of the solution to this end. (Fig. 4.40) shows a comparison of the case study design with a traditional sausage flat and a traditional detached house on the site.

Relationship to New Zealand walk-up apartments

The case study design is a variant of a WUA. It includes appropriate elements typical of WUAs and is limited to three storeys. Like WUAs, the design excludes elevators and includes communal staircases leading to the upper floors. Unlike conventional walk-up apartments, the communal circulation space is not linear or enclosed like many of the precedents, but open-air and meandering in nature. This increases the interface between dwelling and nature, allows the circulation space to act as a source of natural light for the units – like Wakefield apartments - while encouraging social interaction and imbuing a sense of variety.

Also unconventionally for a classic walk-up apartment, some of the apartments are duplexes. There are some examples of duplex New Zealand WUAs (Chapter two) but duplexes are not the norm.

The internal configuration of units is in keeping with the apartments analysed. Like the JGH precedents, living spaces are open-plan and separated from the cellular bedrooms. This allows a greater connection with nature for more of the living spaces.

The design is not single volume like so many of the WUAs analysed, nor is it spread over a large site. The design exemplifies characteristics of the WUAs spread over large sites by including spaces between the built volumes, yet, unlike the WUAs with this characteristic, the design is completely internalised so that it does not rely on green spaces of neighbouring sites. This is typical of JGHs whose designs are internalised as a result of the houses' short life spans and changing neighbouring conditions. This may be a useful strategy for further intensification of the street.

Fig. 4.40: Left to right: The current site structure with a single detached house, A typical 'sausage flat' development with rear parking and the case study design. This figure illustrates that the case study design is cost effective as the case study design includes a greater number of units. In addition, the case study design includes more usable open space than the sausage flats - where open space is largely required for vehicle access @ 1:1000.
Source: Image by author.

Fig. 4.41: Gardens highlighted in green illustrates the spatial layout and integration of gardens and units @ 1:500.
Source: Image by author.

Design Strategies Derived from JGH Principles

1. Integrating garden with architecture.

The definition provided for JGHs in Chapter one is that the garden is an integral part of the architecture, as opposed to a separate spatial entity. Therefore, the principle of integrating garden with architecture is fundamental to JGHs. This strategy is translated into the case study design through the spatial layout of the gardens. Gardens are interwoven with units and are designed in tandem with the units, as opposed to separately as an afterthought (Fig. 4.41). Without gardens, the design cannot function, so gardens and architecture are integral.

Another way that the gardens are integrated with architecture in the case study design is through dissolving the boundary between interior and garden. The interiors are physically connected to gardens by overhead bi-folding glass doors. These doors can be folded upwards completely, eliminating the boundary between interior and exterior and integrating them into one space in a similar way to the sliding doors in JGHs. Alternatively, the bi-folding doors can be opened slightly to introduce ventilation into the space. The bi-folding door is advantageous as space does not have to be left for the sliding door to occupy; rather, the whole door can be opened up (Fig. 4.42).

Fig. 4.42: Bifolding glass doors physically connect the unit interiors and gardens.
Source: Image by author.

Fig. 4.43: Walls extend beyond the interior boundary, blurring the distinction between garden and interior
Source: Image by author.

88 Fig. 4.44: Floor treatments extend beyond the interior blurring the boundary between interior and garden
Source: Image by author.

To further dissolve the boundary between interior and garden, the architecture extends beyond the interior boundary into the garden blurring where the garden begins and the interior finishes. The external walls extend beyond the boundary between interior and exterior making it unclear where the boundary between interior and exterior is (Fig. 4.43) while the boundary between interior and exterior is further blurred by the floor treatment extending between interior and exterior (Fig. 4.44). By blurring the interface between interior and garden the nature-dwelling interface is improved, and consequently the integration of garden and architecture is improved.

Like JGHs, where gardens can be viewed and accessed throughout the house, the case study design's private gardens can be viewed from the open plan living spaces in all three unit types through large curtain walls. This maximises the visual connection with nature in a typical, contemporary New Zealand manner (Many single, detached New Zealand houses now overlook nature through large glazed windows) (Fig. 4.5). The high level of glazing also resonates with the JGH precedents that also utilise glazing to maximise the visual connection between interior and exterior

This strategy may be used as a guideline for future developments as it responds to the principle of a high interface with nature. The strategy also counters the poor interface with nature observed in many New Zealand medium-density dwellings (Chapter one) and the WUAs analysed in Chapter two.

Fig. 4.45: Gardens are visually connected to the interiors by curtain walls and overhead bi-folding doors.
Source: Image by author.

Fig. 4.46: Indicated in green are the connections with garden so the garden can act as a source of light.
Source: Image by author.

2. Garden as a source of light.

Like JGHs, the garden is treated as a primary light source for each unit as well as providing service as a garden (Fig. 4.46) and is implemented in the design through a series of curtain glass walls facing onto the garden. The use of curtain walls rather than windows maximises the amount of light the garden can provide for the interior. It is also in keeping with the JGHs – many of which include curtain walls to maximise the connection between interior and garden (Chapter three) (Fig. 4.47).

This design strategy relates to three of the principles embodied by JGHs. Firstly, by acting as a light source, the strategy provides the unit with quality natural light. Because the garden is private, by using the garden as the primary light source, natural light is introduced into the unit without comprising privacy. As a result, the garden provides outlook as well as light so external windows are only required for additional natural light, increasing privacy. This also increases the dwelling-garden interface as the garden provides alternative functions for the interior.

This particular strategy responds to the issue of deficient natural light identified by Bennet and Isaacs (2009) (Chapter one) in many Auckland dwellings, by providing the unit with a natural light source. The design strategy also addresses the lack of privacy revealed through analysis of New Zealand WUAs. For instance, Tattoo Apartments (2010) employ windows facing onto busy streets. Here the need for natural light impacts on the privacy of the dwelling. In contrast, garden as a source of light is a useful design strategy embodied by JGHs that can improve existing issues with New Zealand WUAs by providing units with a natural light source that does not negatively impact on the privacy of the dwelling, but increases the nature-dwelling interface.

Fig. 4.47: The gardens act as the primary light source for the units.
Source: Image by author.

3. Multiple Sources of natural light.

The provision of natural light alone does not equate to quality natural light. Many of the JGHs analysed employ external windows in addition to gardens to provide multiple sources of light. Richmond (2012) argues that this increases the quality of light in a space. Therefore, the living spaces of the design case study include multiple light sources. The primary light source is generated from the garden, in keeping with JGH precedents, while external windows and glass blocks facing the communal access provide alternative, secondary light sources (Fig. 4.48). This counters deficiencies in New Zealand WUAs where even some exemplary models, such as Tattoo Apartments, feature only one light source (Chapter three). This strategy can be used to improve the quality of natural light in units and is therefore, a useful inclusion in guidelines for future applications.

Fig. 4.48: Multiple Sources of light are provided in all the living areas and a majority of the bedrooms to improve the quality of natural light in the spaces.

Source: Image by author.

Fig. 4.49: Glass blocks allow natural light to penetrate the units without compromising the privacy of the units.
Source: Image by author.

Fig. 4.50: Windows are positioned above head height in order to introduce natural light into the units without compromising the privacy of the units.
Source: Image by author.

4. Introduce natural light without creating views into the unit.

Privacy is a design principle embodied by JGH precedents. To achieve this, natural light must be introduced into dwellings without creating views into the interior. Two of the methods JGHs use to introduce natural light without creating views into the house are translated and adapted into the case study design. The first is the use of translucent screens, such as frosted glass, to allow natural light to permeate the building without creating views into the house. For the case study design, natural light from the communal circulation space is filtered through glass blocks (Fig. 4.49) which provide light but not views. Another way this is implemented in JGHs is by providing windows that are either above or below eye level so that passers-by cannot see in. Following this precedent, external windows are positioned above head height to ensure passers-by cannot see into the units while still allowing natural light to enter (Fig. 4.50). As the garden provides the unit with an 'outlook', additional external windows are only required to provide additional lighting. Thus, the strategy of introducing natural light without creating views into the unit can effectively be employed in tandem with the former strategy to ensure units receive both an outlook and quality natural light.

Privacy for the upper floor units is also necessary. This is provided by a series of ivy-planted trellises positioned to provide high levels of privacy where required, but still connecting the apartment dwellers with nature and natural light (Fig. 4.51). As the ivy-clad trellises are permeable, like the translucent screens adopted by the JGH precedents, natural light permeates through the trellises into the building. Ivy trellis panels screen apartments from each other and act as vertical gardens. The vertical gardens are an important adaptation, as upper floors of JGHs often overlook ground floor gardens. This would compromise the privacy of ground floor gardens in the case study design. Therefore, vertical garden elements are employed to connect upper floor units with nature. In addition they provide an interesting variation in depth as they screen from both sides, but are only required on one, thus enhancing the nature-dwelling interface and the sense of having private internal space/garden.

These methods derived from JGH precedents are adapted to the New Zealand, and higher density, context to effectively respond to three principles - the formation of quality

natural light (by giving architects opportunities to introduce natural light from aspects that are not private or do not have good outlooks) an interface with nature (by using the garden as a light source the garden is visually connected with the house) and a high level of privacy (by not creating views into the house from the outside). Grant (1989) and Warne (2011) claim that New Zealand multi-unit dwellings often lack privacy (p.7; p.10). Indeed, analysis of New Zealand WUAs reveals that units are often repeated, resulting in windows being positioned where possible rather than in relation to the windows' impact on privacy. Therefore, the strategy of introducing natural light without creating views into the units can be used as an effective guideline for other architects and developers to ensure that units receive natural light in a manner that does not negatively impact on privacy.

Fig. 4.51: Trellises planted with ivy screens provide upper units with privacy and give residents the opportunity to grow more or less ivy to increase or reduce privacy.
Source: Image by author.

5. Thresholds

The contention that JGHs are very private from the street is supported by literature (Daniels, 2008) and analysis (Chapter three). In order to evoke a sense of privacy within the gardens and units in the case study design, thresholds are set up between the public street, communal circulation and private gardens and interiors. These are manifested through material change, level change, setbacks and screening. A timber walkway separates communal access from the public street through material change and height (Fig. 4.52-4.53). A majority of the apartment edges are separated from the communal walkway by a setback between the walkway and the built edge, physically separating passers-by from the built edge and windows. The setback zone also has a different surface treatment (gravel) from the walkway. This material alerts residents to the presence of others and the low maintenance surface change signifies that the zone is not for occupation – and is easier to maintain than grass that could be considered inviting (Fig. 4.54).

Access from the communal circulation to the units is via stepping stones. These are small scale, and through a different surface treatment, suggest privacy while also providing a connected access for residents and guests by maintaining the same level as the communal circulation bridge. Therefore, through setbacks, and changes in material and level, thresholds are created to effectively indicate to occupants the level of privacy of spaces.

By strategically considering thresholds, the design responds reacts to the lack of privacy occupants experience in many New Zealand multi-unit dwellings. By providing thresholds, a sense of gradation in privacy can be created. As outlined, thresholds between interior and exterior provide a useful strategy for increasing the privacy in Auckland WUAs, and so are included in the guidelines following.

Fig. 4.52: Thresholds separate the public areas from the private.
Source: Image by author.

Fig. 4.53: Thresholds separate the public areas from the private.
Source: Image by author.

Fig. 4.54: Entrance from street
Source: Author's Drawing

Chapter Five:

Conclusions

Key

Principles	Issues

Quality natural light	High nature-dwelling interface	Privacy	Deficient natural light	Poor nature-dwelling interface	Lack of privacy

Guidelines

1.0 Integrating garden and architecture					
<div>1.1 Issue:</div> <div>Many multi-unit dwellings in Auckland have a low interface with nature. Yet, to address population growth in Auckland - higher density housing models are required to reduce urban sprawl.</div>	<div>1.2 WUA example</div>	<div>1.3 JGH response</div>	<div>1.4 Thesis example(s)</div>	<div>1.5 Principles addressed</div>	<div>1.6 Issues addressed</div>
2.0 Garden as a light source					
<div>1.1 Issue:</div> <div>Many multi-unit dwellings in Auckland receive deficient natural light. This is an issue as natural light has been shown in literature to imbue positive effects on physiological and psychological well-being.</div>	<div>1.2 WUA example</div>	<div>1.3 JGH response</div>	<div>1.4 Thesis example(s)</div>	<div>1.5 Principles addressed</div>	<div>1.6 Issues addressed</div>

Solution Menu:

1.0 Integrating garden and architecture

Spatial structure can be used to integrate garden and architecture.

Bi-folding doors to physically connect interior and garden.

Sliding doors to physically connect interior and garden.

Ground treatment extends beyond the interior into the garden.

Walls extend beyond the interior into the garden.

2.0 Garden as a light source

Fig. 4.55:Matrix - page one.
Source: Image by author.

3.0 Multiple natural light sources

1.1 Issue:	1.2 WUA example	1.3 JGH response	1.4 Thesis example(s)	1.5 Principles addressed	1.6 Issues addressed
<p>Richmond (2012) argues that the quality of light in a space is greatly improved by providing multiple sources of light. This is practiced in JGHs and combats the issue of deficient natural light.</p>

4.0 Introduce natural light without creating views into the unit

1.1 Issue:	1.2 WUA example	1.3 JGH response	1.4 Thesis example(s)	1.5 Principles addressed	1.6 Issues addressed
<p>In order to introduce natural light into a dwelling, privacy is often compromised through the implementation of penetrations such as windows..</p>

5.0 Creation of thresholds to separate public from private spaces

1.1 Issue:	1.2 WUA example	1.3 JGH response	1.4 Thesis example(s)	1.5 Principles addressed	1.6 Issues addressed
<p>JGH are very private from the street. Lack of privacy is also an issue found in New Zealand multi-unit dwellings.</p>

3.0 Multiple natural light sources

4.0 Introduce natural light without creating views into the unit

5.0 Creation of thresholds to separate public from private spaces

Fig. 4.56:Matrix - page two.
Source: Image by author.

Guidelines

The aforementioned design strategies are organised in a matrix (Fig.4.55-4.56). The matrix is provided as a guideline for future architects and developers to apply to WUAs in Auckland. The matrix is developed in two parts. First, an explanation of the issues and examples of responses manifested in WUA and JGH precedents are provided for each design strategy. This illustrates how the case study design relates to the precedents it is derived from. Secondly, the matrix includes easy-to-read symbols demonstrating principles achieved and issues resolved through the design strategy in addition to a solutions menu of how the strategies may be implemented. These are illustrated in generic settings for maximum application. The solutions menu is comprised of strategies implemented in JGHs (Chapter three) and the case study design (Chapter four). Strategies that are successfully tested through the case study design are outlined in green. Therefore, future researchers can easily identify other JGH strategies that may require testing in the Auckland, medium density context and architects, developers and city councils are aware of additional, untested alternatives that have the potential to be employed. As a result, the matrix can be used as a stand-alone ready-to-read reference for other architects, developers and city councils. By illustrating the principles and issues addressed, architects facing specific issues are able to quickly find strategies that relate to the particular issues. Including the WUA and JGH examples in the matrix allows architects and researchers to compare the design case study to New Zealand WUA and JGH contemporaries. Only strategies that relate to the three principles of an interface with nature, quality natural light and privacy are included in the matrix.

While the case study design (Chapter four) tested many of the strategies presented on the solutions menu (Fig. 4.55-4.56) on a specific Auckland site, it is likely that the solutions menu is applicable to many Auckland, suburban sites as the strategies are presented in a generic setting. The spatial structure, used to improve the nature-dwelling interface, is site specific and so is an exception to this, thus, requiring further adaptation for sites with other shapes, dimensions and orientations. As it is impractical to propose a perfect spatial structure for each Auckland site type, as there are so many variants, several spatial structures manifested in JGHs are included in the guidelines to provide other architects, developers, councils and researchers with alternative spatial structures that may be better suited for other sites. This is in keeping with the research aims, as the design case study is not intended as a pattern to be directly copied. Rather, the case study design is considered a mechanism through which principles and strategies (included in the

matrix) can be tested for wider application by other architects, developers and councils.

Alternative, less site-specific strategies to integrate garden and architecture are also presented in the matrix. These include employing elements that physically connect the interior with the garden, such as bi-folding or sliding doors, or extending elements from the interior out into the garden thus, blurring the distinction between garden and interior. As these are not site-specific, they are more readily applicable and adaptable to other designs. Many of these strategies are tested to great effect in the case study design (Chapter four) by physically and aesthetically integrating garden and interior.

The garden as a light source is another strategy with a wide application. Whether the garden is side-lit, top-lit or a combination and whether the garden lights the interior through curtain glazing, translucent screens or windows is dependant on the specific design. However, the strategy itself is widely applicable. This is a particularly useful strategy as it not only provides the interior with quality natural light, but also improves the nature-dwelling interface while enabling privacy (as the garden-light source is private).

The third strategy, Multiple natural light sources, is important in ensuring dwellings benefit from quality natural light. Although this strategy is useful as a stand-alone strategy, it is particularly effective when employed in conjunction with the garden as a light source. As the garden as a light source also ensures the interior benefits from an interface with nature, alternative sources of light are not required to provide an outlook. This increases the scope of application as light sources can be introduced in facades with poor or public outlooks.

To ensure that the multiple natural light sources do not impinge on the privacy of the home, it is useful to consider multiple light sources in conjunction with the fourth strategy - introducing natural light into the home without creating views. This strategy proposes ways to introduce natural light - but not necessarily an outlook - and is particularly effective in tandem with the aforementioned second and third strategies as these three strategies can be successfully combined to fulfil all three principles of an interface with nature, quality natural light and privacy.

In addition to working in conjunction with other strategies, the strategy of introducing natural light without creating views into the unit can be employed as an isolated strategy.

However, this strategy does not create an outlook or provide an interface with nature. Therefore, it is recommended that this strategy is employed in conjunction with the other two, or alternative method, to provide an interface with nature.

The last strategy – the creation of thresholds to separate public from private space, is primarily used to promote a sense of privacy. Through the case study design, it is evident that a combination of strategies – such as level and material change – is useful in achieving thresholds. The more strategies employed in the architecture, the smoother the transition there is from public to private. Of the solutions proposed, only the entrance hall was not tested in the case study design as a result of compact design requirements. The success of an entrance hall is an interesting mechanism for future researchers to investigate.

Like the principles, which are interrelated (Chapter three) the design strategies are also interrelated often addressing multiple principles at a time. Therefore, the strategies are strongest when employed in combination. Some of the strategies, such as thresholds, are more successful in isolation than others (such as introduce natural light without creating views into the unit which is strongest when in tandem with strategies two and three). Therefore, future interpreters of the matrix should consider the impact of using strategies in isolation or combination when selecting solutions to test or implement.

While the general design strategies employed in Chapter four are important in creating a realistic design that fulfils certain pragmatics and adheres to the Auckland context, these strategies are design specific. Therefore, these strategies are less useful for wider application as they rely on design and site specific parameters. These strategies also do not address the research proposition. As the case study design itself is intended as an example of how the strategies may be implemented and not as a design that should be replicated on every site, these strategies are omitted from the guidelines.

Research process and outcomes - evaluation and conclusions

The intent is for the research to follow a clear and rigorous methodology that contributes to desired outcomes for the project - a successful application of design principles adapted from JGHs for medium-density housing in a New Zealand context. The literature review reveals that many of the negative attributes of New Zealand medium-density housing are in opposition to the merits of the quarter-acre dream. Analysis of New Zealand WUAs verifies many of the negative attributes outlined in the literature review, as well as providing insight into the design of WUAs so that a more suitable variation may be designed (Chapter four).

Design principles embodied by JGHs are uncovered through the general analysis of 50 precedents. Specific strategies for achieving these principles are thereafter revealed through further investigation. These strategies are then successfully adapted in a realistic case study design to demonstrate that the strategies could be effective in the New Zealand context and potentially suitable for WUAs.

As a result, the strategies are proposed as guidelines for other architects to impose on future designs. This would allow Auckland WUAs to reconnect with nature whilst improving the quality of natural light and privacy. This is deemed to be a useful outcome for architectural practitioners and has the potential to contribute to improving Auckland's medium-density housing stock. The research also has possible useful application in response to Auckland's housing shortage, and thus responds to a currently prominent architectural issue in New Zealand.

An alternative outcome of the research is a design that could be tessellated and adapted along a street to assist with overall suburban intensification. Although this is a useful strategy for intensifying Auckland suburban centres, simply tessellating and repeating the design has the potential to create monotony. Therefore, appropriate design strategies are used to articulate design principles through a matrix. This is deemed to be a more useful approach, as principles could be applied to other designs, to provide similar resident-centric outcomes. The matrix also has potential to be used as part of design guidelines for intensifying typical Auckland sites in suburban centres, for other architects and developers to apply their designs to achieve quality, medium-density housing.

The research was restricted by limited access to plans and sections of contemporary New Zealand WUAs. A trend of publishing single, detached houses or occasionally high-rise apartments is evident in New Zealand architectural journals such as Home and Architecture New Zealand. While this practice resonates with the quarter-acre dream, it is frustrating for researchers of alternative modes of housing. Some architects of walk-up apartments are helpful and provide plans of WUAs; others are non-responsive. In addition, the procurement of plans and sections from local authorities is often difficult, time-consuming and costly. The analysis of New Zealand WUAs could potentially have been improved by the inclusion of non-architectural WUAs. However, this was not possible because of the nature of this project and limited access to plans and sections.

The research could also be improved by testing the design on other types of typical Auckland sites including sites with an East or West aspect and different shaped sites. However, this is beyond the scope of this project and so is left to further researchers to provide insight into additional or alternative strategies that may be added to the guidelines. The guidelines themselves are intended as open-ended and to be further tested, refined, updated and added to by future researchers. As a result, it is hoped that the guidelines will become increasingly useful and relevant over time.

In addition to providing design strategies and principles that are readily applicable for other architects, developers and city councils, the research demonstrates a useful application of several methodologies. These methodologies can be followed by others to expand and improve the current research. Alternatively, the methodologies can be used in the application of different research. The methodologies are as follows:

1. Development of a typology.

The research shows that it is possible to provide a robust methodology to develop and create an understanding of a typology. For instance, this methodology, illustrated in Chapter three, can be used by others to explore how different typologies can contribute to the improvement of medium-density housing.

2. The establishment of principles.

A methodology demonstrating how principles can be derived from precedents and established in a case study design is also provided by the research. This can be used by others to further the research by establishing more principles and expanding the matrix.

3. Site selection.

Chapter four identified a way of determining where to site medium density housing. This has potential for architects, developers and city councils intending to intensify suburbs.

4. The matrix as a tool for others.

The development of a matrix illustrates how a potentially useful, visual tool can be developed from research to aid other professionals. It is intended that further research is undertaken by others to expand, and therefore increase the usefulness of, the matrix by following some of the aforementioned methodologies.

5. Contribution to a current body of knowledge.

The research contributes to the conversation concerning the current housing shortage in Auckland by providing principles and strategies that can be used to create potential solutions. This encourages others to undertake research that is directly applicable and relevant to current issues.

JGH provide useful design principles and strategies for reconnecting New Zealand walk-up apartments with nature. The case study design demonstrates that it is possible to successfully implement principles embodied in JGHs to overcome issues found in existing New Zealand WUAs. Affordable, medium density housing that provides a context for the development of a community and responds appropriately to the ‘quarter-acre dream’ is the way of the future for housing in New Zealand. Hopefully, this research can play a useful part in realising that dream.

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4.09: Communal space locator plan. Image by author.

4.10: A playground is included at the front of the site as an amenity to the case study design and the wider community. Image by author.

4.11: A covered barbecue and seating area is provided to encourage social gatherings and community activities. The roof acts as a shade in summer and shelters inhabitants from the rain and wind so that the space can be utilised in a range of weather conditions. Image by author.

4.12: Pockets of vegetable gardens are included to encourage social interaction between inhabitants. This also encourages residents to directly engage with nature while encouraging healthy eating. Image by author.

4.13: Communal circulation routes including access to each unit. Ground floor and second floor. Image by author.

4.14: The communal circulation creates a distinct front, middle and rear creating a range of garden and unit sizes to encourage resident diversity. Image by author.

4.15: Repeated service core reduces the overall cost of the development without imbuing a sense of monotony. Image by author.

4.16: Stacked services reduce cost and minimise plumbing issues. Image by author.

4.17: Each block is composed of three interlocking units of different sizes and numbers of bedrooms to encourage diversity. Image by author.

4.18: Each block is comprised of three interlocking units. Image by author.

4.19: Section perspective of the three interlocking units. Image by author.

4.20: Sectional perspective of a typical block. Image by author.

4.21: Unit one plan (Ground). Image by author.

4.22: Unit one isometric. Image by author.

4.23: View of Unit one from the garden. Image by author.

4.24: View of the garden from Unit one. Image by author.

4.25: Unit two plans (Ground and first). Image by author.

4.26: Unit two isometric. Image by author.

4.27: View of Unit two from garden. Image by author.

4.28: View of garden from Unit two. Image by author.

4.29: Unit three plans (First and second). Image by author.

4.30: Unit three isometric. Image by author.

4.31: View of Unit three from garden. Image by author.

4.32: View of garden from Unit three. Image by author.

4.33: Basement parking. Image by author.

4.34: Separate vehicle and pedestrian entrances. Image by author.

4.35: The perception of the density of the case study design is reduced through the contemporary aesthetic, inclusion of visible vegetation and the elimination of above-ground parking. Image by author.

4.36: The street elevation is in keeping with the scale of the surrounding trees. Image by author.

4.37: Massing is broken into two volumes minimising the appearance of density from the street. Image by author.

4.38: Roof plan – the design is built to the site boundaries. Image by author.

4.39: An example of how the case study design could be tessellated. Image by author.

4.40: Left to right: The current site structure with a single detached house, a typical ‘sausage flat’ development with rear parking and the case study design. This figure illustrates that the case study design is cost effective as the case study design includes a greater number of units. In addition, the case study design includes more usable open space than the sausage flats- where open space is largely required for vehicular access. Image by author.

Fig. 4.41: Gardens highlighted in green illustrates the spatial layout and integration of gardens and units. Image by author.

Fig. 4.42: Bifolding glass doors physically connect the unit interiors and gardens. Image by author.

Fig. 4.43: Walls extend beyond the interior boundary, blurring the distinction between garden and interior. Image by author.

Fig. 4.44: Floor treatments extend beyond the interior blurring the boundary between interior and garden. Image by author.

Fig. 4.45: Gardens are visually connected to the interiors by curtain walls and overhead bi-folding doors. Image by author.

Fig. 4.46: Indicated in green are the connections with garden so that the garden can act as a source of light. Image by author.

Fig. 4.47: The gardens act as the primary source of light for the units. Image by author.

Fig. 4.48: Multiple sources of light are provided in all the living areas and a majority of the bedrooms to improve the quality of natural light in the spaces. Image by author.

Fig. 4.49: Glass blocks allow natural light to penetrate the units without compromising the privacy of the units. Image by author.

Fig. 4.50: Windows are positioned above head height in order to introduce natural light into the units without compromising the privacy of the units. Image by author.

Fig. 4.51: Trellises planted with ivy screens provide upper units with privacy and give residents the opportunity to grow more or less ivy to increase or reduce privacy. Image by author.

Fig. 4.52: Thresholds separate the public areas from the private. Image by author.

Fig. 4.53: Thresholds separate the public areas from the private. Image by author.

Fig. 4.54: Entrance from the street. Image by author.

Fig 4.55-4.56: Matrix. Image by author.

Appendix a.

50 JGH precedents categorised in Chapter two:

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Appendix b.

The following colour scheme is applied to diagrams in the thesis for consistency and clarity.