

Suburban Renovation:
Linear Intensification of Urban Transport Corridors,
incorporating mixed-use typologies.

Abstract

The focus of this research is the linear intensification of urban transport corridors, incorporating mixed use typologies. Suburbs in Auckland which fall on motorway, and railway routes suffer many adverse effects of rapid growth from the last decade: excessive traffic congestion; dangerous environment for cyclists, pedestrians and children; deserted corners and dead ends beside motorways and railways potentially brew crime etc. Public bus network also becomes inefficient due to excessive vehicles on the road. In attempt to relieve some negative impacts of urban growth, the implemented strategy will be to intensify existing underused low density suburban and industrial areas along motorways and railways with mixed use communities, with objectives to improve multiple aspects of sustainability and quality of the built environments.

The studied site is based in Mt. Roskill, Auckland City, an industrial/commercial zone surrounded by low-medium density suburban detached housing. Existing industrial warehouses backed onto the new State Highway 20 motorway, with future plans to run a new Rapid Transit rail route along it, opens up opportunities to formulate designs which can cater for new public space while it is desirable, at the same time, to retain building structure which are still functional, as demolition is regarded as wasteful in terms of materials and labour.

The research explores future possibilities for intensified re-development of the site, and its implications of how it can improve the quality of residential and business activities on a wider urban scale. Compatibility of typologies is investigated, and the study aims to create architectural solutions for mixed use, high density development along urban transport corridors. The design project proposed, in this context, a medium rise mixed development that rationalizes vehicular access and parking, introduces a coherent linear arrangement of public space, re-introduces elements of natural landscape, and suggests that good quality environments are possible in a typical example of these suburban higher industrial neighbourhoods.

Contents

| | |
|--|-----------|
| 1. Introduction..... | 6 |
| 1.1 Existing Problems | 7 |
| 1.2 Architectural Questions | 8 |
| 1.3 Research & Design Objectives | 9 |
| 1.4 Outline of Project | 10 |
| 2. Review Current State of knowledge..... | 11 |
| 2.1 Intensification and Urban Transport Corridors | 12 |
| 2.2 Planning strategy: The T.O.D urban neighborhood | 13 |
| 2.3 Urban Regeneration and sustainability | 15 |
| 2.4 Sustainability and High Density mixed use communities..... | 16 |
| 2.4.1 Environmental Sustainability and mixed use communities | 16 |
| 2.4.2 Economic Sustainability and mixed use communities | 16 |
| 2.4.3 Social Sustainability and mixed use communities | 17 |
| 2.4.3.1 Security by Design Principles | 18 |
| 3. Methodological Approach..... | 19 |
| 3.1 Auckland Regional Growth Strategy & policies | 20 |
| 3.2 Urban analysis | 21 |
| 3.3 Case studies: Investigative method | 22 |
| 4. Project Context..... | 24 |
| 4.1 The site | 25 |
| 5. Project Development..... | 28 |
| 5.1 Design strategy | 29 |
| 5.1.1 Technical & functional design | 29 |
| 5.2 Design developments | 30 |
| 5.2.1 Urban masterplanning | 30 |
| 5.2.2 Business activity design | 32 |
| 5.2.2.1 Retail and markets area | 32 |
| 5.2.2.2 Light manufacturing and studios | 34 |
| 5.2.2.3 Urban farm: Roof harvesting | 36 |
| 5.2.2.4 Offices & clinics | 38 |
| 5.2.3 Residential area design | 39 |
| 5.2.3.1 Typical apartment design: Level 1 | 40 |

| | |
|---|-----------|
| 5.2.3.2 Typical apartment design: Level 2 | 41 |
| 5.2.3.3 Typical apartment design: Level 3 | 42 |
| 5.3 Concept in theory: Parasitic Architecture | 44 |
| 5.3.1 Application to existing structures | 44 |
| 5.3.2 Application to aesthetics | 45 |
| 6. Conclusions | 47 |
| 6.1 Investigative analysis of final design | 48 |
| 6.2 Critical analysis: Limitations & further developments | 50 |
| 7. Appendix | 51 |
| 7.1 Auckland's growth strategy & policies | 52 |
| 7.2 Selected urban analysis | 54 |
| 7.3 Selected case studies: High density developments | 56 |
| 8. Bibliography | 60 |

1. Introduction

1.1 The Existing Problems

Auckland has experienced rapid growth in population over the last 10 years. Projections show that by 2036 the population would have reached up to 2 million.¹ Growth of New Zealand cities have developed through the “green fields” approach, where new open rural land would be re zoned and developed to fulfil needs. This resulted in the horizontal sprawl formation, which is an unsustainable development pattern.

Motorways are built to make commuting from suburbs to economic centres more convenient, however this created other problems. Established low density zones experience the adverse effects of being close to main transport corridors: excessive traffic congestion; dangerous environment for cyclists, pedestrians and children; deserted corners and dead ends beside motorways and railways, potentially brews crime etc. Public passenger bus network also becomes inefficient due to excessive private passenger vehicles on the road.

Passenger Rapid Transit (Railway) routes are established to improve public transport, but to be efficient, higher densities must be achieved around the stations. Intensification is the ideal way to support public transportation, but a balance between business and residential activities around the transport nodes, and functionality of layout is mandatory to ensure positive outcomes.

Vehicular oriented planning of low density urban growth leads to sprawl, which in multiple aspects, is an unsustainable development pattern. Some issues are relieved by upgrading public transport and infrastructure networks. However, the current low density configuration of suburban Auckland, fail to maximize efficiency of buses and trains and is unable to function at full capacity. Many residential suburbs are also faced with unsafe environments for pedestrians, cyclists and children due to increased traffic volume.



Figure: 10 Highways Interchange. Houston, Texas.
Source: Google

¹ “Population projections” <http://monitorauckland.arc.govt.nz/our-community/population/population-projections.cfm>
(Accessed March 2012)

1.2 The Architectural Questions

In observation of established international cities, it was seen that they underwent similar problems of growth and sprawl at some stage in its history. Patterns start to emerge where there are numerous similarities in the way growth and intensification has been implemented. Breaking down the functionality; efficiency; and sustainability to its roots in an architectural perspective, the design problem is recognised as requiring an approach, through planning, that is appropriate in areas with compatible mixed use typologies.

Mixed use buildings and developments are a specific niche in the New Zealand building industry. Learning from successful international examples where more than one usage in buildings is common, mixed use communities with higher densities may be a good strategy to relieve many issues of unplanned growth, and to help the regeneration of underused low density areas within the Metropolitan Urban Limits (MUL).

The questions are formulated in response to many of Auckland's problems with urban growth and sprawl:

- Is medium-high density mixed use typologies appropriate for intensification development along Auckland urban corridors and transport nodes?
- What densities are appropriate for Auckland situations?
- What types of uses are compatible?
- How to promote public transport, walking and cycling, with the reduction of frequent private passenger vehicle use, through mixed use, macro and micro planning?
- How to implement functional and high quality architectural design to achieve various aspects of sustainability and improve standard of living/working to problematic suburban and commercial areas near urban transport corridors?

1.3 Research and Design Objectives

The objective of this research is to find solutions for intensification and regeneration of existing low density suburbs, supporting linear development along urban transport corridors and transit nodes. The research aims to formulate design outcomes which focus on sustainable and efficient operation of the built environment with the following aspects:

- Environmental Sustainability
- Economic sustainability
- Social sustainability

The architectural design objective of the built environment:

- *A specific building programme*: mixed use typologies incorporating higher density residential space. Other uses may depend on those existing or may be established due to the needs of the area.
- *Planning requirements*: proximity and ease of travel to work and transport nodes, which are reflected in the planning which may include the wider area outside of the specific site. Public and private realm must be recognized as it can greatly affect the design outcomes of mixed use buildings.
- *Building methods and technology*: the final result must address the issues of acoustic performance (especially near motorways and railways), energy and resource efficiency in everyday activities (water use, power use, renewable energy etc.).
- *Natural environment*: emulate suburban green environment in an urban setting, focusing on high density residential areas. Greenery and planting are advantageous in many ways and contribute greatly in creating high quality living environments. Apart from positive psychological effect it can have, it also has practical applications of acoustic buffers, privacy barriers, and possible crop harvesting opportunities etc.
- *Building style and identity*: to establish a design aesthetic appropriate to its setting. However, it is crucial that design is attractive and appealing as a result especially for high density residential areas, which have not been popular in Auckland. High quality architectural design can address this problem. There is often a danger of developer driven, very plain and badly designed apartments/townhouses which deteriorate into slums because they have no character or individuality, resulting in high vacancies.

1.4 Outline of Project

The research & design project investigates linear intensification along transport corridors. An urban regeneration and Transport Oriented Development (TOD) scheme will be implemented on a site in Mt. Roskill, a light industrial and business zone surrounded by low-medium density detached housing (15-20 DPH). The site is located adjacent to the new State Highway 20 motorway extension from the motorway, where vehicle on-off ramps are in close proximity, at the end of the urban block. A new Rapid Transit Route is also proposed to be built alongside parallel to the motorway, connecting the Southern and Western passenger rail routes.

A large existing warehouse on the site backs onto the motorway at the southern end, and most of the structure will be retained and adapted for the new development. The northern façade will be utilized for re development of a new urban space, with other building structures, which has direct contact with the main road. The design outcome will be a high density T.O.D urban community, where living and working can functionally exist together through good architectural layout and planning.

Different compatible mixed use typologies and requirements will be investigated to ensure a high quality living environment is provided. A target of high density living at 80DPH will be tested, and must cater for various types of occupants and their different needs. A range of affordability in the types of living units is important to bring a balance to the economic status of the area. The scheme as a whole, should not only be economically self sustaining within its own members of the community, but will also bring in business from a wider urban area.

2. Review Current State of knowledge

2.1 Intensification and Urban Transport Corridors



Figure: High density urban transport corridor. Chicago, U.S.A.
Source: Google

An urban transport corridor refers to any main transportation route within the metropolitan area of a city, which connects main economic centres. Urban transport corridors can be motorways, railways, main arterial roads, canals etc. and has significant implications on the economic livelihood of a city. They often connect shipping routes from ports (airports, harbours) to main economic centres. It is common for different types of transportation lines to be built alongside each other, to minimize the area environmental impacts like air pollution and noise. Establishing a good public transportation network with the transport corridors is essential to the efficiency of commuting around the city.

Distributed along the urban transport corridors are the nodes, which are points of entry into the corridors. These can include bus transit terminals, train stations and motorway access ramps etc. Often, these are built within the same vicinity, also to reduce spread of negative environmental impacts. For many new nodes being established in the suburbs due to public transportation and infrastructure upgrades, the way to increase its efficiency and productivity is the intensification of density. Urban Intensification occurs in various formations, depending on demographics and its intended functions. Some include radial intensification (surrounding nodes), linear intensification (between nodes and along corridors), Vertical intensification (increase density of a site by building up).

Intensification can have certain negative impacts within established low density suburbs. Not only does it affect the physical activities but also psychological impacts of residents and occupiers. Low privacy and insufficient living space causes stress and reduces quality of living², such as overcrowded compact housing environments experience frequent noise disturbance etc. Established low density residential and industrial suburbs experience the adverse effects of being close to main transport corridors and nodes: excessive traffic congestion; dangerous environment for cyclists, pedestrians and children; deserted and under-used corners and dead ends near motorways and railways potentially brew crime etc. Public bus network also becomes inefficient due to excessive vehicles on the road.

For intensification to achieve positive results, correct strategies and methods should be assessed and implemented to sites which are suitable. Intensification around transport nodes requires a balance of mixed uses, ideally creating a symbiotic relationship between different uses, which can thrive and sustain each others' existence.

²Witten, Karen et al. Growth Misconduct: Avoiding sprawl and improving urban intensification in New Zealand. Wellington: Steele Roberts Aotearoa, 2011. (p. 16-17)

2.2 Intensification strategy: The T.O.D Urban Neighbourhood

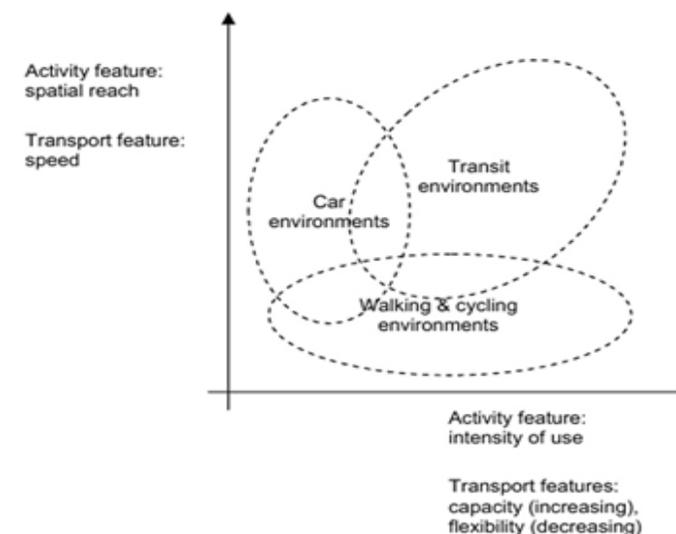
The “Three Magnets for the 21st Century”, defined by Ebenezer Howard, symbolizes modern city planning trends. Three different zones exist in the metropolitan area of established cities:³

Central Inner city: high density living allowing social and employment opportunities; accompanied by various other activities such as close proximity to commercial/retail and easy access to public transport. However high concentration of buildings and people can cause the possibility of poorly planned mass housing, which is followed by excess of noise and disturbance; pollution; further away from natural landscapes; higher crime rates and with also increase of rental cost.

Suburban living: Freedom of space and full individual privacy; freedom of cars; more natural environment; ownership of homes with good property value. However, sprawl on the outskirts of the city creates inconvenience of travel (poorer public transport networks); lack of community and neighbourhood support; less local jobs and possibility of isolation.

The Urban Neighbourhood: Communities that can be a mixture of medium to high density dwelling, and commercial, often located on the perimeters of the city central districts. Many social and economic advantages are associated with the urban neighbourhood. It provides sufficient privacy and security without isolating, incorporating into a sense of community; mixture of classes creating diversity; more local services in close proximity compared to suburban areas; more environmental awareness as a closer community; and more possibilities of mixed use buildings creating more economic opportunities. However, planning and layout of different uses and densities must be organized correctly to achieve maximum efficiency of activities.

The Urban neighborhood functionally, explores balance between extremes of central city and suburban development. However, as densities increase, transportation and land use becomes competitive. TOD strategies are effective for higher density urban environments, and are increasingly becoming popular in city planning trends in many established cities worldwide. There are two main relationships in the planning design of TODs: the speed of transportation and the scale of which an urban system works, expressed in terms of distances between residence and workplace. Secondly, the correlation between the capacity and flexibility of transportation system; and the level of spatial concentration of activities, mainly identified by residential and employment densities.



The figure outlines the different modes of transportation with respect to its urban environment:⁴

The car: low capacity high flexibility and high speed, best suited for long distance, and low density urban environments.

Public transit: matches speed of car, higher capacity but lower flexibility.

Non motorized: high capacity and flexibility but lack speed and ability for longer distances.

³ Rudlin, David, and Nicholas Falk. Building the 21st Century Home – The Sustainable Neighborhood. Oxford: Architectural Press, 1999. (p.11)

⁴ Curtis, Carey Renne, and Bertolini, Luca. Transport Oriented Development. Abingdon: Ashgate Publishing Group, 2009. (p.5)

The main challenge of TODs is provide a competitive alternative to the car (high flexibility) with a combination of public transit and non motorized modes of travel. This can be successful in the form of short distances and higher density spatial layout of the built environment. However, cars still have its benefits in certain aspects of urban developments. They should not be totally excluded from TOD communities, rather, they need be tamed and integrated into a pedestrian friendly environment. Slow speed light traffic and parking sharing paths with pedestrians, creates activity and prevents areas becoming deserted, hence more attractive to pedestrians.⁵

Fundamental principles of TODs:

- Mixed-use residential and commercial functions at higher densities.
- A centre with a public transport network: train station, metro station, tram stops, or bus stops etc. surrounded by relatively high density development progressively becoming lower, spreading outwards.
- Generally are located within a radius of 400 to 800m from a transit stop, which is considered to be an appropriate scale for pedestrians.
- Excellent pedestrian facilities such as high quality crossings, narrow streets etc.
- Daily commodities in close vicinity so that it can be accessed by walking or cycling.
- Organisation of streets and parking to minimize the use of the private car for short trips, where it is more convenient to use alternative non-motorized mode of transport.

2.3 Urban Regeneration and sustainability

Urban regeneration is often referred to as land redevelopment and intensification of medium to high density in urban land use, and re organization of the environment especially for pedestrians and strategic placement of urban greenery.⁶

Urban regeneration has many implications to the sustainable factors of growth. Sustainability of redevelopments and the built environment refers to variable factors of human activities of a site and its impact to the natural environment, which is quantifiable by the means of air quality; water use, land use, energy use, and ecology. Sustainable urban regeneration aims to achieve revitalization of existing communities, enhancing its human, economic, social and environmental qualities.

The sustainable urban regenerative process involves several aspects, which can be categorized by its size and relative to the site of development:⁷

- Regional scale strategies of establishing urban green belts and greenways, moderating climates and increase recreational opportunities and bio-diversity.
- City scale strategies involves providing a hierarchy of distinguished areas like central city, business districts and neighborhoods, supported by an effective infrastructure, with an emphasis of pedestrian accessibility and public transit. Clustering of activities and provisions of community greenways increases pedestrian enjoyment and expresses efficiency in activities.
- District and neighborhood strategies which encourage pedestrian and cycling, connecting activity centres, schools, parks etc. creating effective neighborhood definition and establishing important nodes in the wider cityscape. These nodes should also combine public transit linking to other significant neighborhoods.
- Clustering and densification strategies of residential developments can achieve increased opportunities for positive community interaction. Through effective densification nearby to community amenities and greenways allows sufficient utilization of urban resources and services. The more people that share community facilities the more amenities and services can be provided efficiently and economically. Residential densities at a minimum of approx 40 DPH creates pedestrianisation and public transportation more viable.
- Dwelling unit strategies to reach a high level of land and energy conservation includes correct passive solar planning layout and environmental psystems to optimize the re-use/recycling of renewable resources like sun, wind, water land etc. Idealistically, possibilities of future expansion of housing due to needs of families over time to be allowed for.

⁶ Marchettini, N, et al. Urban Regeneration and Sustainability: Sustainable City III. Southampton: WIT Press, 2004. (pp.360-365)

⁷ ibid.

2.4 Sustainability and High Density mixed use communities

2.4.1 Environmental Sustainability and mixed use communities

A sustainable community refers to the ability of the neighbourhood and wider urban system to remain for years to come and with minimal environmental impacts in everyday activities. The typology of the buildings are an important factor when weighing the pros and cons in regards to the environment i.e. high density autonomous housing vs. single detached buildings.

Autonomous urban building types are potentially more energy efficient when in operation than detached/semi-detached forms. Since a row of flats or shops have less exposed wall and roof/floor area, heat loss transfer would be lower. This also applies vertically in mixed use buildings where work space and shops below housing will lose less heat than single storey structures. Higher density use of a site is also regarded as sustainable use of land.

The dense, walkable urban layout is most efficient form of settlement, as opposed to a dispersed settlement. Compact urban communities are able to support a good public transport system and have the density of demand to make services such as kerbside recycling viable. Sustainable mixed use communities must be designed as such that encourages walking and less need of a private motor vehicle, reducing environmental impacts without the use of fossil fuels for everyday travel.

A publication for the “Department for Communities and Local Government” in the U.K. has carried out case studies of 12 different successful mixed use developments. They found that an average of 38% of households did not own cars mainly due to the fact that it was not needed as shopping, work and leisure was of walking distance. They also found that for the households that did own cars, it was less frequently used after moving into the mixed use developments, and were mainly used for occasional long distance trips to visit friends etc.⁸

2.4.2 Economic Sustainability and mixed use communities.

Mixed use development traditionally were the “corner shop” where small retail store owners lived above their shops for economic and convenience reasons. Also the New York Lofts where people, often artists both lived and worked, as it allowed them to work irregular hours and was the most cheapest way.⁹

⁸ Department for Communities and Local Government (U.K.), “Mixed Use Development – Practice and Potential”, online publication (2001), (pp. 40-42), www.communities.gov.uk.

⁹ Rudlin, David, and Nicholas Falk. *Building the 21st Century Home – The Sustainable Neighborhood*. Oxford: Architectural Press, 1999. (p.111)

As of the modern age today, live/work units were seen to be both profitable for developers and has kept local authorities happy as it attracts employment to areas. Most importantly, mixed use developments aims to combine housing with economic regeneration of an area. There must be a balance of both vertical and horizontal mixed use within the area such as retail, offices, temporary accommodation, residential accommodation and public facilities. This way, it creates activity throughout the day and having them in close proximity promotes walking rather than car use, which also enhances the social aspect of a community. Residents can also live walking/cycling distances to their workplace, which is efficient cost and time wise.

Having both retail/commercial and residential in the same vicinity can boost business as it will be a convenience for residents to purchase goods at a more frequent rate (i.e. Grocery store 2 minutes walking distance means local residents can buy goods when they need it and as often as they need without the hassle of transportation to remote areas). As a community, this will create a good flow in economic supply and return, as retail in mixed use areas can be sustained by regular income. Offices in the area can also contribute to sustaining the economy of a community, as workers will also use local retail facilities. Rental income of offices/shops can also be made which can contribute to the upkeep of the area. Offices in the area can also contribute to sustaining the economy of a community, as workers will also use local retail facilities.

2.4.3 Social Sustainability and mixed use community

Many households living together may be considered a “community”. It presents the idea of belonging, a common bond or a shared identity. Aspects of a good community is the willingness to help and support neighbors in times of need, and to some extent the suspicion of outsiders. However, urban trends in the last hundred or so years have been driven by the desire to live in separation, with society looking inward to the family and less reliant on the community.

Future developments of the cityscape sees dwelling of families much less in an urban context, as family members go out in search of employment, education or a partner, they may find more need for a community as a cure for loneliness. The self employed home worker, retired, or single individuals, may look to their home environment for support and social contact.¹⁰

¹⁰Rudlin, David, and Nicholas Falk. Building the 21st Century Home – The Sustainable Neighborhood. Oxford: Architectural Press, 1999. (p.115)

2.4.3.1 Security by design concepts within mixed use communities

Mixed use developments aim to find a balance between the two extremes of concentrated residential areas and mass commercial/business zones through applying security by design concepts. Retail activity and operation of businesses occupy the development in the daytime, while at night, residential activity may contribute in deterring crime being committed in the empty offices and retail stores. The co-operative structure of the tenants is a large factor for “passive security” principles. A design layout which can help promote good relationships between residents and store owners should be the initial approach. Some general security by design concepts below suggests layout and elements that should be considered in mixed use communities with medium-high density residential:¹¹

- Residential housing should be clustered into small groups and have defined private and public boundaries.
- A “perimeter block” housing layout has clear distinctions of the public and private realms, with these interconnected by networking of streets to create more sense of community between clusters of housing to prevent isolation.
- Rumble strips, or changes in road texture should be used at entrances to areas to give impressions of private property.
- Public access should be restricted to as few routes as possible to avoid unnecessary public entry.
- Communal areas such as playgrounds should be open and supervised by surrounding houses.
- Good lighting covering all parts will deter intruders and reduce fear of crime.
- House frontages should be open so that views are not obstructed by planting and high walls or fences.
- Garages for parking is preferred but if communal parking is required, it should be in small groups and open to view and well lit.
- Commercial developments should create a defined perimeter and also be integrated with housing in mixed use situations to increase “natural surveillance”.

¹¹ Association of Chief Police Officers (U.K.), “Secured by Design principles”, online publication (2004), (pp. 4-11), <http://www.securedbydesign.com/professionals/guides.aspx>

3. Methodological Approach



3.1 Auckland Regional Growth Strategy

Projections show up to the year 2031, there will be potentially 1.93 million people in the Auckland Region, an increase of about 450,000 people since 2011 and a further forecast of possibly 2.3 million by 2051.¹²

Various growth trends of Auckland region and future demands were identified and studied. A range of issues have been addressed and are outlined in various publications and policies. These were assessed and accounted for in the final design outcome, and assisted in the selection of the site.

Transport Network Development

The dashed red lines is the proposed main transport corridor networks, mainly motorways, and possible incorporation of railway systems. New rail lines have been proposed to be established alongside state highway 20 to Auckland Airport, with interchange stations at Onehunga, which may be completed by 2030. The green line represents major bus routes, with bus lanes to improve speed of commuting during peak traffic hours. An expected result from the implementation of the Auckland Regional Land Transport Strategy (RLTS) is 37,000 more households will be within 30 minutes travel to work by passenger transport in 2016.¹³

Intensification

It was found that many planned intensification areas fall on major transport routes, both on currently existing and future proposed areas. These are identified by the Authorities as “main economic corridors of Auckland”. Mixed used typologies are encouraged in existing town centres, and also along transport and economic corridors. Existing business zoned lands within the MUL was to be retained and intensification and retrofitting brownfield sites are possible options. Areas of intensification are subject to availability of public transport provisions and also access to motorways.

The type of housing with most demand increase by 2051, is low rise apartments (up to 3-4 storeys), which will account for 21-23% of all housing types in Auckland. This is an increase from 9% proportion of all housing types in 2006.¹⁵ The current Auckland MUL (metropolitan urban limits) means a limited availability of greenfields can be developed for additional housing. This sees intensification within existing residential areas a viable and most efficient option. This is evident in the increased proportion of future multi unit dwellings, and the reduction of detached and single storey low density housing developments.

Please see appendix for selected relevant regional policies and objectives.



¹⁴ <http://www.aucklandcouncil.govt.nz/SiteCollectionDocuments/aboutcouncil/planspoliciespublications/theaucklandplan/aptd-businesslandandemployment.pdf>

3.2 Urban Analysis

Selected nodes with train stations from Australia, U.S.A and Canada, was studied to understand the urban layout and its likely process of past and future development. Compared to old European cities which had organically formed over centuries, more younger countries like Australia, have more relevance to New Zealand cities, in the way that growth had developed. An example would be cities like Los Angeles or Melbourne, have grown largely on the result of the motor vehicle and post industrialisation age zoning policies. Whereas areas of central London with history dating back over 1000 years ago, may have dense urban mixed-use neighbourhoods with small streets and alleys at appropriate scale for horse carts and pedestrians.

The objective was to find patterns in which different stations and corridors have been developed. The road network was also investigated, focusing on hierarchies and how they are arranged, in respect to its built environment. Two types of demographically different areas was distinguished in the study: Railway stations which were in central business districts and smaller economic areas in more suburban environments. These had slightly different configurations, but still shared similarities.

An investigative comparison was carried out between consistent aspects observed on all the locations sampled:

Road Layout and access

Road grid layout was found most ideally to be planned regularly in respect to the main arterial roads if topographical conditions allow. Roads in business zones are almost always arranged as regular as possible. Intensification which occurred on arterial roads made it difficult for pedestrians and cyclists as they consist up to 8 lanes wide, hence, they commonly have alternative access and car parks at rear of the site via local and service roads.

Railway lines ideally follow main arterials and highways, however in some cases they can cut through regular grid roads in the general direction towards the central district, independent of any road grid configuration.

800m radius of railway station

It was found that around the direct vicinity of train stations, both central districts and suburban areas had mixed typologies, but not necessarily occurring in the same building. Common typologies found nearby stations in more suburban areas were retail and hospitality businesses, community facilities, public open green space, and schools. For central districts, commercial buildings were the dominant, and liv-

¹² "Population projections" <http://monitorauckland.arc.govt.nz/our-community/population/population-projections.cfm>

¹³ "Passenger Transport Network Plan" <http://www.aucklandtransport.govt.nz/improving-transport/plans-proposals/IntegratedTravel/Pages/PassengerTransportNetworkPlan.aspx>

¹⁵ "Future housing demand study 2010" <http://www.arc.govt.nz/auckland/aucklands-growth/publications.cfm>

ing was usually in the form of temporary accommodation like hotels. Nodes could be distinguished either as business or residential dominant developments.

Density

It was found that commonly occurring in suburban centres, that linear intensification with higher density commercial activity occurs along the main arterial roads, i.e. continuous shop front retail, and progressively becoming less as it spreads towards housing. If two main transport corridors exist parallel i.e. railway and motorway, it will most certain become a main economic corridor, with intensified medium to higher density activity with various mixed typologies ranging from industrial to higher density residential. Distributed along the corridor would be supported by nodes e.g. motorway entry points and railway stations, where intensification will take a radial formation around them. In central areas, high density activity is more evenly distributed across the district, and becoming less as it spread towards suburbia.

See appendix for selected studies.

3.3 Case study: Investigation method¹⁶

Selected high density mixed use developments internationally and locally in Auckland were studied. Various functional aspects were compared with the objective to investigate what types of qualities make a successful design. The successful developments are defined by the ability to maintain long term tenants and contributing to improving value to its immediate urban context.

A summary of the main aspects investigated:

Typologies

Developments which were sampled are mostly higher density residential dominant, with some business activities. It has been found that only limited types of commercial are suitable near residential i.e. smaller business with quiet activities and regular operating times. The proportion of other typologies against residential, is important for the measure of the quality of the living environment and the likelihood of long term tenants occupying the nearby shops.

Residential and commercial density

It was found that higher concentrations of business activity areas are less desirable for dense residential, as living quality can be severely compromised. In the contrary, high density residential areas

¹⁶ David Turner, John Hewitt, Cesar Wagner, Bin Su, Kathryn Davies. Best practice in medium density housing. Report for Housing New Zealand Corp. (2004) pp. 23-35, p.67.

thrive on certain types of commercial activity within close proximity, especially of walking and cycling distances. Having appropriate businesses in close proximity to residential enables smaller pedestrian streets and easier for pedestrian access.

Open space (public and private)

High quality successful residential developments have provided some form of outdoor private space for all units, but in various sizes to create more variety. Built in planting facilities for private harvesting opportunities is also common, many which have been used for crop harvesting or dense natural environment which improves aesthetics and provides shading and privacy. Residents shared facilities are common. For developments which have larger sites, private outdoor facilities for residents are provided i.e. tennis courts.

Residential privacy

It was found that Interior living space for residents are arranged that there are minimal overlooking between units if possible. In the more successful developments, private outdoor areas avoided being directly in plain view between units. If this is unavoidable, the further apart the better.

Entries to units are not directly visible to the general public, without barricading, which is often achieved by raising heights of residential living space from the street level, and recesses from main pedestrian areas if on the ground level. Often, architectural screening devices will be deployed, integrated with natural planting.

Identity

A common trait that successful high density developments share is having a unique physical aesthetic and a good balance of natural planting in both private residential apartments and public areas. The more unpopular developments often had an exterior which looked too commercial.

Security

Dense residential areas are created to have a smaller, more inward interaction. In multi level developments, they often overlook commercial areas. Residential only entry points have been placed away from plain public view where possible. For many contemporary high density developments are often equipped with a security guard office, or electronic swipe card entry gates.

Service and refuse collection

The higher quality developments commonly have its own private service lane for refuse trucks, avoiding the refusing truck having to manoeuvre on the main street.

Carparks

Carparks are always allowed for in the design of high density living, mostly underground in multi level buildings. For some which are located in strategic areas close to good public transport and facilities may require less parking to residential unit ratio. However, public carparks are always present for especially where commercial activities occur. High residential areas may also provide limited guest carparks.

Access to public Transport

Successful high density developments were commonly within walking distance of public transport nodes e.g. metro or railway stations. This also had numerous positive implications on the design of the development i.e. allows lower demands of residents and retail carparks.

4. Project Context

4.1 The Site

Location

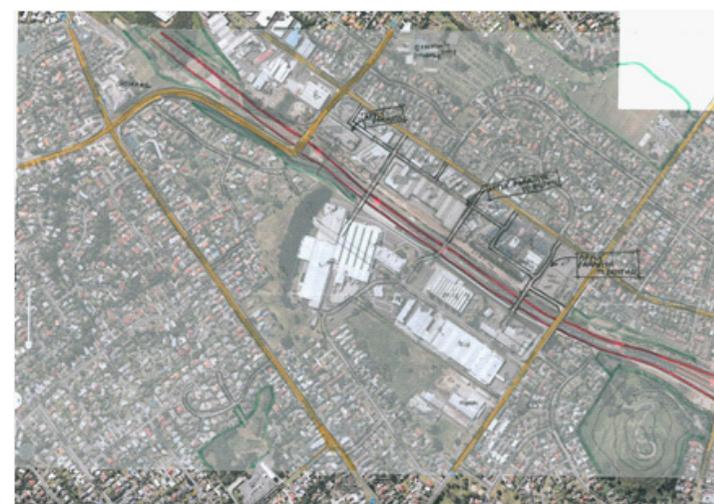
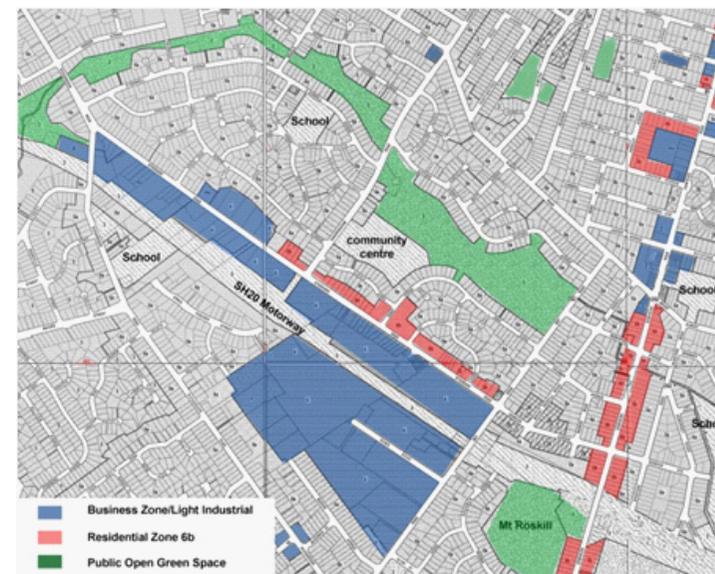
The site is situated between Mays Roads and Sandringham Road, on the strip of land between in between SH20 and Stoddard Road, Mt Roskill, Auckland. It is geographically centred between the Onehunga and Waterview state highway interchange nodes, which has potential becoming a strategic location for the southwest corridor.

Typologies

The motorway cuts through a strip of light industrial factories and warehouses on both sides, followed by a row of retail and services in loose formation, detached buildings. In the wider urban neighbourhood near the selected site are a variety of typologies including schools and community facilities etc. In a largely suburban low density residential area with density of about 15-25DPH, mostly Residential 5a, 6a and some 6b (red) zones along main arterial roads. Reserved open green space surrounds the outer perimeters of the suburb, shared with adjacent neighbourhoods. A variety of different zones are distributed around this area, which makes a strategic area for intensification.

Corridor description

The transport corridor identified in this site is the SH20. Plans of developing the passenger railway network parallel with the motorway will be implemented in the near future. The site is located on the final strip of the new State Highway 20 where it currently terminates at Maioro Road off ramp. Motorway entry points often mean a likely establishment of a higher density intensified node, which could also be a suitable location for a train station





(Left) Stoddard Road is seen here, currently in mostly low-medium density formation on both commercial and residential zones. Housing on the left hand side of Stoddard Road is currently zoned R6b, where it can potentially be built up to 10m high, 3 storey townhouses. However they have yet to be developed and remain as single storey flats or detached housing. Frequent bus service passes through Stoddard Road, with additional motor vehicles during peak hours due to motorway access located on Maioro Road.

(Below) New State Highway 20 extension under construction: view to southern end of existing warehouses on selected site to the left. Sufficient allowance of land between buildable site and motorway is reserved for proposed passenger transit railway.



Figure: Proposed SH20 and Southdown railway corridor
Source: "Auckland Transport Network Plan"



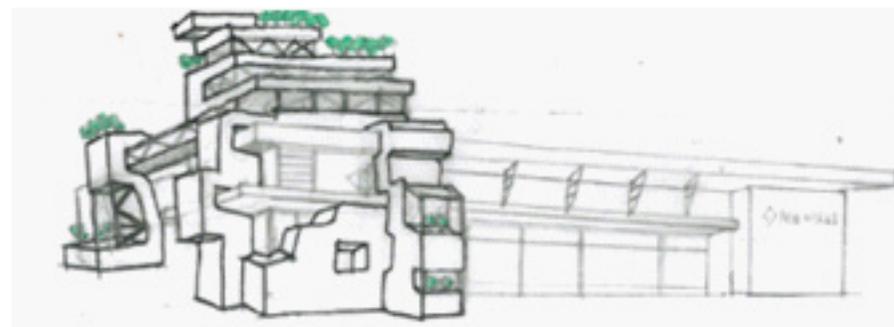
Large series of existing warehouse structures have been chosen to be retained. There are many similar scenarios in Auckland where potential strategic sites for development with large Industrial warehouses have a similar building to motorway formation. It was seen to be wasteful for total demolition of many large, still usable warehouse structures, as sustainability objectives is a goal to reach as part of the final outcome design.

(Below) The northern façade of the warehouses face directly onto smaller commercial sites, adjacent to Stoddard Road. This area, with multiple land ownerships, also makes it practical to become a space with more public activities, and a shared service lane.

(Below) Independent structure with larger tolerances between warehouse bays bears opportunity for rainwater catchment apparatus.



5. Project Developments



5.1 Design Strategy

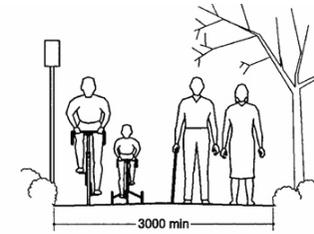
5.1.1 Technical & Functional Design (edit and add)

Structure: The structural layout was made as regular as possible, steel framing with an 8mx10m grid in most parts. Dimensions were largely influenced by factors of basement carpark dimensions,¹⁷ functional sizes of apartments and commercial, and structural products on the market at standard sizes¹⁸ e.g. spans on precast suspended flooring. Larger built in planter troughs were located near primary structure, for load bearing and drainage pipes.

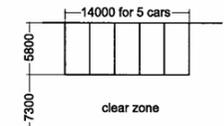
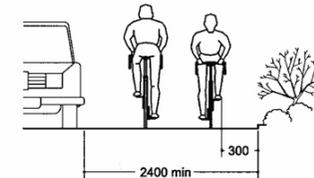
Environmental services: A site level drop of approx 3m from Stoddard Road to the existing warehouses saw opportunities to partially excavate for a basement carpark. Efficiency of building operation and maintenance was considered, which includes 1200mm minimum continuous openings for natural ventilation of underground basement carparks, where the mechanical ventilation installation requirements can be reduced and some cases not needed. This raised 1200mm vent opening also generated the design of terraced apartment units facing Stoddard Road with a raised front patio which has privacy advantages for the residents.

Every residential unit has a conservatory on the northern face, which has multiple environmental benefits for the apartment. It acts as a twin skin system, where naturally heated air inside can be circulated into the apartment in winter or expelled in the summer by low energy and natural means. Exposed hard surfaces like brick or concrete in this area improves thermal mass qualities, good for passive heating and cooling.

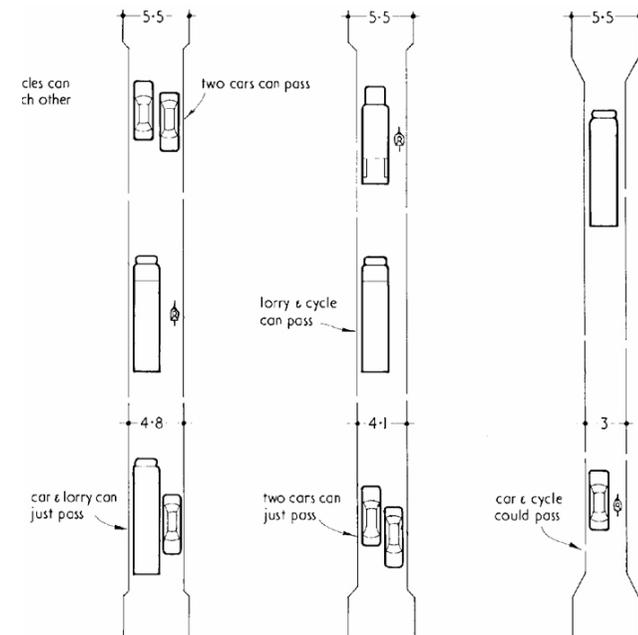
External dimensions: Functional sizes of elements requirements according to technical data determined sizes of road widths and service vehicle manoeuvring dimensions.¹⁹



4.22 Cycle path shared with pedestrians



e head-on parking, 26.5 m² per car



¹⁷ David Adler et al. *Metric Handbook Planning and Design Data*. Second Edition. Oxford: Architectural Press, 1999. (chapter 4 Design for the vehicle)

¹⁸ Stresscrete Precast Concrete Manual (p.41-44)

¹⁹ David Adler et al. *Metric Handbook Planning and Design Data*. Second Edition. Oxford: Architectural Press, 1999. (chapter 4 Design for the vehicle)

5.2 Design Developments

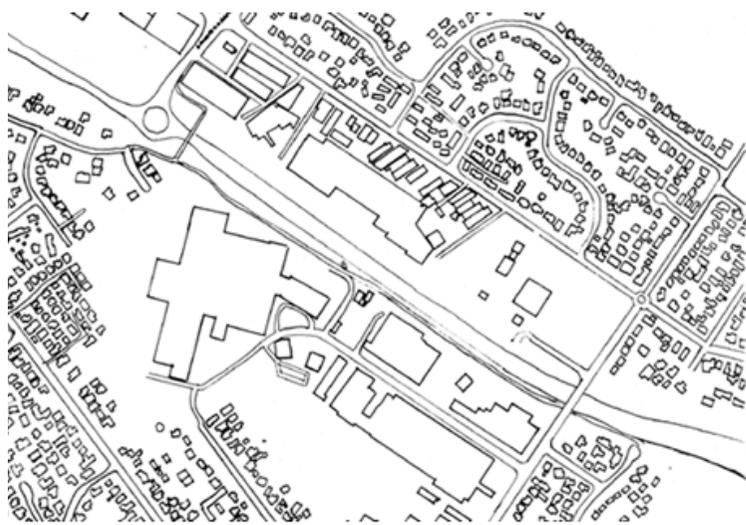
5.2.1 Urban Master planning

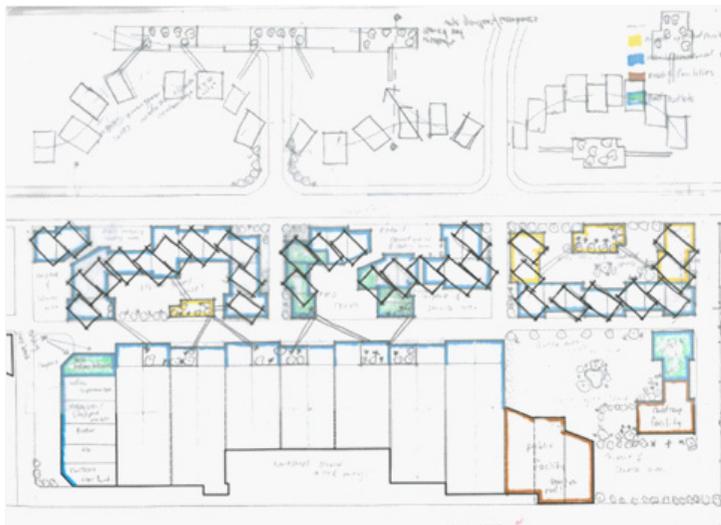
Relationships of the existing buildings on the site and its context were studied. The goal was to establish which typologies were suitable and possible intensification densities to implement. It was important to masterplan with the wider suburban community in view, as intensification can have a lot larger impacts on surrounding low density housing. The goal is to achieve a linear intensification growth pattern.

It was originally thought that intensification of business (blue) would occur where it currently is located, facing Stoddard Road. The reason was being on the main street receives higher exposure to public and convenient for access and car parking to the shops. Residential Intensification (Red) would be tucked away at the rear of the sites away from to the main road. The existing light manufacturing warehouse structure would be retained, with some resident shared space opened up.

This urban block is unique relative to the wider Auckland metropolitan, that it is located in the centre of the proposed “Southdown” railway line connection between Onehunga and Avondale station. As an area of future intensification of both business and residential activity, demographically it would be regarded as a suitable location for a train station. A vacant site currently used by Metrolink for bus parking and maintenance, could also be a suitable location for a bus transit terminal and bus workshop facilities. With these opportunities to establish a good public transit node, it is now deemed possible to create a Transport Orientated Development style of intensification.

Stoddard Road serves as a feeder road to the SH20 motorway, which means high levels of additional traffic especially during peak hours. Later developments of the masterplan, saw relocation of the most intensive business activities away from main road traffic. The aim was to create a more pedestrian friendly urban environment, and also acting as a buffer zone between preserved light manufacturing industrial areas (yellow). Sufficient open public space and community amenities are also to be considered and must be integrated with existing buildings, unlikely to be demolished because they will be beneficial to the new proposed area of development e.g. existing New World Supermarket. Retaining of certain larger industrial/commercial structures to achieve aims of sustainability through lower energy inputs and reusing of original structures to the redevelopment process.



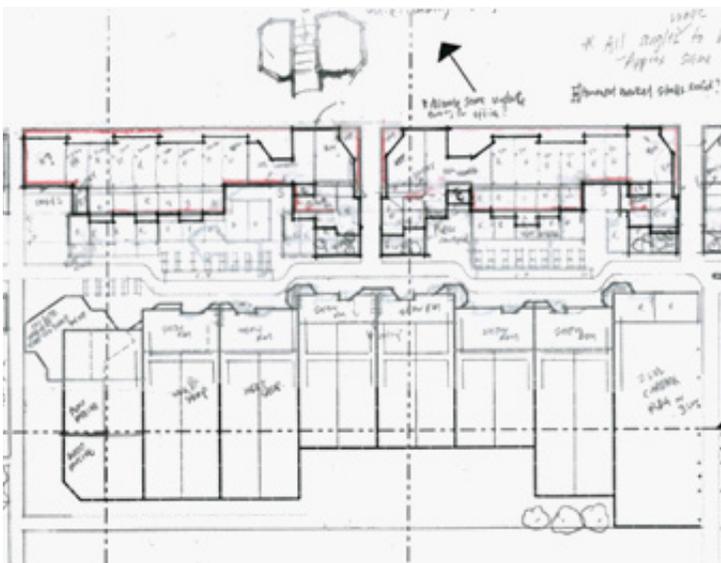


5.2.2 Business activity design

5.2.2.1 Retail and markets area

After establishing general typologies on the masterplan, the next step was to investigate which types of business were suitable for intensification. A more specific area from the larger urban block was selected to be studied closely, which by this stage community planning had become priority. A layout which functions well commercially; to have good retail exposure, bringing high economic returns while integrating with an intensive residential development was the objective.

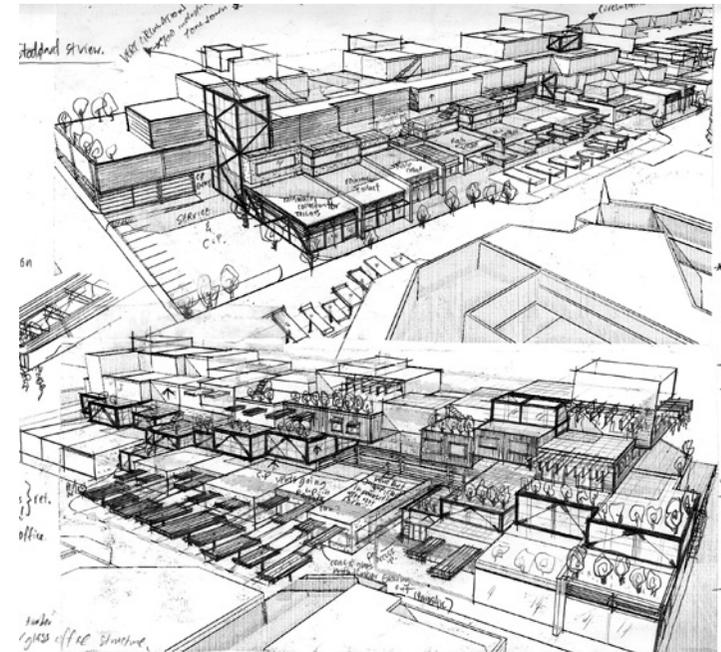
Existing light industrial warehouse structure was chosen to be retained and with the intention to be somehow reused. From the result of masterplanning, the site adjacent to the warehouse has been selected to become the location of the proposed train station with an open public station square for recreational and community facilities. This area will now be the heart of commercial activity for the proposed intensified community due to its proximity to public transit.



Decisions of which types of commercial units would be established was initially based on existing shops in the area, as they are mostly locally owned by members living in this particular neighbourhood. This part of Mount Roskill has a broad mixed ethnic community, many of which are Middle Eastern, Chinese and Indian families. There is also a significant elderly population, where there are currently retirement villages situated on Stoddard Road. The types of existing shops reflected many amenities which are used by the residents in this area, e.g. stores selling imported Middle Eastern and Indian spices and food. There are also other specialist stores in the area where people from outside of the immediate community would likely come to use i.e. bridal gown tailors, specialist sporting and exercise equipment distribution etc.

Final decisions of retail types required for a high density living and working community:

- Various sized retail stores. Allowances in floor area are made for staffrooms, office within shops. Larger units are likely for distribution stores especially ones with high storage demands. Some units have double heights, and could be used for different applications depending on the type of shop.
- Requirements of food outlets and allowances for its servicing like exhaust ducts and fumes to have minimal effects on residential areas i.e. outlets must higher than the topmost apartment.
- Provisions of permanent market stall space: this can create a mixture of different levels of retail throughout the community. Outside food outlets will be suitable for food type stalls where food preparation can be kept in one area for better management especially hygiene and cleanup.
- Some retail units to be visible and accessed on Stoddard road, to enable more exposure and have a connection for business activity at rear.

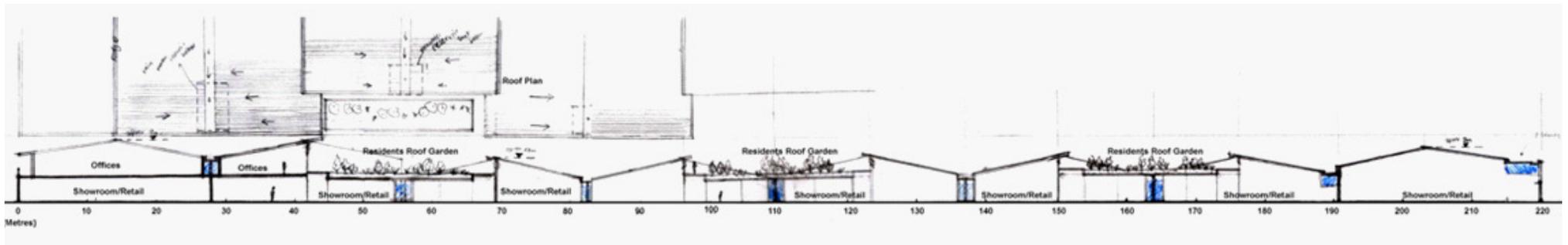
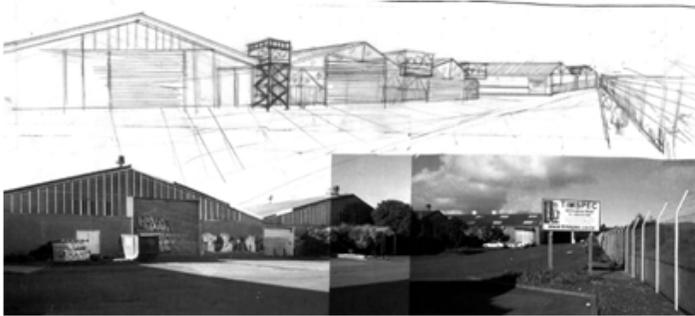
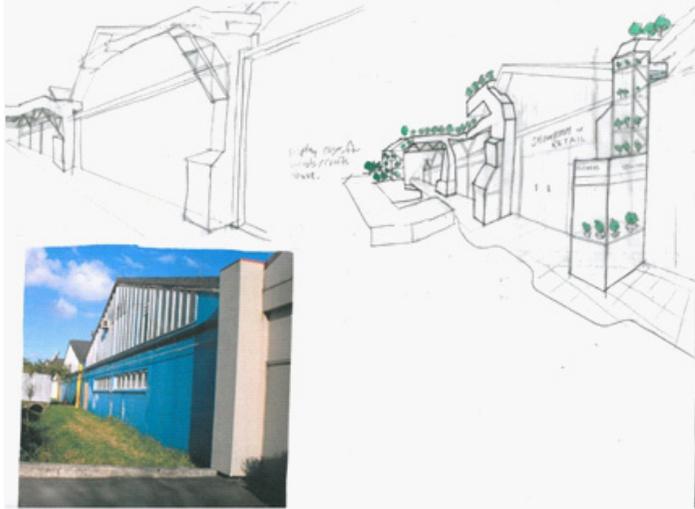


5.2.2.2 Light manufacturing workshops and studios

A series of existing warehouses stretches over 220m along parallel to the SH20 and is currently used for light manufacturing and storage. Retaining and refurbishment for additional uses can fulfil sustainability objectives and satisfies the regional policies. Total demolition had been considered, however, sustainability issues arise where recycling materials will still require large inputs of energy, which includes transportation to junkyards, labor etc. Weighing out the options, the final decision was to retain as much structure as possible. Energy input will still be required for refurbishment and structural strengthening etc. but this creates a good opportunity to explore options of interesting architectural solutions in dealing with existing warehouse structures, where similar situations such as this occur frequently throughout Auckland.

As with the original concept, a second storey will be added above the showrooms, with some lighter workshops, studios and offices. It is thought that these could be small craft/art workshops or larger design studio offices (i.e. Architect and landscaping studios etc.) which compliments well with various showrooms on the floors below, creating good exposure and relations between the similar industries. Large display cases surrounding the staircase to the upper studios gives them opportunities to directly showcase their works and products to the public at street view. This is beneficial both in terms of commercial exposure and improves visual interest and aesthetics to the community.

However as housing intensification design developed in the area, industrial activities were seen to have too much impact to residents, and the best option was to push it back toward the motorway and further from housing. At ground level of the northern warehouse façade saw the opportunity for more retail units, which was a typology more suited to mix with other retail and food outlets on the other side of the proposed lane.



Approximately 10m depth of the northern façade was rebuilt and transformed into large retail “showrooms” which connected to large workshops and storage which is the existing retained warehouses. These showrooms could be more specialized manufacturing and distribution stores e.g. kitchen and furniture showrooms, with connected workshops out the back large enough for assembly of units and storage etc. A large existing service area at the rear, against the motorway has remained untouched, which is suitable for truck access, deliveries etc. causing less disturbance to other commercial and residential activities.

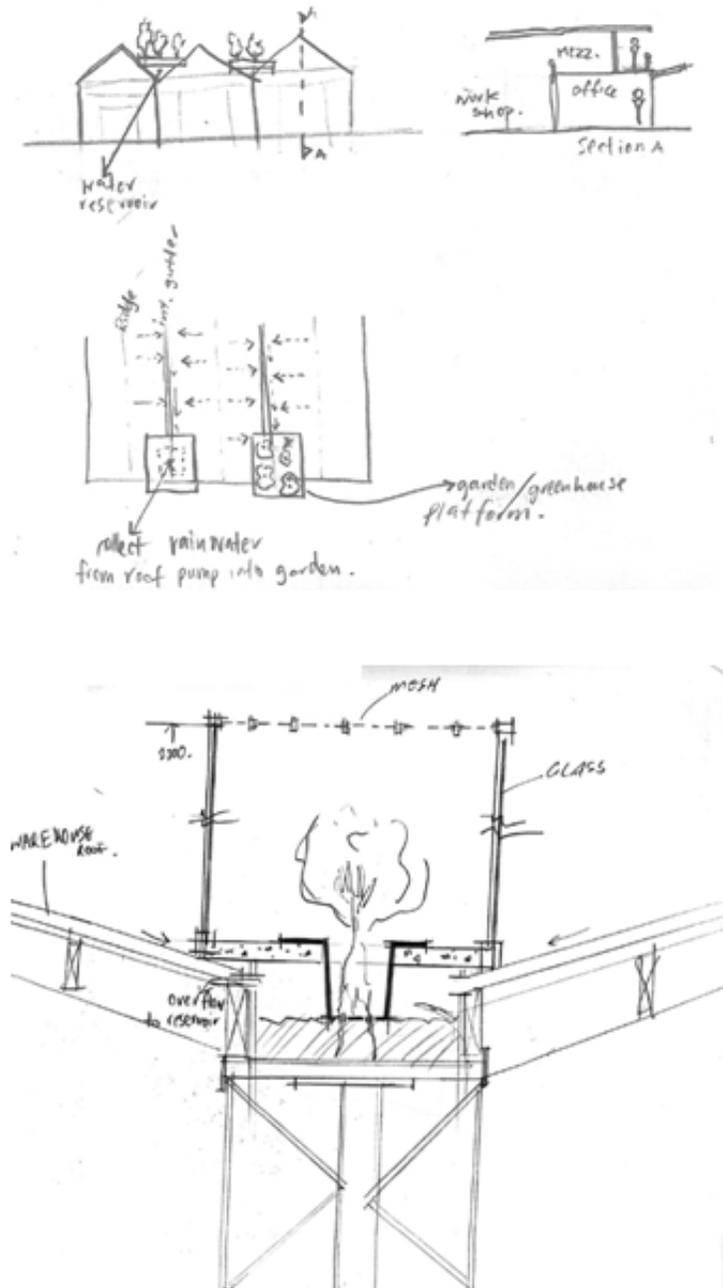
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5.2.2.3 Urban Farm: Roof harvesting

As part of the concept of a sustainable community, the idea of being able to grow crops locally and sell is beneficial in many aspects. Within the MUL there will be no vacant farming land left, as greenfields and farmlands near the metropolitan area gets pushed out further, where commuting and delivery of produce start to increase. Despite construction and maintenance being higher in cost, with the elimination of transportation and delivery, urbanized crop harvesting and selling on site could find a way to balance out. Urban farming also means growing produce and plants in a more controlled environment, eliminating inconsistencies of natural outdoor conditions, resulting in higher quality results.

Initially, it was thought that from a sustainable sense, capturing rainwater from the large roof surface area of the warehouse and reusing would be enough. However, as residential intensification design developed, especially after the higher stories were added, it seemed that residents overlooked vast areas of warehouse roofing and the motorway was unsightly. As previous research has stated, close contact of natural environment contributes to relieving stress especially in high density living and working areas, the ideals of generating as much urban green as possible became imminent. In spite of the advantages of urban greenery, the problems of maintenance especially costs, becomes problematic. Growing plants and fruit to generate revenue was inherently the best solution, and nurturing them with captured free rainwater is the bonus.



This idea of the urban farm generated the design of a full scale roof harvesting operation on the existing warehouses, where the roof area now have maximized function. In the design of the roof harvesting systems, having conservatories and semi outdoor growing environments, can create more variety of plants and produce, while pests such as birds can be kept out with glass barriers and mesh screens.

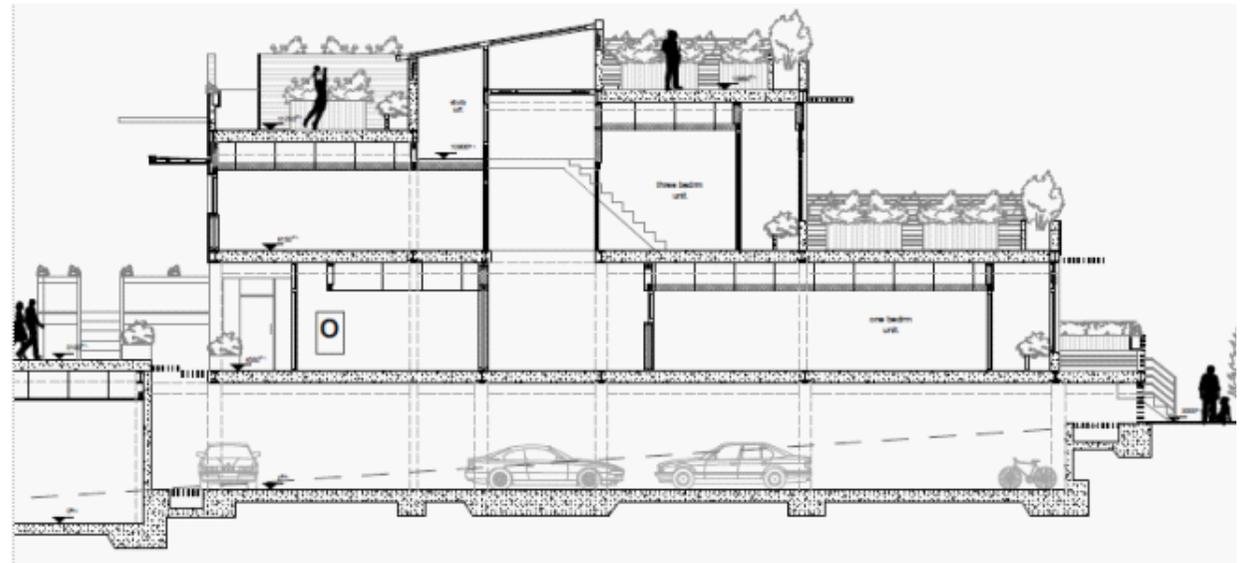
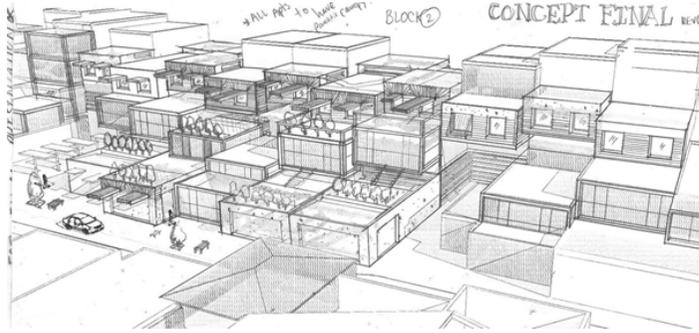
Slotting in between and separate units in the upper floor studios and workshops, are conservatories which potentially can have dense fruit trees. This adds some natural softness to the hard edged industrial areas. Additional structure would be required and integrated to the existing warehouses. Stretching across the valleys of the warehouse roofing are semi outdoor growing platforms, where independent structure will be erected.



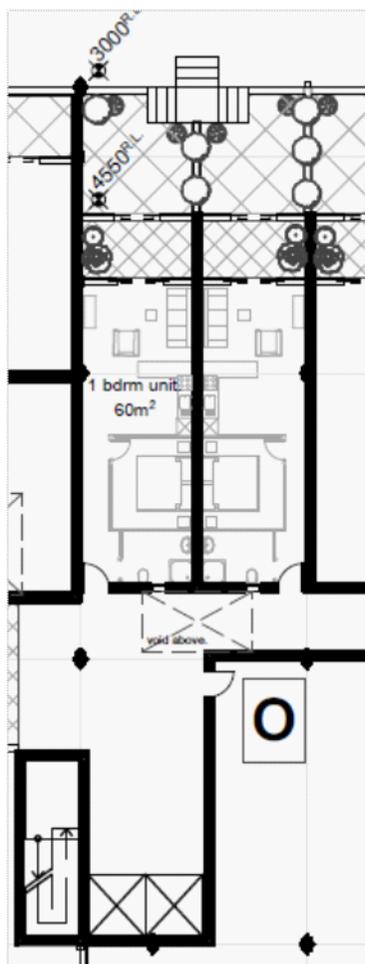
5.2.2.4 Offices & clinics

Placement of offices has more flexibility compared to residential and commercial retail typologies. They do not need as much public exposure compared to retail, quite the contrary; they prefer a quieter environment as long as access is convenient and can easily be identified by the public. This makes offices suitable for being the closest to residential units in higher density mixed use environments. They have regular operation times with mostly quiet activities.

Office units are located on the second level, slotted in between residential units, this makes a good vertical buffer area between retail and residential units. However, to remain connected to the main street, some offices can also be accessed through Stoddard Road. Varying height glass boxes, raised half floors at most forming terraces, provide access for residents by small flights of stairs, allowing permeability for residents from their apartments to the public retail areas. Alternatively, lifts are also provided, with 2 per block. These areas also serve as common areas shared between office occupiers, in the hopes some positive community interaction can occur during their transitions. This shared space has limited public access, where everyone must pass through a reception lobby at retail street level. This door can be locked during after-hours and operated with electronic swipe cards, improving security and privacy. Office lighting demands are different to residential, as they prefer ambient lighting over direct sunlight. This makes them more suitable facing the southern areas and has maximum glass surface to get exposure to indirect sunlight. Types of business suitable for this area could also be small healthcare clinics i.e. dentists, G.P's etc.



out compromising lighting requirements. Exposed hard surfaces in the conservatory i.e. tiled floors and concrete wall panels, improve solar heat gains by absorbing solar energy and continue to release heat at night, moderating temperatures and also reducing heat loss by conduction from the interior. During summer, wide overhanging screens shade high angle afternoon sun to prevent excessive heat gains. Both layers of glass walls can be fully opened to create a semi outdoor environment, while the fan pump expels warm stale air from inside and drawing in fresh air from the exterior. Exposed hard surfaces are also naturally cooled at night, with open conservatories. Additionally if cost allows, double glazing could also be used to further improve insulation values. Cross ventilation is also available on most units, with openings to the exterior on both the south and northern sides of the apartment.



Typical apartment design: Level 1

Access

Level 1 apartments are mainly accessed from terraces at Stoddard Road Level. They have a level raise of about 1500mm (from Stoddard Road to finished floor height), which structure has allowed for continuous vent openings for natural ventilation of the basement carpark. These terraces are also private outdoor areas, with shared stairways with the neighboring unit. A more private rear entrance can be from lift and stairwells at Level 0 from the business areas.

Privacy and security

Privacy from the general public facing the street is addressed by medium height fence screens and planting. Most importantly the raise in floor level for private terraces, clearly defines the private and public realm, reducing visual and spatial impacts from street activity. This simultaneously heightens passive security, creating more obstacles for unwanted strangers. A shared foyer and walkway between office units and apartments is an alternative access route. These will mostly be used by members of the residential community as transition spaces to their shared facilities and retail areas below. It also provides convenience for those with mobility issues or moving furniture which require the elevator. However, these areas are not well surveillanced and will require restricted public access after-hours. Privacy concerns from neighboring units mostly occur at the exterior spaces. Shielding screens with planting separates outdoor areas for individual units. More outdoor privacy is provided within the conservatories, where it can fully open to the exterior to become more of a semi outdoor space.

Lighting

A full height glass wall on the northern façade provides natural lighting for the single bedroom units. Due to the depth of the apartment most living activities will be at the front of the unit. Translucent screens or windows can be installed in the bedrooms, where in single room apartments, bedrooms will

mostly be used for sleeping, hence requiring lower levels of natural lighting. The rear access corridor have open lightwells voids at regular intervals, providing some natural light to bathrooms.

Features and variety

Choice of units is limited at street level, where they are mostly single bedroom housing for lower budget living likely for students or young couples. These have less outdoor space as the types of tenants are likely to be mostly out busy during daytime, but enough private recreational space to relax in the sun on the weekends. These single bedroom units share a front staircase with their immediate neighbour, with the intention to create more chance for social interaction, without compromising privacy. Despite having smaller private space, access to residents shared facilities most convenient compared with other units.

Typical apartment design: Level 2

Access

Level 2 apartments have various access points, depending on its location. The units closer to the two ends of each block can either be entered via vertical access shafts with both lifts and stairs, or through a series of small flights of stairs via the office shared terraces. Some units near the middle of the block are either entered from the level 3 common areas with stairways down to their level 2 apartments (in this case, using the vertical access shaft) or from the office shared terraces. Keeping fire escape routes in mind, most units have been given 2 points of access, however a small number of units have only 1 stairway route, but this can be made acceptable with the installation of higher levels of fire safety precautions e.g. automated sprinklers.

Privacy and security

Privacy from public on the main street on the northern area is not an issue as apartments are tapered back from the boundary at upper levels and private outdoor gardens is not within sight of pedestrians at street level. However some security measures may need implementation at access points from retail and business areas especially from the office shared terraces. These areas have general public access during business hours, which means the final flight of stairs entering residential realm may need gates, entered with electronic swipe cards. Privacy concerns from neighbouring units mostly occur at the exterior spaces. Shielding screens with wide planting troughs provide separation for outdoor areas of units. More outdoor privacy is provided within the conservatories, where it can fully open to the exterior to become more of a semi outdoor space.

Lighting

A full height glass wall on the northern façade provides natural lighting for the apartments, where consequently, most living activities occur at the northern end. However, due to the depth of these apart-

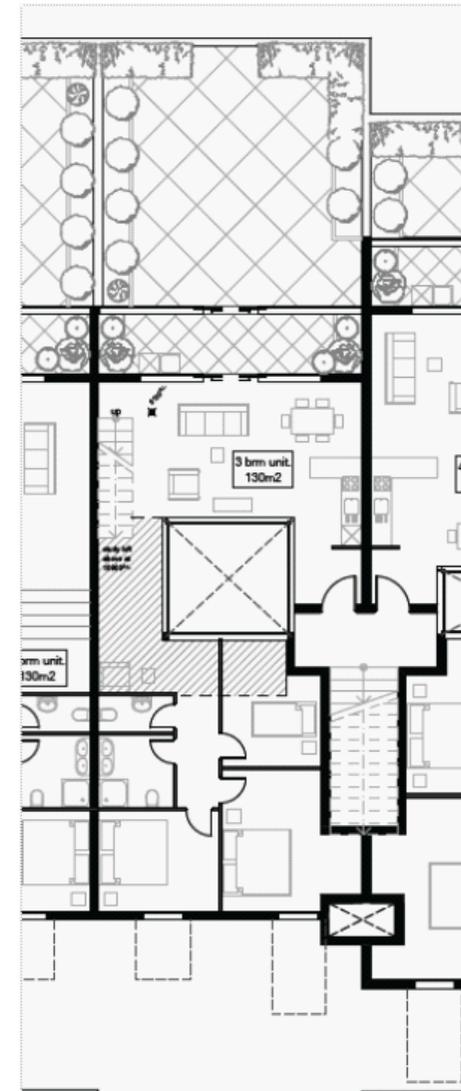




Figure: Internal lightwell
Source: Google

ments, practical lighting values start to diminish nearing the heart of the unit. A lightwell void passing through every unit addresses this issue, providing natural lighting. Some bedroom and bathroom units are also built around the lightwell core, while others have windows on the southern walls. Issues of noise transmission and heat loss can be reduced significantly with double glazing and acoustic treated laminate glass. For spaces where more privacy may be required, frosted glass can be a good option.

Features and variety

A variety of units can be found on this floor; from more compact 1 bedroom to spacious 4 bedroom units. All units have external private space, with a range of sizes depending on the preference of the tenants. Some larger family situations would suit larger external courtyards for the children to play, while some have smaller front patios, but all equipped with planting troughs and the potential to harvest own crops. It is possible that units will be rented out to individuals which prefer more independent activities and privacy, hence the provisions of large double rooms and multiple bathrooms, and en-suites for some. There are 2 large residents' common areas at both ends of each block. Several units surrounding them gain entry via passing through these areas, creating more opportunity for community interaction.

Typical apartment design: Level 3

Access

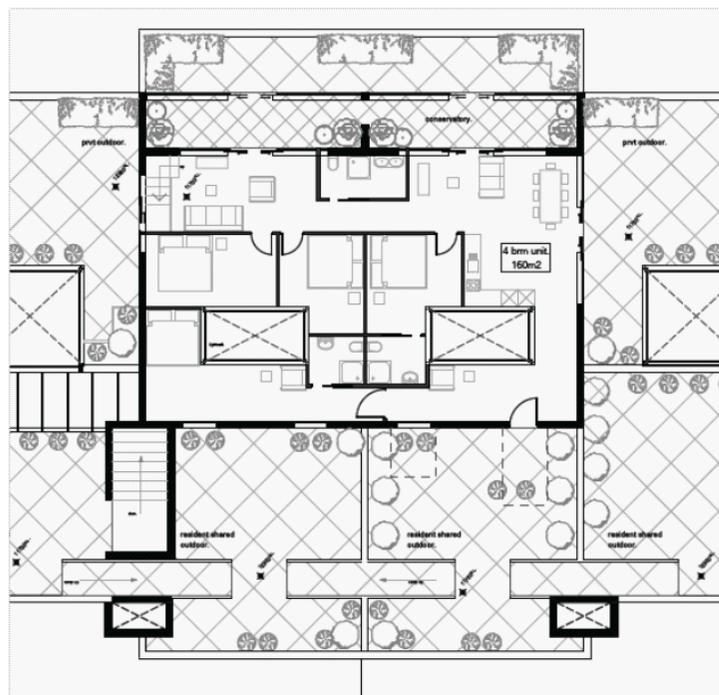
All level 3 apartments can be accessed from both vertical shafts. Common residential shared outdoor courtyards along the southern areas serve as transition and recreational spaces, which are used by members of the residential community living in that particular block.

Privacy and security

Privacy from public on the main street on the northern area is not an issue as apartments are tapered back from the boundary at upper levels and private outdoor gardens is not within sight of pedestrians at street level. The top floors are the most secure units from public, where access is not possible without swipe cards through the vertical shafts. Privacy concerns from neighbouring units mostly occur at the exterior spaces, and is addressed the same with other floors, through large planter troughs and greenery creating physical separation. An additional feature on the top floor is that external private areas are split into individual courtyards with 1200mm level differences with its neighbouring courtyards. This height difference gives visual and spatial separation where privacy and unit ownerships/boundaries are more distinguished.

Lighting

As with other floors, full height glass walls on the northern façade provides natural lighting for



the apartments. Lightwell voids passing through every unit addresses lighting issues providing natural light to bedrooms, bathrooms and living space closer to the core of the apartments. A basic rule of thumb for lightwells to be functional, a height by width ratio of 2:1 must be achieved. This ratio has been the main factor to the dimensioning of the voids.

Features and variety

Top floor residential units are catered especially for larger families who prefer spacious outdoor living environment and maximum privacy and security. They potentially could contain up to spacious 4-5 bedroom units with generous sized outdoor courtyards. Other choices in the top level are limited 1 bedroom and 2 bedroom apartments. The top floor also offers the most outdoor freedom with large shared continuous courtyards, all separated into 8m segments, with level changes of 1200mm, defining individual areas. These are serviced by ramps, which connect vertical shafts on both sides of the block.



Figure: Internal lightwell
Source: Google

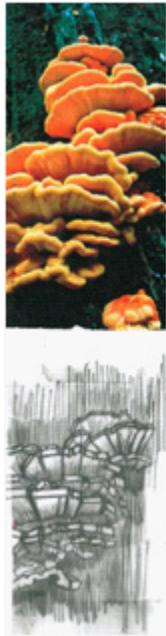


Figure: Parasitic tree roots growing over Angkor Wat temple, Cambodia.
Source: Google

5.3 Concept in Theory: Parasitic Architecture

“Parasitic architecture can be defined as an adaptable, transient and exploitive form of architecture that forces relationships with host buildings in order to complete themselves.”²²

“Parasitic”, is a natural metaphor, personifying concepts of existence occurring in biological organisms. A parasitic relationship sees perseverance, from siphoning surplus energy from hosts for sustenance, and not killing it for its own sake of survival. Parasites undertake a selection process prior to engaging its host, to exploit certain weak spots in its construction, conforming to physical attributes and upkeeping its needs, and ultimately becoming firmly integrated with the host.

Parasitic concepts in architecture, tests the traditional limitations in the boundaries of architecture. It redefines spatial relationships in the built environment, which were not possible through traditional techniques of urban design. Parasitic Architecture allows for further possibilities and opportunities, not confined within the limitations of infrastructure, and operate in existence with the host. These newly emerged potential, are not possible within the original existence of the host itself, and therefore, the relationship between the parasite and its host become symbiotic.

5.3.1 Application to existing structures

Parasitic organisms were observed, in the way which they attach onto and thrive from their hosts. Certain fungi latches itself onto old tree bark, while certain types of trees grow roots and branches, weaving through and partially engulfing its host, reaching higher terrain for natural sustenance.

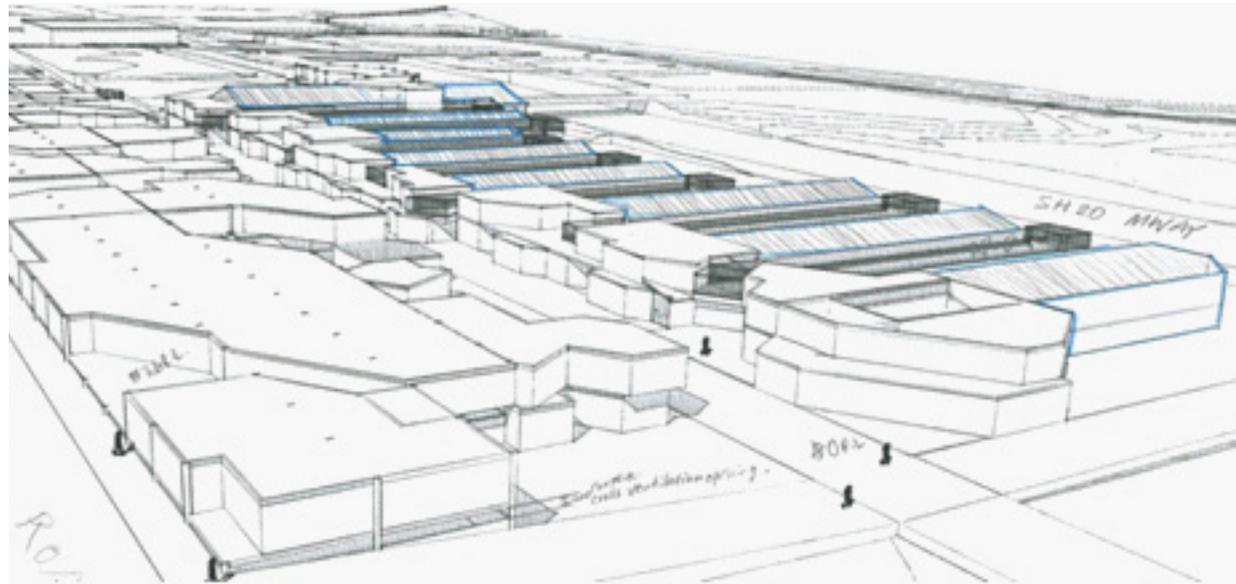
On the studied site, the host building has been identified as the existing warehouse structures, adjacent to State Highway 20. New physical structure, parasitically attaching onto the host, and absorbing excess energy not needed by the warehouses, is a display of functional parasitic activity. More specifically, the process of urban farming leeching collected rainwater from the warehouse, enabling new life. Retail showrooms engulf the northern façade of the warehouses. These new functions have a dependency on the host warehouses, as large storage and workshop facilities. Conversely, parasitic building structures defined new activities and purpose for the existence of old warehouse structures, hence a symbiotic relationship.

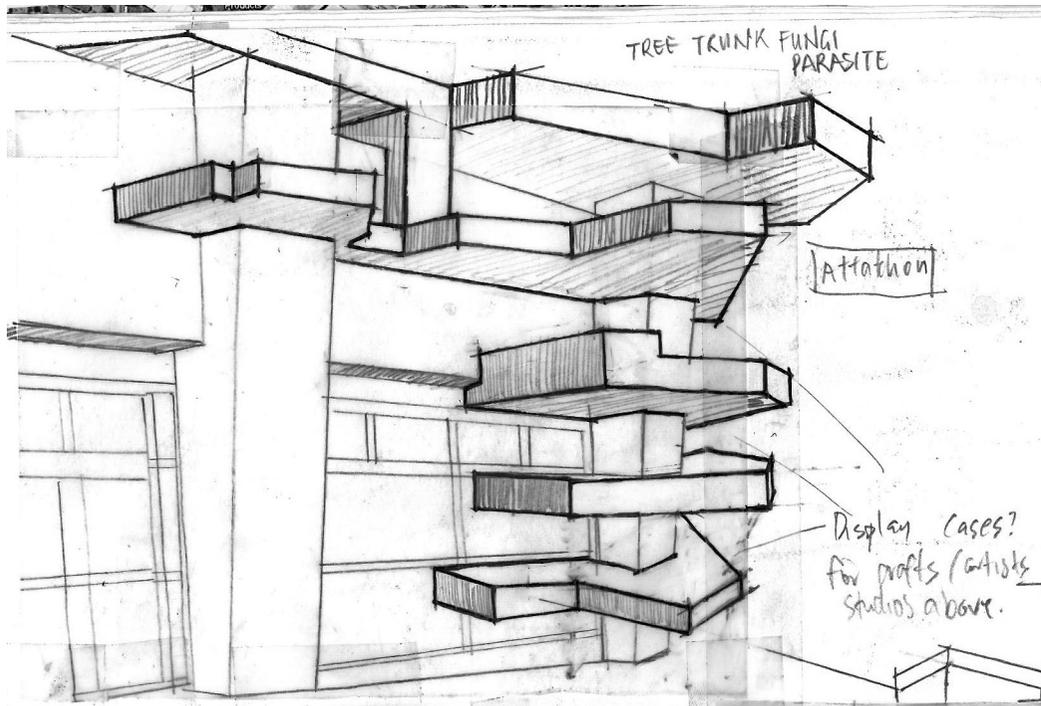
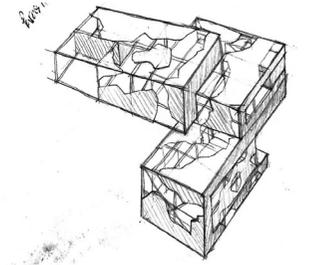
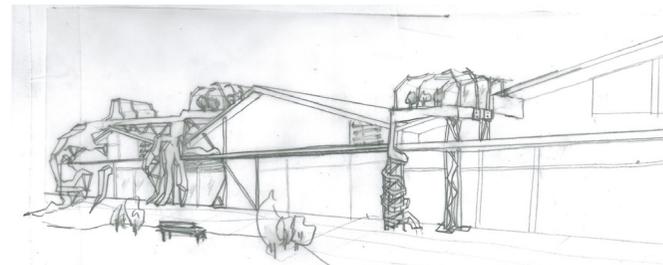
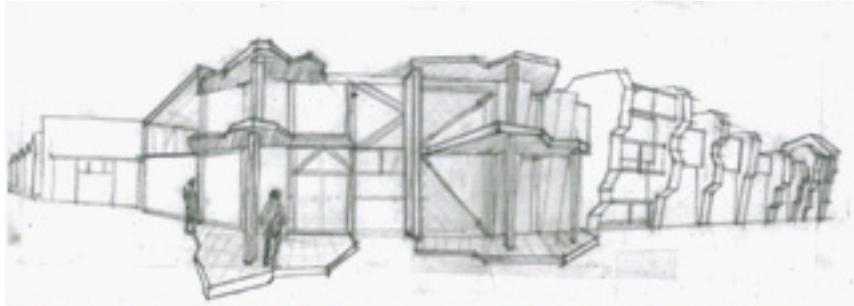
²² “Parasitic architecture” <http://www.freewebs.com/parasitic-architecture/introduction.htm>

6.3.3 Application to aesthetics

Aesthetics in itself is a function. These functions include attracting people from outside of this community to visit, potentially bringing more business and revenue to the neighbourhood; the ability to maintain long term tenants through attractive looking living and working environments, with high quality design and finishes. Parasitic Architecture style is used to create more visual interest in the designed buildings and spaces, and the chance to create an iconic area for the train station.

Combined with the conceptual theory of “Parasitism in Architecture” and parasitic relationships occurring in nature, a style of architecture developed. Not only does physical shape and form represents parasitic elements in nature, but also the use of materials, juxtaposing and contrasting to each other, holistically integrating as one. Having good looking exterior of buildings may not be enough; hence practical functional uses are always considered. Parasitically attached timber to concrete, serves as canopies for stall space and weather shielding, while on the showroom areas, timber and glass boxes attached to the concrete exterior serve as display cases. Not only do these elements demonstrate physical parasitic attributes, but also for practical utilities.





6. Conclusion

6.1 Investigative analysis of final design

Typologies: Higher density residential apartments with shared facilities; commercial offices, retail area including food and market stalls. In its immediate vicinity sharing the same pedestrian and service lanes are larger retail showrooms; light manufacturing workshops/studios and urban harvesting operations.

Residential density: 80DPH / 168 HRH (Residential density is calculated for each block where the apartments are built. This does not include the retail showroom and industrial warehouse area)

Open space (public): Open public spaces is provided along the business activity lane, where street furniture and recreational facilities can be found. A large open public square by the station and a green reserve is located within 5 minute walking distance. This area is also to have community facilities like public library, R.S.A's etc. It is important to also include urban green "pocket parks" in dense built environments, for a high quality recreational area. These areas not only serve this community, but also intended for people who come visit and shop from other neighbourhoods, with well established public transit networks serving this area.

Open space (prvt): There are 2 types of open private space for residents within these developments. Every apartment unit has their private outdoor terraces or courtyards which vary in size, giving tenants more diversity. These areas have the most privacy, and with hopes that individual outdoor areas will have dense foliage grown over time, providing a high quality private recreational area. The other type of private open space for residents is terraces and courtyard spaces, distributed around the second and third levels, shared amongst apartment tenants.

Privacy: Residential units have been designed to give maximum privacy. They are all orientated in the same direction where no two units will be facing closely each other, making interior living areas and bedrooms uncomfortable. Exterior areas have been shielded from neighboring units through foliage and high screening devices, however as with any high density compact living, sound transmission in these outdoor areas may still be an issue. Lower level outdoor space may still have some overlooking issues from upper level units, but will not have too much impact due to the distance and small visible areas. This emphasizes the importance of having dense foliage which aids the screening.

Identity: Iconic architecture created for proposed future transit node, and finding methods of linear intensification that could be potentially applied Auckland wide. This is important because it can potentially attract members outside community to come visit. Style of architecture is important to the identity of

developments, where the parasitic architecture concept has formulated many aesthetics and functions of the building and gives visual interest. The intention is to make residents and tenants feel proud of their working and living environments. Having identity in the built environment creates a stronger sense of belonging to the tenants, and creates more of community cohesion. Shared facilities and recreational spaces also enhance community bonding and interaction, creating positive attitudes towards each other and their built environment.

Security: All shared exterior courtyard and terraces for residents and office tenants overlook the business lane, providing some passive security measures especially at night times where being away from the main street may be slightly deserted. Apartment bedrooms also overlook the business areas, with these configurations, “eyes on the street”²³ natural surveillance can be achieved. During the daytime, there are thriving commercial activities in the area. This creates obstacles for burglars and unwanted strangers attempting to access the apartments.

Servicing: Every block has allowed for 2 service areas where a refuse vehicle can easily manoeuvre to collect skip bins. Rubbish chutes are located at vertical shafts, where it can service all floors. Below these shafts is the location of refuse pickup.

Carparking: A carpark to residential unit ratio of 1.9 was achieved, which means a total of 72 carparks between 38 units. The minimum requirement of residential units to carparks ratio is 1.2. Slight higher allowance has been given, for extra which may be demanded for residents willing to pay more. Public car-parking buildings within 5minutes walking distance in the vicinity can also be an alternative for residents who require. Some limited on street parking is available on Stoddard Road and in the retail lane. This can be convenient for residents’ visitors afterhours.

Access to public transport: Proposed public transit is within 5 minute walking distance. This includes a new train station and the possibility of a bus transfer station.

The design project proposed, in this context, a medium rise mixed development that rationalizes vehicular access and parking, introduces a coherent linear arrangement of public space, re-introduces elements of natural landscape, and suggests that good quality environments are possible in a typical example of these suburban higher industrial neighbourhoods. Different typologies have been tested for compatibility and a layout formation has been established, where implementation to other sites in Auckland, with similar urban layout, could be possible.

²³ Jacobs, Jane. Life and death of American cities. Westminster: Vintage, 1992. (p.50)

6.2 Critical analysis: limitations and further developments

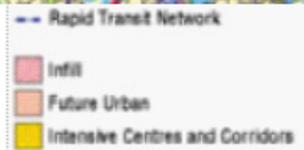
Due to the scale of the project, under limited time constraints, it is acknowledged and identified that certain aspects had been given more focus, while some other issues are resolved to a basic standard and could possibly be further developed.

- Current dimensions especially apartments are generous and could be smaller and still function adequately.
- Apartment interior planning is not final but an indication of a possible layout. They are subject to change and even allowed for further future renovations and additions/alterations of interior partitioning. This has been made possible through regular layout of structure, where no interior walls of apartments are load bearing.
- Lightwell positioning and sizes could be further developed and fine tuned for many units. Even the possibility to have internal balconies within void space, where having access is advantageous for maintenance and avoiding overlooking from other units. However, additional glass treatments like frosted or tints could be applied for maximising privacy issues.
- The business activity lane could be smaller. The current service street, at 5m wide, is enough for 2 passing traffic lanes. There are parallel car parks on this lane which makes manoeuvring more convenient. However excessive wide streets can cause drivers to be careless and exceed speed limits. This can be controlled by designated bike lanes, series of pedestrian crossings and speed bumps. Minimum widths of one way streets could be down to 3m. Current chicanes in the lane may also be subject to more streamlining, with radii adjusted.
- Roof penetrations and retrofitting of water collecting systems is inevitable and further engineering and logistics issues may arise in the process, especially when dealing with foundations and assembly, and is possibly costly.

7. Appendix



Figure: Growth Concept 2050 (1999)²⁴



7.1 Auckland’s Growth Strategy & policies

Rail Upgrades

A future proposed expanded rail system would include an airport rail link connection From Avondale to Onehunga, running parallel to State Highway 20 to the airport an underground loop under the Auckland CBD. By the year 2030 this expanded rail system could be carrying 30 million passengers, up from the current five million passengers per year.²³

NZTA Motorway Upgrades: Waterview connection State Highway 20²⁵

The opening of the Mt Roskill extension of SH20 means about 50,000 vehicles a day will be spilling into nearby streets. This is expected to rise to more than 60,000 in a few years. The Waterview connection is the final stretch in the proposal to complete the western ring route, which connects the southern to the western motorway, and is also the main route from the airport to the city.

Intensification

Housing

Future housing demand study 2010²⁶

By 2051, the amount of population growth will see housing demand double, requiring an additional 450,000 dwellings. Low rise apartment are highest in demands in all housing types.

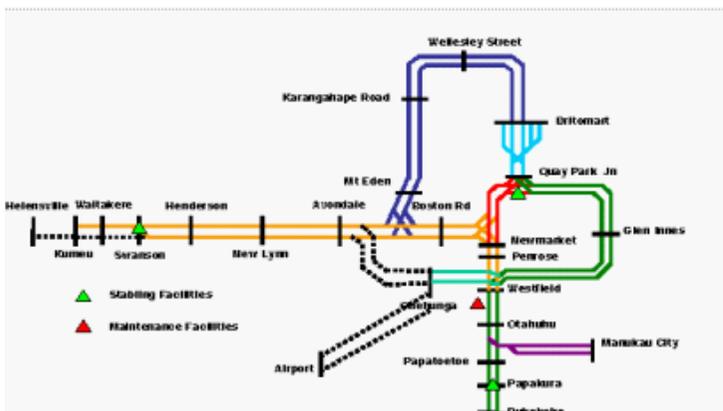


Figure: Proposed “Southdown” rail line, connecting Avondale and Onehunga stations.²³

| Typology | 2006 Housing stock | | 2051 Housing stock | |
|--------------------------|--------------------|---------------------------|--------------------|-------------------------|
| | Proportion (%) | Total number ¹ | Proportion (%) | Total additional number |
| Standalone houses | 76 | 311,000 | 64-71 | 268,000 – 330,000 |
| Single storey flats | 13 | 51,000 | 6 | 0 |
| Low rise apartments | 9 | 37,000 | 21-23 | 149,000 – 172,000 |
| Mid-high rise apartments | 2 | 10,000 | 2-7 | 18,000 – 51,000 |

²³ “Passenger Transport Network Plan” <http://www.aucklandtransport.govt.nz/improving-transport/plans-proposals/IntegratedTravel/Pages/PassengerTransportNetworkPlan.aspx>

²⁴ “Auckland Regional Growth Strategy (1999)” <http://www.arc.govt.nz/auckland/aucklands-growth/publications.cfm>

²⁵ “Passenger Transport Network Plan”

²⁶ “Aucklands growth:Future housing demand study” <http://www.arc.govt.nz/albany/fms/main/Documents/Auckland>

Business Land Capacity²⁷

- At the current rate of take-up, the region has vacant business land capacity that should last to somewhere between 2011 and 2020.
- Vacant business land is being used up at an approximate rate of 129 hectares per year. At this rate, this land will be used up in 12 years. This time frame does not take into account the potential for businesses to intensify their operations rather than grow outwards.
- No new greenfield land will be allocated as business zones, which means new commercial buildings will occur on rezoned land within the MUL or intensification of existing business areas.

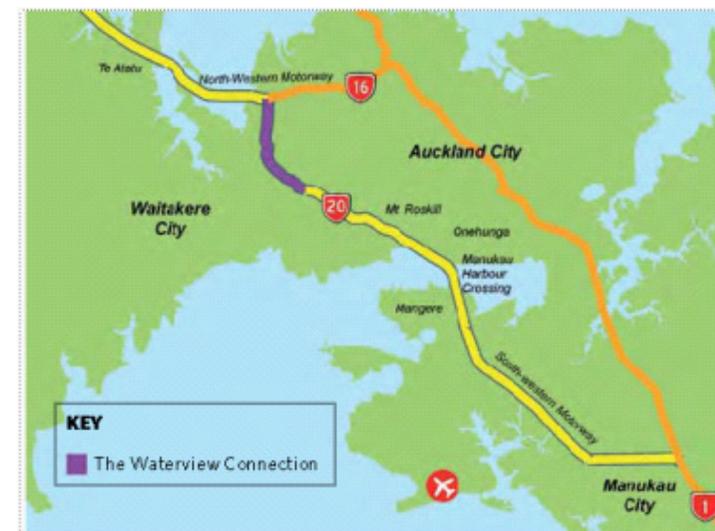
Mixed Use and Corridors

Auckland Regional Business Land Strategy aims to achieve these objectives:²⁸

- Enhancing local employment opportunities to reduce cross-region commuting.
- Encouraging more 'mixed-use' developments in town centres to support both residential and business growth.
- Supporting town centre development through the provision of public transport.
- Supporting heavy business areas with adequate road infrastructure, including motorways.

Re-use and/or redevelop under utilised brownfield business land, by:²⁹

- Auckland local authorities retaining business-zoned areas specifically for business activities.
- Encouraging the growth of residential mixed-use activities in town centres, high-density centres and corridors, where it can contribute to investment in and growth of business activity.
- Undertaking a regional assessment of brownfield business sites to determine their potential for re-development.
- Working with existing owners of brownfield business sites to ensure appropriate consolidation, re-development and intensification.

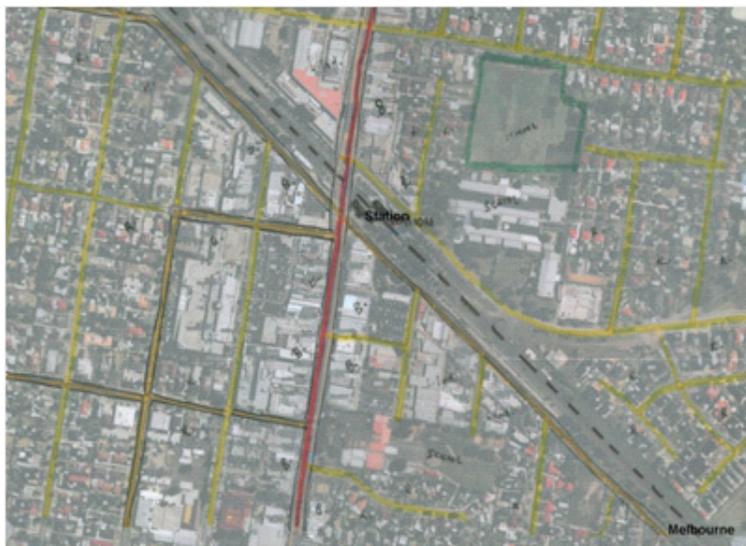


²⁷ <http://www.arc.govt.nz/plans/regional-strategies/auckland-regional-business-land-strategy.cfm>

²⁸ *ibid.*

²⁹ *ibid.*

7.2 Selected urban analysis

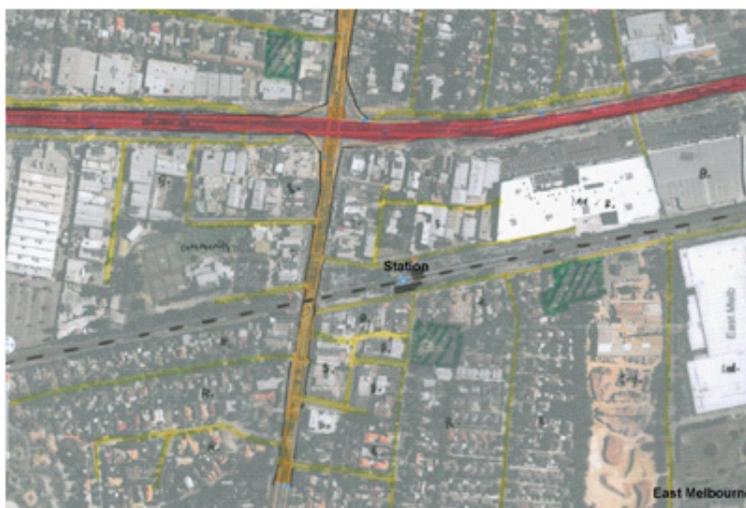


Location: Springvale Railway Station. A large suburban centre with railway station about 30kms South-east of Melbourne central.

Road layout and access: The collector and smaller local roads grid arrangement is regular and are in sync with the main arterial 4-6 lane arterial road. The railway line cuts through the grid on an angle, heading towards the central station. Generous amounts of carparking are provided along the railway line, in the vicinity of the station.

800m radius of railway station: 2 Schools, small business incl. hospitality and shop front retail. Some larger retail like groceries stores and automotive services are located on the edges of the business zone. Community facilities e.g. childcare centre, community health centre etc. Detached housing and low rise townhouse flats.

Density description: Dense smaller business like retail and hospitality have been intensified along the main arterial road, and some spreading around the train station. The arterial road can be identified as an economic corridor, while the rail transport corridor serves as alternative transport to city and other economic centres. Residential is mostly low-medium density detached housing with also some low rise townhouses. Immediate areas surrounding train station are mostly business zones, with only one small block of medium density flats directly located by the station, hence making this node more business focused.



Location: Nunawading Railway Station, located in a large suburban centre about 20kms East of central Melbourne, Australia.

Road layout and access: A large economic centre, developed between a main arterial road of up to 8 lanes, and railway line which runs alongside with the road. Road grid layout is regular and in sync with the main arterial and the main feeder road. There are smaller service roads alongside the railway lines, with carparks for “park and ride” viability, and as a buffer area separating the residential area.

800m radius of railway station: School. Various types of business from smaller retail and hospitality to larger distribution stores and warehouses. Community facilities e.g. library, community centre etc. Detached housing and low rise townhouse flats. Industrial warehouses with light manufacturing and storage activities. Small green reserves have been distributed among residential areas.

Density description: higher density commercial zone has been developed in between the main arterial road and railway line, establishing the economic corridor with the transport corridor. Medium density townhouse flats and compact detached housing are in the immediate vicinity of the train station, separated from the commercial areas by the railway and main arterial road. More smaller commercial are situated around the train station amongst the residential areas following the main feeder road to the arterial but only limited amounts. A balanced mixture of typologies are distributed around train station. Business and residential density are relatively even, but are mostly physically separated.

Location: Brisbane Central station, Australia.

Road layout and access: there are 2 main arterials parallel cutting through the central urban district with the railway line underground also in the same direction.

800m radius of railway station: Variety of mixed businesses ranging from corporate tower office buildings, shop front retail, and hospitality venues such as restaurants and bars etc. Temporary accommodation is located closer to the station. Residential start to frequent more near the outer perimeter of the 800m radius. At every significant urban block, there are public open squares distributed throughout the vicinity of the train station, surrounded by high density business activity. A large public open green is situated beside the station and stretches out and beyond the 800m radius, parallel to the railways tracks, creating a buffer area for a mixed use area with more high density apartment flats.

Density description: Very high density of business. Distributed across the centre are high density residential, mostly high rise apartment buildings. Some blocks further away from the most central areas have some medium rise apartments. These may be found slotted into smaller sites amongst high rise business buildings. A business zone dominant district.

Location: Toronto central station, Canada.

Road layout and access: An expressway viaduct runs through central urban district with railway line in the same direction. Smaller collector roads are arranged in regular grid. Service lanes provide alternative access to buildings away from main streets. Metro Rapid Transit station, which runs underground is one of several means to other economic centres.

800m radius of railway station: The main station is more commonly used for longer distance travel and interchange, with open rail above ground. A network of tram routes are available for shorter distance travel within the inner city areas, where stops appear frequently. A Metro Rapid Transit station within walking distance. Variety of mixed businesses ranging from corporate tower office buildings, shop front retail, and hospitality venues such as restaurants and bars etc. Temporary accommodation is located closer to the station.

Density description: Very high density business zone. Distributed across the centre are high density residential, mostly high rise apartment buildings. A business zone dominant district.





Case Studies of high density developments

Habitat 67³⁰

Typologies: Experimental high density urban residential for the Montreal Expo (1967). Includes resident shared facilities and a convenient store. Other commercial facilities in the original design were never built due to cost issues.

Residential density: 70dph

Open space (public): The whole development is arranged into 3 clusters, with residents units built around a shared courtyard. Provided on the site also has a tennis club, and green reserve. There are various terraces and walkway/rooftop on the upper floors with shared residents outdoor space.

Open space (prvt): The ideal spaciousness of a suburban traditional suburban home have been implemented for a high density urban setting, where every unit has its own private outdoor patio with planter boxes. The architect believes “For Everyone a Garden”.

Privacy: Planning arrangement layout prevents living areas of units are not in direct sight of each other. However some private exterior terraces are overlooked by units above, but impacts are lessened by mature foliage and shading devices.

Identity: This building is the pioneer of its kind worldwide, and is a landmark to Montreal city and even Canada. It is a privilege to be able to own or reside in this complex. Arrangement and layout of units and residential common areas create a sense of community, and creates positive interaction without being intrusive.

Security: Security service including an entrance gate, security cameras, doorman service on a 24 hour basis

Servicing: Large service bays are allocated on site where entered through rear service driveway.

Carparking: 200 carparking spaces underground, with on site visitors parking.

Access to public transport: Habitat 67 is built on a peninsula near the Port of Montreal. There is a private bus which travels between the central city area and the complex. A ferry terminal to Montreal Central urban area is located about 600m away from the residence. Bus services operate at the ferry terminal on the mainland, or alternatively a 10min (1.5kms) walk to the Metro station.

³⁰ http://www.habitat67.com/privileges_en.html

Odhams Walk

Typologies: High Density Residential mixed use with Health centre, retail, offices, Community facilities. The housing development, which sits above two storeys of office and retail space, was designed as a series of irregular blocks stepping up in height from two storeys in the centre to four storeys around the edges of the block. The blocks cluster around a series of small interconnected courtyards, linked to the street by two wide ramps and smaller external stairs. Of the 102 housing units, 60 are one bedroom flats and the remainder are two to four bedroom units.

Density: 154 DPH/523 HRH

Commercial Units/EPH: 15+some in home business

Open space (public): There are larger outdoor areas and terraces on rooftops at the upper levels shared between residents. A ground level courtyard which is semi open access to public, where some commercial and community facilities are located.

Open space (prvt): Most housing units have private outdoor space, in various sizes and layouts. Some have larger patios with the ability to harvest crop. Some are smaller balconies but large enough for some basic outdoor furniture. However certain lower level private balconies and courtyards are overlooked by floors above but dense planting creates a less intrusive environment.

Privacy: The development is designed to respond to the intense urban surroundings, with outward-facing shops and more quiet internal courtyards. The abundance of terraces, balconies and roof gardens, which were carefully planned to minimise direct overlooking from surrounding flats, and the irregular stepped profile of the housing blocks make the development feel more spacious than statistics suggest.³¹

Identity: Unique style of brick construction with dense mature shrubbery and planting create a serene village environment despite being located within a dense urban environment. Many different types of apartments units available allowing a mixture of different types of tenants from single elderly to families, but all like minded to participate in creating a safe close knit community.

Security: Public access to inner courtyards are restricted after 8pm by a gate sealing off entrance to street pedestrians.³² However during normal business hours, the tight resident community have initiative to watch out for unwanted strangers which enter the premises.

Servicing: A common service bay which is located within the complex at street level, for refuse trucks and other service vehicles.



Figure top: From street view

Figure below: terrace view

Source: Google



³² http://www.designforlondon.gov.uk/uploads/media/Housing_for_a_Compact_City_Part2.pdf

³¹ <http://multiminded.co.uk/homes/projects/films/odhams-walk-the-making-of-a-sustainable-community/>

Carparking: A rate of 1 carpark to 10 units of housing in a common secure parking building at basement level, which is also used by tenants of commercial units. Alternatively, on street parking and parking buildings are also available within the vicinity.

Access to public transport: Covent Garden Underground station is located within 5 minutes walking distance. Public passenger bus also service main streets surrounding the development.

Beaumont Quarter

Typologies: High Density housing, residential shared facilities, commercial.

Residential Density DPH: 69DPH

Open space (public): Public open space which is usable for any sort of recreational activities is minimal. Small public grassed areas exist but only mounds with planting, which seem more for enhancing the natural environment than practical use. However, Victoria Park is across the road from the scheme. The scheme is pedestrian orientated, where public courtyards and landscaping are used as transitional spaces.

Open space (prvt): Private outdoor space is minimal, with a small fenced patio (varying from approx. 10-15m²) or open patio for parking in townhouses. Upper floor apartments have open private balconies. Housing units opposite one another is in close proximity and privacy is achieved through the architecture by the use of louvers, providing some separation from pedestrians at street level.

Privacy: Residential privacy is relatively low in many units, especially where units have outdoor patio or terraces directly opposite within a tight space no larger than 5m. Elements such as full height screens and fences are implemented but this is only remedial to some visual privacy. Intertency noise and overlooking units on higher levels still will cause issues.

Identity: Identity is created through the modernist urban style of architecture. Use of materials and color palettes also contribute to the clean and up-market style of the whole development. There are not really any unique features worth noting, as it displays only very common building trends.

Security: Because of the transparency of the private space in the development, any suspicious activity can be noticed from units. There are no physical restrictions elements into the common area so members of the public can enter, however, layout of the units is close together with only one front entry to dwellings, with hopes that burglary or vandalism would be less prone. Entry into upper floor apartment



complex is restricted by access cards.

Servicing: The scheme provides good networks of streets which provide easy access for rubbish collecting and service vehicles, as the main street network is wide enough for most large vehicle which may need to enter. Maintenance is minimal to the outdoor area as there is only small amounts of planting which needs to be pruned/cut few times a year. However, most maintenance will be required for the indoor gym and pool facilities.

Carparking: For the majority of the apartment units, parking is underground, otherwise at the frontage of the dwelling. Some public car parks are provided for guests. There is a single car park in front of each of- fice unit. These are most likely for clients. The scheme is more pedestrian orientated as many of the public areas especially outside housing units cannot be accessed with a vehicle.

Access to public transport: There are some bus stops located within walking distance of the developments but only serving limited routes. Most trips to other parts of Auckland will most likely involve interchanging at central city stations.

8. Bibliography

Books

Rudlin, David, and Nicholas Falk. Building the 21st Century Home – The Sustainable Neighborhood. Oxford: Architectural Press, 1999.

Walters, David. Designing Community - Charrettes, master plans and form-based codes. Oxford: Elsevier, 2007.

Witten, Karen et al. Growth Misconduct: Avoiding sprawl and improving urban intensification in New Zealand. Wellington: Steele Roberts Aotearoa, 2011.

Curtis, Carey Renne, and Bertolini, Luca. Transport Oriented Development. Abingdon: Ashgate Publishing Group, 2009.

David Adler et al. Metric Handbook Planning and Design Data. Second Edition. Oxford: Architectural Press, 1999.

Marchettini, N, et al. Urban Regeneration and Sustainability: Sustainable City III. Southampton: WIT Press, 2004.

Jacobs, Jane. Life and death of American cities. Westminster: Vintage, 1992.

Reports

Common Ground Urban & Architecture Ltd. “New Lynn Urban Regeneration Framework”, report for Waitakere City Council (2008), <http://www.waitakere.govt.nz/abtcit/cp/newlynn.asp>

David Turner, John Hewitt, Cesar Wagner, Bin Su, Kathryn Davies. “Best practice in medium density housing” report for Housing New Zealand Corp. (2004)

Publications

Department for Communities and Local Government (U.K.), “Mixed Use Development – Practice and Potential”, online publication (2001), www.communities.gov.uk.

Association of Chief Police Officers (U.K.), "Secured by Design principles", online publication (2004), <http://www.securedbydesign.com/professionals/guides.aspx>

Online Journals

Bell, Stephanie, "Mixed-use Developments Bring the City to the Suburbs." CIRE Magazine (July/August, 2005), http://ciremagazine.com/article.php?article_id=845

Websites

Waitakere City Council. "New Lynn Town Centre", <http://www.waitakere.govt.nz/abtccit/cp/newlynn.asp>

Ministry For the Environment. "Urban Design Case Studies - New Zealand Urban Design Protocol" <http://www.mfe.govt.nz/publications/urban/urban-design-case-studies-mar05/html/page5.html>

Auckland regional Council Website "Publications" <http://www.arc.govt.nz/auckland/aucklands-growth/publications.cfm>

Auckland regional Council Website "Auckland Regional Growth Strategy Document.pdf" <http://www.arc.govt.nz/albany/fms/main/Documents/Auckland>

Auckland City Council Website, "Growth Management Strategy" Documents, <http://www.aucklandcity.govt.nz/council/documents/growthstrategy/default.asp>

"Passenger Transport Network Plan" <http://www.aucklandtransport.govt.nz/improving-transport/plans-proposals/IntegratedTravel/Pages/PassengerTransportNetworkPlan.aspx>

Parasitic Architecture

<http://www.freewebs.com/parasitic-architecture/> (Accessed August 2011)

<http://www.rps.psu.edu/0009/parasite.html> (Accessed August 2011)

Population projections

<http://monitorauckland.arc.govt.nz/our-community/population/population-projections.cfm> (Accessed March 2012)

Daylighting: Design Strategies

http://wiki.naturalfrequency.com/wiki/Daylight_Strategies



