Designing Affordability: Innovative Affordable Housing Design Strategies for Post-Industrialized Seoul

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ABSTRACT

In the mid-1990s, Korean home owners began to organize Jaegaebaljohap (regional redevelopment unions), controlled by large developers whose goal is to maximize profit, to improve their living condition. As a result, the area of redevelopment filled with high-rise luxury condominium housing. Jaegaebaljohap provides a ‘right of purchase,’ representing the market value of the existing homes that can be used for buying new homes, to the residents. Even if people have the ‘right of purchase’, they often are not wealthy enough to pay the additional cost for the new homes. As a result, they have to be displaced in which they have resided for decades.

The objective of this research is to explore applicable affordable housing design strategies for Seoul that will enable them to sustain the lives of their inhabitants without displacement. An overview of Korean urban context and the housing problems regarding displacement are discussed first. Then theoretical framework and types of affordable housing design methodologies are examined, and based on the literature review, feasible affordable housing design methodologies are selected for the urban context of Seoul. Lastly, from an analysis of the case studies, viable architectural approaches for affordable housing design strategies are suggested. The affordable housing design strategies for Seoul, examined in this research consider high density multi-family housing types with mixed-use of development and related urban design strategies.

The findings show that there are feasible affordable housing design strategies including green-sustainable design that do not require displacement and compromising livability through cost reduction housing design methodologies applicable to Seoul.

RESUME

Dans les années 1990, les propriétaires de maison coréennes ont commencé à organiser des Jaegaebaljohap (unions régionales de réaménagement), contrôlée par les grands développeurs dont le but est de maximiser le profit, afin d'améliorer leur condition de vie. En conséquence, la zone de réaménagement remplis de logements en copropriété de luxe tours. Jaegaebaljohap fournit un «droit d'achat», représentant la valeur de marché des maisons existantes qui peuvent être utilisés pour acheter de nouvelles maisons, pour les résidents. Même si les gens ont le «droit d'achat», ils ne sont souvent pas assez riche pour payer le coût supplémentaire pour les maisons neuves. En conséquence, ils doivent être déplacées dans laquelle ils ont résidé pendant des décennies.

L'objectif de cette recherche est d'explorer les stratégies de conception applicables à prix abordable pour le logement à Séoul qui leur permettront de soutenir la vie de leurs habitants sans déplacement. Un aperçu du contexte urbain coréen et les problèmes de logement concernant les déplacements sont discutés en premier. Puis cadre théorique et les types de logement à prix abordable des méthodologies de conception sont examinées, et basé sur la revue de la littérature, réalisables abordables méthodologies de conception de logements sont sélectionnés pour le contexte urbain de Séoul. Enfin, d'une analyse des études de cas, des approches architecturales viables pour la conception de logements à prix abordable on suggère des stratégies. Les stratégies abordables de conception de logements pour Séoul, examinés dans cette recherche considère haute densité de logement types de logements multifamiliaux avec usage mixte de développement et de stratégies liées à l'aménagement urbain.

Les résultats montrent qu'il existe des stratégies de conception possibles abordables logement, y compris la conception verte durable qui ne nécessitent pas le déplacement et

l'habitabilité grâce à des méthodes de réduction de compromettre la conception du coût du logement applicables à Séoul.

ACKNOWLEDGEMENTS

As I conducted this research, I have found the fact that I needed to study more about what I used to think I knew. Learning from the study is that housing as a physical urban form that interconnects wider urban space with individual issues and vice versa. Conducting this study was also a priceless opportunity to rethink about the contemporary worldwide housing issues and the importance of quality housing as a basic human right in order to preserve our current and future lives. The special appreciation must go to Prof. Avi Friedman for guiding me through the course of the studies and the research. Without him, this research would've been impossible. I thank to my best friends, Mr. Kevin Chan and Miss. Maneka Faizi, for being always with me every night and encouraging me. My classmate, Miss. Caitlin Turski, spent her precious time on my humble paper to help me to produce a quality research; even though she was away. I also thanks to Mr. Mateo Polanco for being my translator. Lastly and mostly, my deepest gratitude must go to my family for always supporting me and trusting me with love.

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Even though home ownership is often considered a common and universal dream, regardless of varying economic and cultural situations, more and more people in contemporary cities have been surrendering dreams of home ownership due to high costs. This trend includes post-industrialized Asian countries, especially Korea. Professor O'Neill (2008) makes an important note in his report describing housing and human rights remarking as "access to appropriate and affordable housing is a fundamental human right which is "essential for individual, family, and community wellbeing (O'Neill, 2008)." This right to affordable housing can be applied to every city throughout the world.

In the Korean culture, a house is more than a place to live; it symbolizes a family. Culturally Koreans highly stress values of groups and communities rather than individuals. The house, then, represents a miniature form of the society. During the 20th century, Korean society experienced upheaval due to rapid social, cultural and political changes that greatly impacted the conditions of housing and the urban context. These changes are ongoing and continue to cause new problems regarding housing affordability in urban areas. This research focuses on housing affordability issue in urban renewal areas in Seoul and potential architectural approaches to providing innovative affordable housing design utilizing methodologies from a range of literatures and case studies of applicable projects for the Korean urban context.

1.2 BACKGROUND OF THE STUDY

1.2.1 GENERAL IDEAS OF AFFORDABILITY

To discuss housing affordability, clarification of definitions is needed. The words 'affordability' and 'affordable housing' can be understood differently under different housing circumstances.

Affordability is based on the total household income that a single family would spend on their home regardless of home ownership types; therefore it is a relative term to each household's economic circumstance (An, 2003). According to the statement by the U.S. Department of Housing and Urban Development in 2012, affordable housing is commonly defined as a house for which a household pays no more than 30% of its annual household income spending on housing. Therefore a family sending more than 30% of their income for housing may have difficulty affording basic necessities such as food, clothing, transportation, and medical care. Affordable housing is normally provided and needed for four household categories based on income level. These categories are extremely low-income (ELI) - less than 30 percent of the AMI (Average Median Income), very low-income (VLI) - between 30 percent and 50 percent of the AMI, low-income (LI) - between 50 percent and 80 percent of the AMI, and moderate-income (MI) - between 80 percent and 120 percent of the AMI (Schmitz, et al. 2005). Those of the moderate-income class, especially comprise the economic backbone of society. However, in most of post-industrialized high-cost areas across developed nations, including Korea, these moderate-income households have experienced increasing difficulty in owning decent houses. This leads to a level of poverty that threatens the economic stability of society (Schmitz, et al. 2005).

1.2.2 CHRONICLE CHANGES OF HOUSING SITUATION IN KOREA AFTER THE KOREAN WAR

During the course of the Korean War most of the cities in Korea were damaged. In Seoul, the capital city of Korea, very few structures survived from intensive war time bombardment. After the war, Koreans started to rebuild their homes as squatter settlements without specific urban design or planning on any buildable land they could find, such as mountains, river banks, and rice pads (Son, 2007). Moreover, during the industrializing period from 1955 to late 1980, the population of Seoul increased dramatically from 1.5 million to 10 million (Figure 1.1). As a result, the land became a high value asset, and high cost caused serious

housing shortages (Son, 2007).

Year	1949	1955	1960	1970	1980	1990	2000	2005
	Numbers of People							
Population	1,437,670	1,568,746	2,445,402	5,525,262	8,350,616	10,603,250	9,853,972	9,762,546

Figure 1.1: Population changes in Seoul after independency (Source: Korean Statistical Information System, 2010).

From the 1960s to 1970s, the military dictatorship in Seoul bulldozed many of the squatter settlement areas formed after the Korean War. Meanwhile, the government started public housing programs to solve the housing shortage problem for low and mid-income households. They especially focused on mid-rise multi-family housing (Ha, 2000). The first public housing project in Seoul was the 'Mapo apartment' in 1962 (Figure 1.2); however, this project lost its focus as affordable public housing. Rent turned out to be very expensive, rising to 2,444 won at a time when the average salary was only 6,000 won. The 450 apartment units filled within three month (Lee, 2003). Moreover, homeless people who had lived in the squatter settlements and the slums did not receive any benefits from the public housing system; they were removed from their homes by the government and were forced to settle outside the city without proper housing or support. The government concentrated on economical development for the country rather than on a public welfare system that would include housing (Park, 2006).

Figure 1.2: The first public housing project in Seoul; Mapo apartment in 1962 (Source: Money Today, 2004).

In the mid-1980s, the urban housing situation changed. Koreans had gained economic

stability and then naturally wanted to improve their living condition; at this time, they enjoyed the flourishing new material culture that became accessible to most of the Korean public. Within this new material culture, a new and better house was the first thing many families want to acquire. Meanwhile, the central government launched a huge public apartment housing program aiming to provide 1 million homes (Figure 1.3), including 190,000 government subsidized public houses, throughout large cities in Korea (Kim, 2001). Thus the central government started to build huge satellite cities that were mostly composed of luxurious high-rise condos rather than affordable public housings around Seoul to accommodate the housing program (Son, 2007). By 2002 the housing distribution ratio reached 100% in national wide (Park, 2006). However, rich households regarded homes as an investment tool, and they began to own multiple houses. As a consequence, the cost of homes was increased dramatically in a very short period (Park, 2006). The old residential areas of the inner city formed after the Korean War, which had survived the urban renewal projects of the 1960s and 1970s since they provided relatively good living conditions compared to the squatter settlements, quickly became recognized as poor neighborhoods or slums. Many homeless people once relegated to the outside of city started moving back into the old neighborhoods (Park, 2006). Both the municipal and the central government still considered these areas in need of improvement, and they wanted to replace them with luxurious high-rise condos that would represent the economic stability of the city and the nation (Son, 2007).

Year / Area	1995	2002	2005	2008	2010
	Housing Distribution Ratio (%)				
National Wide	86.0	100.6	105.9	109.9	112.9
Seoul	68.0	82.4	89.7	93.8	96.7

Figure 1.3: Housing Distribution Ratio after 1 million homes program (Source: Korean Statistical Information System, 2010).

In the late 1990s, home owners and the municipal government began to organize a system called Jaegaebaljohap (regional redevelopment unions), which were essentially groups controlled by mainly developers and landlords whose ultimate goal is to maximize profit, to improve their living condition (Ha and Kim, 2002). As a result, the area of redevelopment filled with luxury high-rise condominiums. The 'regional redevelopment union' provided a 'right of purchase' for people living in the area that represents the value of the existing housing and could be used for buying new homes. However, even if the people including tenants obtained the 'right of purchase', most were not wealthy enough to pay the additional housing cost for the new high-rise condominium homes (Ha, 2000). As a consequence, they had to leave the town in which they have lived for decades and move to the out-skirts of the city.

After 2000, the government's public housing efforts focused on government subsidized high-rise rental apartments located primarily in new satellite cities according to AMI (Area Median Income) for low-income households (Park, 2006) Despite this, there are few opportunities to move into these government subsidized high-rise rental apartments due to the high volume of applicants and strict requirements for the application process. Moreover, as Figure 1.4 shows, rent and housing costs increased faster and higher than ever in the history of Korea so that even mid-income households were forced to barrow housing loans that they would be unable to pay back (Park, 2006). The reason the HAI (Housing Affordability Index) curve is higher than the housing cost curve is that home buyers could borrow a loan for more than their actual HAI during periods of housing market inflation.

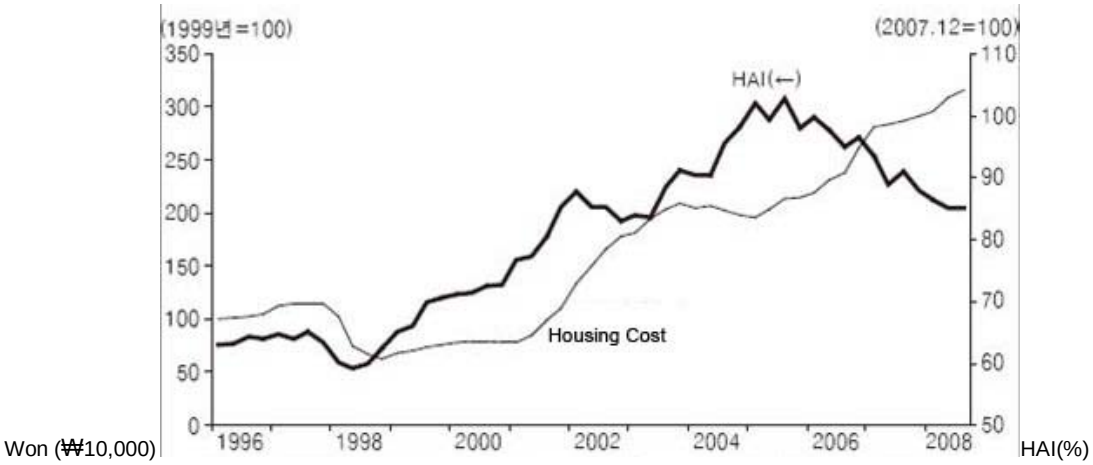


Figure 1.4: HAI and housing cost changes after 1996 in Korean housing market (Source: Kookmin Bank in Korea, 2009).
($1.00 CAD = ₩1,150 Korean Won)

The situation of those displaced from urban renewal area who decided to remain in the inner city became even worse. They once owned a home, but after displacement they had to live in rental homes since they could not afford the expensive houses built by large residential developers in the city (Park, 2006). Their housing expenditure exceeds far more than 30%; meanwhile, their non-housing expenditures, such as food, child care, medical care, and education, which are a critical investment for future well-being, have decreased (Thalmann, 2003). It can ultimately lead to the dismantling of the basic family unit that forms a society. In addition, due to an over-inflated housing market, increasing numbers of house poor households are not specific to a particular country or region; rather, it is has become a worldwide phenomenon.

1.3 RATIONALE FOR THE STUDY

1.3.1 CURRENT GLOBAL AFFORDABLE HOUSING SITUATION

One way of achieving affordability starts with the government's financial support programs, such as subsidy, grant, tax credit or land donation toward affordable housing development programs for low-income households. Among the means of financial support, government

subsidy plays the biggest role in providing necessary affordable housing projects and numbers of units for the urban poor (Davis, 1995). For example, in the 1980s the US government provided financial support of $26.6 billion for public housing programs. However, by 1989 the amount of government subsidy declined to $7.6 billion; this 72 percent decrease left 250,000 children homeless (Davis, 1995). Of course, the other cost reduction tools for affordability are important as well; however, without support from the public launching affordable housing programs is nearly impossible. Some may argue that they do not want their tax money to be spent on the poor, but it is a long-term social investment to maintain a stable society in the future. However, since the growing demand for affordable housing has continued over the time, government funding cannot provide the ultimate solution for housing affordability. According to Edward Glaeser and Andrew Cuomo's report in March, 2000, there has been continual growth in the affordable housing crisis (Glaeser and Gyourko, 2002).

Urban zoning systems and land use control also provide fundamental distribution for housing affordability at the municipal government level (Glaeser and Gyourko, 2002) in addition to the financial support. Particularly within many North American cities, municipal governments maintain lot size regulation and foot print ratio regulation to maintain and force lower numbers of housing per capita to have a luxurious appearance. They also only permit single family detached houses in many urban residential areas, and many residents in these neighborhoods do not want to have amenities within their territory because they believe high amenities lead to implicit zoning taxes; however, the zoning tax does not impact the marginal cost of additional land (Glaeser and Gyourko, 2002).

1.3.2 SOCIO-DEMOGRAPHICAL CHANGES IN METROPOLISES INCLUDING KOREAN CITIES

As the average monthly income & expenditure curves in Figure 1.5 indicate, by 2008 the average household's total expenditure exceeded their average income due to the

dramatically increasing cost of home ownership. In other words, home affordability in Korean society has been seriously weakened in the last decade, leading many Koreans to give up their home ownership or move to cheaper and smaller houses.

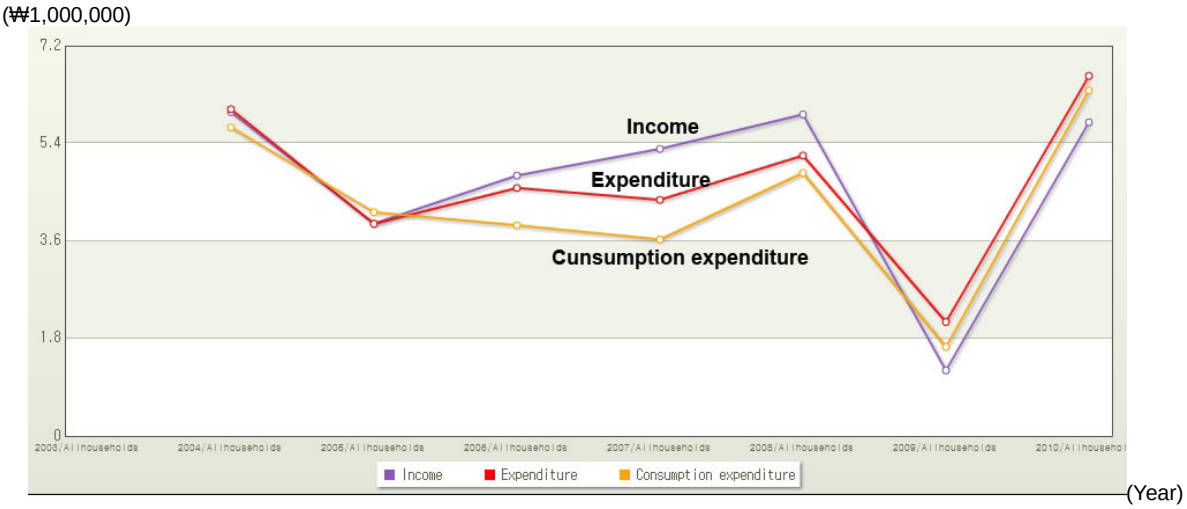


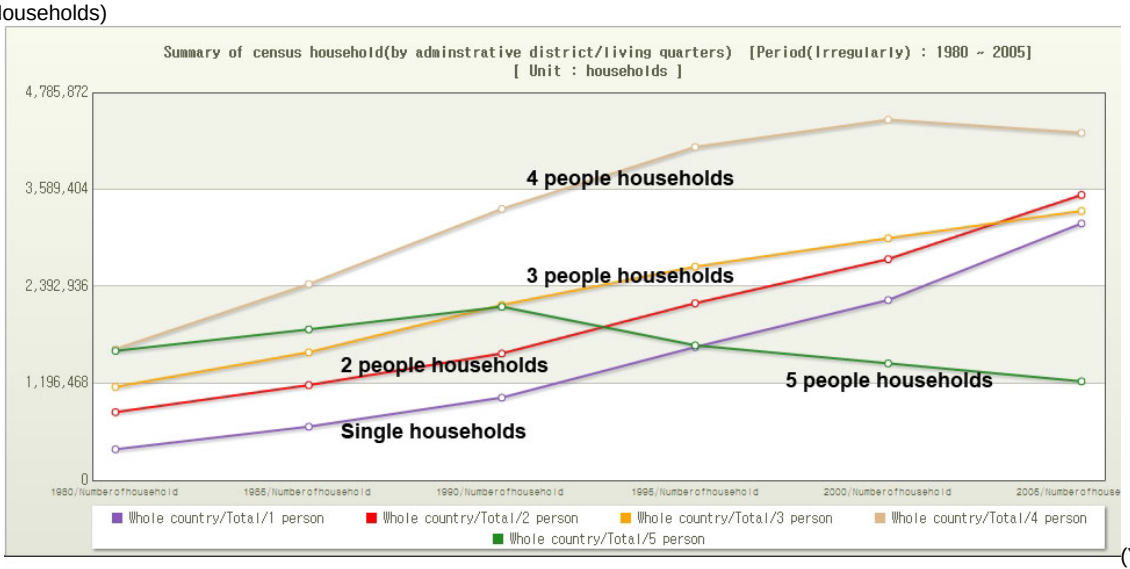
Figure 1.5: Average monthly income & expenditure over last year increase rate in Korea during 2003-2010 (Source: Korean Statistical Information System, 2011).

In the last few decades, post-industrialized nations have undergone significant socio-demographic and life-style changes that have greatly impacted affordable housing. Traditional family compositions continue to fade away as society becomes more complex. Nuclear families became a standard household type as divorce rate increased. Numbers of single parent families have increased rapidly over the last several decades as well as the single family household type (Friedman, 1996). In terms of family size, households tend to have fewer children than ever before; moreover, many families do not have any children at all under the age of 25 living with the parents in the home (Friedman, 1996).

Figure 1.6 indicates significant household type change in Korean society since 1980, following industrialization. The graph shows a rapid increase in single and 2-person households and a subsequent decrease in comparatively larger households over this period of time. More significantly, beginning in the 1970s the birth rate has dropped continuously following the baby boom of the post-war period; as a consequence, the population

percentage of elderly has been increasing. A diminishing youth population with smaller family size has created a scenario in which large houses occupied by middle-class families may be needed to find practical alternative housing design strategies for smaller or non-child households (Freidman, 1996). This phenomenon is not limited to Western countries. In post-industrialized Asian countries including Korea, the birth rate has also dropped rapidly over time, as Figure 1.7 shows below.

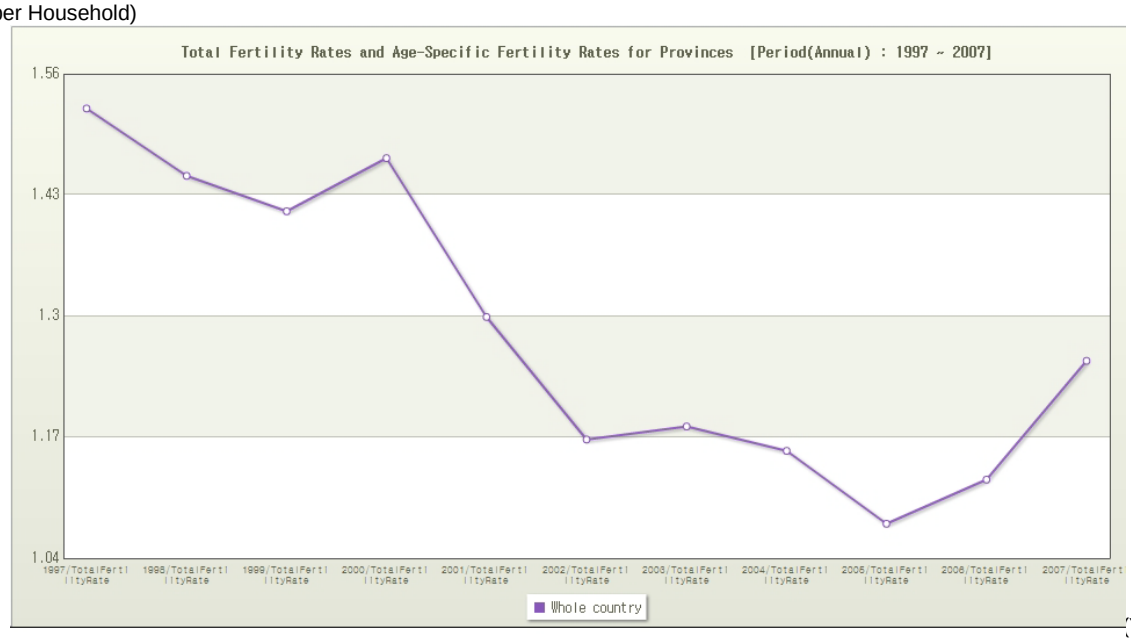
(No. of Households)



(Year)

Figure 1.6: Summary of census household change in Korea during 1980 – 2005 (Source: Korean Statistical Information System, 2011).

(No. of Children per Household)



(Year)

Figure 1.7: Birth rate change in Korea during 1997 – 2007 (Source: Korean Statistical Information System, 2011).

As the data indicate, Korean cities have a growing need for shifts in design approaches, methodologies and policies representing socio-demographic changes in affordable housing to ensure a comfortable, convenient and secure life. This is the reason to introduce new architectural approaches of innovative affordable housing design methodologies for Korean metropolises, especially Seoul, for low and mid-income households who are the backbone of the society.

1.3.3 NECESSITY OF AFFORDABLE HOUSING IN SEOUL

Urban renewal projects, including housing regeneration in Korean cities, have stressed the physical retrofit of deterioration to maximize landlords' profits rather than containing and strengthening urban low-income households (Ha, 2007). Easing poverty (particularly housing poverty) did not follow the economic growth of the nation. Indeed, during the course of industrialization and urbanization, along with rapid economic growth, the economic gap between the poor and the rich widened. Even until the late 1990s, nearly a quarter of households lived in houses that did not meet minimum housing standards in terms of floor space, by which a household of four people must exceed 37 square meters and have basic facilities including running water, a sewer system and electricity (Ha, 2007). Providing proper shelter for low-income households became a serious issue in terms of basic human rights. The housing issue has also led to displacement of the low-income tenants, destabilization of the society, and segregation between the rich and the poor due to high housing costs compared to income level; even middle-income households have to periodically move around to seek cheaper housing. Hence, providing affordable market housing and affordable non-market social housing for both middle-income and low-income households is not only stabilizing society but securing the human right to prevent unnecessary social cost spending.

1.4 RESEARCH QUESTIONS

The research question provides a focal point from which researchers can investigate their topic, and it also serves as a return point when the research veers in unintended directions. As an architect, the author is seeking possible architectural design solutions for theoretical and practical methodologies in housing affordability that can provide security for the urban dweller's life; however, the author will not analyze the financial and socio-political aspects of housing affordability. If the research question can be described in a short sentence, it can be asked as follows:

> "What design strategies and applications of innovative affordable housing methodologies can be used to improve living quality in Korean cities, especially in Seoul?"

1.5 GOALS AND OBJECTIVES

The primary goals of this research are to explore various ranges of innovative affordable housing design methodologies, along with architectural theories and applications regarding affordable design and related urban issues, and to determine whether architectural innovations can really help to achieve housing affordability in the Korean urban and cultural context. The objectives of this study are here to:

- Explore the issues of housing affordability, and affordable development strategies.
- Identify existing design applications and methodologies for affordable housing design in Korea.
- Demonstrate and determine newly adopted architectural innovations for affordable housing design.
- Propose innovative affordable housing design strategies, applications, and methodologies for the Korean context.

1.6 METHODOLOGY

The methodological approach to this research has focused primarily on a combination of literature review and analytical case study. At the beginning of the literature review, the author introduces a brief description of urban planning policies and development methodologies that have effects on affordable housing development programs taken from research on post-industrialized cities.

The analytical case studies, mostly located in North America and Europe, have demonstrated and determined a variety of existing design methodologies as well as showing how the innovative design methodologies and applications investigated through the literature review have been implemented. From the case studies, the research will aim to suggest the applicable innovative affordable housing design tools as qualitative research results rather than quantitative for use in Korean cities, especially in urban renewal areas.

1.7 SCOPE OF THE RESEARCH

Despite the fact that affordable housing development has been around since the beginning of the 20th century, the theories and design approaches have changed over time as society evolved. To establish reasonable limits and concentrate on the research topic, it is important to define the boundary of the research project. The intention of this study is to explore the literature related to the architectural applications and methodologies on high-density and high-rise affordable housing design that is applicable to the Korean context. Furthermore, this research includes the case study reviews of projects that demonstrate where the theories, application, and methodologies from the literature have been implemented successfully from the ideas to the execution of project.

In order to maintain the depth of the topic, this report will not investigate every affordable

design methodology or detailed application from the past. Rather, this research focuses on feasible architectural design innovations applied for affordable housing development in the post-industrialized cities in Korea.

1.8 OUTLINE OF RESEARCH

This report is structured in four chapters. Chapter one provides a brief background of the urban condition, socio-demographical changes, and housing issues existing in Korea, and the research question, scope, and objectives are presented with a broad view of the study.

Chapter two presents the theoretical background of housing affordability with the existing architectural design methodologies practiced from the past and the applicable innovative architectural design methodologies for affordable homes. In this chapter, various architectural design innovations through all fields of architecture will be discussed as potential approaches for housing affordability.

Chapter three provides a broad view of many areas in which innovative affordable design methodologies have been successfully implemented in real world architecture, and it will examine feasibility and effectiveness of the architectural innovations within the frame of housing affordability.

Chapter four, the final chapter, summarizes the information and discussion from chapters one through three and provides the final analysis and recommendations of the feasible affordable design tools based on author’s professional experience in the Korean urban context.

CHAPTER TWO

THEORETICAL FRAME WORK FOR HOUSING AFFORDABILITY AND INNOVATIVE AFFORDABLE DESIGN STRATEGIES

2.1 INTRODUCTION

Achieving housing affordability requires multi-strategy and multi-tactic approaches according to the given urban context, including social, economic and physical elements, but those strategies and tactics do not necessarily need to be new technological interventions. Architectural design innovation often translates differently within different times and places. For example, a simple development strategy, as practiced in Western cultures for many years now, can be considered a new architectural approach in the Asian urban context.

To achieve housing affordability, many development strategies must be considered before technological interventions are sought. Multi-family development is the essential approach for any affordable housing project; it is closely related to high-density and high-rise residential development as well. Mixed-use development strategies are also often considered, especially for affordable housing with urban revitalization development projects within old parts of cities. The concepts of flexibility and adaptability can save initial building construction cost through maximum space utilization, which residents are able to adjust to their lifestyle changes so they can assume an active part in the design of their own space; however, the easiest method of achieving housing affordability is probably to make a house smaller, with efficient use of interior space corresponding to the user's needs.

Innovative design and newly adopted construction methods also help to reduce housing cost. Prefabricated housing is not a newly developed concept; however, it has been adopted only recently in the current construction industry owing to the technical difficulty of the on-site fabrication process. The main idea of this method is to break down building components into parts and to fabricate most of the components in a factory for later assembly on the construction site; therefore, prefabrication reduces field work and leads to saved construction time. Panelization also belongs to the concept of prefabrication in the wider

view. Construction cost and material cost generally play a major role in housing affordability; however, simple low-tech sustainable design technologies can also reduce housing cost for both the short and long term in the complex urban condition.

In this chapter, an in-depth review of the fundamental theoretical framework and newly introduced technological innovations for housing affordability, briefly discussed above, is conducted as the base standard for the case studies.

2.2 FUNDAMENTAL CONCEPTS OF AFFORDABLE HOUSING DESIGN

An expensive home can be considered affordable housing if it meets a certain income target regardless of the initiator, source of funding, type of project and financial aid. According to the U.S. Department of Housing and Urban Development (HUD) in 2012, however, 12 million households, including rented and owned, now pay more than 50 percent of their annual incomes for housing, and a family with a single earner on the minimum wage cannot afford the local rent rate for a two-bedroom apartment in the United States. Michael Stone's idea of 'shelter poverty' is based on a 'market basket' assessment of what families can truly afford for rent after taking into account an estimate of the amount of income needed to cover basic expenditures. The result of this analysis illustrates, for many households, that 30 percent of their income is too high an amount of expenditure; some households can afford absolutely nothing for housing (Bratt, 2002). This analysis is mainly based on what has happened in the U.S.; however, it has increasingly become a global issue. Therefore, the lack of affordable housing is a significant problem for low-income households, preventing them from obtaining their other basic needs, such as food, healthcare, and saving for the future.

Besides the concept of affordability that has been described above, according to Friedman (2005) there are important measuring concepts for affordability; '*access'* is the term that

refers to the ability of future homeowners to receive financing for a home. The '*affordable gap*,' on the other hand, is the difference between the amount a household can pay as a percentage of income without hardship and their actual rent or mortgage payment, i.e. little more than 30 percent (Friedman, 2005).

Even though affordable housing projects for low-income households have been rejected by NIMBY (Not In My Back Yard) neighborhoods in numerous cities, there is a rapidly increasing demand for affordable housing in highly developed counties, and it has made affordable housing an important focus for many architects' practice (Schmitz et al., 2005).

Affordable housing design strategies are a very important tool for reducing the cost of housing; however, there are also many other strategies that can lower the housing cost (Friedman, 2005). For instance, controlling and changing public policy and land use regulation set by the government would be effective tools to make affordable housing more efficient; providing accessible private and government financing such as '*Housing Trust Fund*' or '*Community Land Trusts*' can promote increases in housing development; redevelopment of '*brownfields*' formerly used as industrial sites, and renovation of existing structures in old urban districts, which can offer a cost-saving advantage (Friedman, 2005).

Moreover, reducing the construction cost of a house, which consists of '*hard costs*' and '*soft costs*,' plays another important role in the affordable housing development process. Hard costs normally include the cost of land, i.e. the amount spent on acquiring the project site, development associated with the preparation of the site and infrastructure, material for construction, labor involved in the process of construction, and landscaping. Soft costs consist of the financing that makes a project possible, professional fees for various consultants throughout each stage of development, marketing costs, taxes, overheads incurred by the builder through the project's lifecycle, and profit for the builder (Friedman,

2005).

2.3 AFFORDABLE HOUSING DEVELOPMENT STRATEGIES

2.3.1 MULTI-FAMILY DEVELOPMENT

Multi-family housing is not a new concept in the history of architecture. It can be defined as any building that contains more than one dwelling unit, and it can be stacked or stand by side with a shared exterior wall (Schmitz, 2000). Regardless of dwelling connection types, ownership of the multi-family home comprises three types; condominium, which has individual ownership of each unit with some shared communal elements in the property, cooperative, a non-profit corporation and purchase shares, and timeshare ownership, which has right of use during a specified period of time each year (Schmitz, 2000).

Although large-scale multi-family housing development can help to intensify population in urban areas and is considered to be an important means of achieving housing affordability, zoning rules in many cities prohibit the multi-family development in designated urban areas. Because zoning systems are considered to be regulatory mechanisms that protect property value by controlling local land use, many NIMBY residents in urban areas fear that large-scale multi-family development may initiate the dismantling of the existing zoning rules that protect their property value, and thus they strongly oppose affordable multi-family development projects (Pollakowski et al., 2005).

2.3.2 HIGH-RISE AND HIGH-DENSITY DEVELOPMENT

High-density and high-rise residential building is commonly placed in the category of multi-family housing, and these two terms are strongly correlated (Schmitz, 2000); however, multi-family housing development does not always combine with high-density or high-rise

residential development. High-density or high-rise residential structure is also not a new housing type in the history of architecture. It first appeared in the modern era in the twentieth century, introduced by Le Corbusier, Mies van der Rohe and Walter Gropius. Those modernist architects tried to find a universal answer to urban housing and social problems. In 1925, Le Corbusier proposed the Plan Voisin (Figure 2.8), which was his ambitious solution for the new center of Paris (Millais, 2009). The project also provided for housing the urban poor who lived under extreme conditions including lack of fresh air, natural light, and basic utilities. The concept was to provide affordable housing within a healthy environment that allowed low-income households to enjoy natural sunlight, ventilation to fresh air and large open spaces. Le Corbusier's concept of the Plan Voisin was later adopted as a public housing typology throughout the world, but in 1972, with the demolition of Pruitt-Igoe (Figure 2.9) in St Louis, historians and post-modern architects denounced modernism's idealism as a symbol of architectural failure because it had created other serious urban problems (Millais, 2009). In the industrializing Asian metropolises such as Seoul, Tokyo, Hong Kong, and Taipei, high-rise and high-density lifestyle was accepted at the time as both luxurious Western housing style and affordable housing typology (Yeung, 1983). In the context of affordable housing, however, especially in the mega-cities, Le Corbusier's utopian ideology is still applicable and provides the base line for affordable housing design.

Figure 2.8: Plan Voisin de Paris, reflecting the modernist public housing solution, designed by Le Corbusier in 1925 (Source: Wikipedia.org, nd).

Figure 2.9:The Pruitt-Igoe public housing project designed by Minoru Yamasaki in St Louis became the icon of modernism's architectural failure (Source: Wikipedia.org, nd).

Density can be defined as “a measure of how many dwelling units per acre (hectare) are placed on the site, sharing its land and infrastructure cost” (Friedman, 2005). Expression of density can include gross density of an entire neighborhood, gross density of a specific

project and net density. Those terms refer to the total dwelling units divided by the total land area, the land allocated to the site and the land apportioned to the footprint of the dwelling (Friedman, 2005). Therefore, higher density means the higher potential housing affordability of the site. Floor area (or space) ratio (FAR or FSR) is another key term that is determined by a ratio, the enclosed floor area of a building divided by the area of the lot. The higher FAR or FSR, the more residents share the same lot and basic infrastructures; the building becomes more affordable (Friedman, 2005). Therefore, a combination of a small building lot with higher density will ultimately lead to a saving on land costs that contributes to housing affordability. Indeed, increase of those indexes helps not only to achieve housing affordability but to preserve green areas.

Even though in some countries high-rise and high-density development has been criticized as a living machine that destroys community values and lacks any architectural esthetic, there are feasible benefits, especially when the value of land is too high. New urbanism shares these benefits of high-density development and helps prevent urban sprawl from spreading further into rural areas, increasing the efficiency of urban infrastructure, reducing automobile dependence by promoting public transportation and encouraging social contacts among residents (Zhao, 2010). High-density and high-rise development also reduces the environmental footprint in the urbanized area by improving the efficiency of the existing infrastructure system. Furthermore, recent designs for high-rise and high-density housing projects throughout a wide range of urban contexts have avoided the mistakes of modernism while enhancing the urbanity of architectural esthetics and affordable solutions.

2.3.3 MIXED-USE DEVELOPMENT

Mixed-use development can be defined as a mixture of different functions and activities in a single architectural structure. It has been the predominant means of natural development in most cities throughout history. The typical mixed-use development style comprises

commercial or community space on the ground floor, which is more accessible for public use, and residential space on the upper floors (Liu, 2007). In the late twentieth century, urban planners and architects recognized the potential feasible benefits and advantages of mixed-use development after witnessing the fall of utilitarian urban planning (Liu, 2007). Under mixed-use development, residents can enjoy amenities in close proximity, reducing traveling distance and providing a walkable, pedestrian-friendly environment. The latter reduces individual dependence on automobiles and fuel, and it contributes to a healthy lifestyle through community engagement. It ultimately reduces environmental impacts in urban areas (Liu, 2007).

The biggest advantage of mixed-use development in old urban centers is the urban revitalization that improves livability of the area through enhanced walkability from one space to another. If working places, commercial spaces, services, and recreational spaces are close to homes, people prefer to leave their car and walk to their destination; this naturally creates an economic boost in the area (Liu, 2007).

2.3.4 INFRASTRUCTURE

Efficient use of infrastructure, which is defined as tangible and intangible systems including roads, transportation systems, running water, storm drainage, sewers, electricity and communications systems to provide necessary utilities and comfort, is also one of the cost reduction strategies for affordable housing (Friedman, 2005). These systems are always installed in multi-layer systems, usually with roads and streets. Almost all buildings today are connected with improved and new kinds of infrastructures, and these infrastructures are maintained and installed by tax paid by the residents in the area. Therefore, avoiding extension of the infrastructure can decrease the cost per dwelling, and a compact development shares out these infrastructure costs to improve housing affordability. For example, a simple installation retaining pond or rainwater storage through a green roof

system can save the costs of storm water drainage. Multi-connection of sanitary sewers and water lines for multi-dwelling units can save construction time and piping cost.

2.3.5 CIRCULATION

Road and street systems also play important an role in housing affordability since they are constructed with the funds collected from residents' taxes, and other infrastructures are installed through the circulation system. Usually 30 percent of a residential development site is allocated for roads and parking which are included in the development cost. Therefore, a circulation system for residential development needs to be carefully designed owing to its effect on overall construction costs and esthetic appeal to the community (Friedman, 2005).

Street hierarchy, which is divided into lanes, alleys, subcollectors, collectors, local and areal streets, is the first element to be considered since it is part of a comprehensive movement system of directed traffic flow of vehicles and pedestrians that connects different parts of communities in the area (Friedman, 2005). Linking a newly developed community to existing communities benefits not only the efficient flow of vehicular and human traffic networks but the integration of social networks. For successful networking, human traffic, including bicycles, has to be considered prior to vehicular traffic to reduce automobile dependence and safety of residents through intersection design that is a source of indirect cost reduction (Friedman, 2005).

Traffic speed, parking, bicycle paths and sidewalks are the elements that influence cost-effective factors in the design of local streets (Friedman, 2005). If large trucks and vans are expected to pass, the street needs to be wider. If the traffic volume and speed are low and slow, the road does not necessarily need to be wide. The principle is equally applicable to bicycle paths and pedestrian sidewalks. In streetscape design, many cost-reduction design strategies can be considered in terms of pavement materials, curb design and landscaping.

Bricks or interlocking pavers can be used for slowing down traffic to insure the safety of pedestrians and bicycles. Curbs, divided by different materials or lines, can be placed at the same level as vehicular traffic surface with speed regulators with ‘Xeriscapes,’ dry landscapes that reduce irrigation and vegetation planting costs (Friedman, 2005). All of these methods can be combined to maximize cost-reduction strategies.

2.4 AFFORDABLE HOUSING DESIGN STRATEGIES

2.4.1 OPEN SPACES DESIGN

As Le Corbusier’s Plan Voisin suggested, as housing density increases, the spaces between individual dwelling units need to be increased as well for functional and psychological health. According to Friedman, open spaces design should adopt several key principles. Open spaces need to incorporate existing natural features to reduce costs through conservation design which saves costs for changing existing natural environment. All homes and all residents have to have equal access to open spaces to enjoy sunlight and fresh air; this can also reduce the need for artificial lighting and air conditioning. Open spaces need to be become the green lungs and play area for residents to insure both active recreation and passive recreation. Also, open green spaces can function as integrated storm-water management systems. Large-scale open spaces need to be connected through public transit systems, but regardless of the scale noise and privacy have to be considered. Most importantly, open spaces have to be designed to contribute to the health and well-being of the community (Friedman, 2005).

Innovative landscaping reduces costs for dwelling units. Rather than using lawns, be water-efficient local plants used for ground cover multi-vegetation to save irrigation and use of fertilizer. A mix of hard landscape with low or no maintenance native trees and plant helps achieving affordability. These local trees are used for sunshades preventing heat gaining

during the summer and passive solar gaining during the winter; grouping of trees can be used for protecting and redirecting winter wind to reduce heating costs (Friedman, 2005).

2.4.2 FLEXIBILITY AND ADOPTABILITY IN AFFORDABLE HOUSING

The Modern concept of '*flexibility*' in space was suggested for the first time in 1927 by Mies Van der Rohe when he introduced an inner moving wall in an apartment at an exhibition in Stuttgart, Germany (Friedman, 1996). The concept of flexibility in architecture is described as "the capacity designed into buildings and building programs or technologies to provide an effective initial fit and to facilitate response to future change (Friedman, 1996)." As Figure 2.10 demonstrates, flexible design in affordable housing can accommodate changes to the units and allows for maximum space utilization; therefore, residents are able to adjust and participate in the design of their own space, and they can have control of construction cost as their lifestyle changes (Schneider and Till, 2007). In other words, the user of a house not only gains a voice in the design process but also retains the power to change their space throughout the lifespan of the house (Schneider and Till, 2007). In this case the user or owner rather than the architect takes responsibility for the design. The concept of flexibility best fits with a compact housing style, in which users choose to adapt their small house in response to changes in their lives and households (Friedman, 2005).

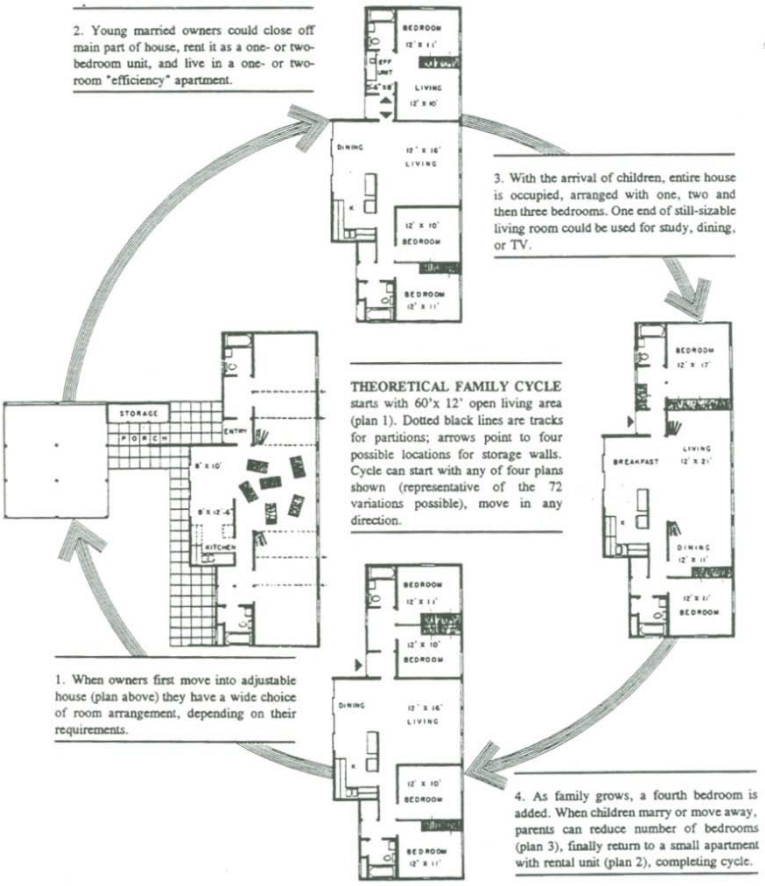


Figure 2.10: Flexible affordable homes: Changes throughout the family lifecycle (Source: Friedman, 1996).

Often the concept of flexibility is confused with the idea of '*adaptability.*' Sometimes these terms are used to explain the same thing. The term adaptability is described as "capable of different social use," whereas flexibility is defined as "capable of different physical arrangements" or issues of form and technique associated with the architectural design process (Schneider and Till, 2007). As Figure 2.11 shows, adaptability relies on designed spaces or physical forms so that people can use spaces in their own way, especially through the organization of rooms, circulation patterns, and designation of the spaces (Schneider and Till, 2007). There is a strategy, however, that achieves both flexibility and adaptability. '"Open building" is an approach in which the "base building or shell" can be fitted out to satisfy a user's requirement (Figure 2.12). "Open building" process combines off-site preparation and on-site installation of prefabricated "packages or infill (Freidman, 1996)."

The downside of the open building concept is that in some cases it could cost more because it needs to build another floor on top of a base floor; even so, it can easily respond to the user's lifestyle changes.

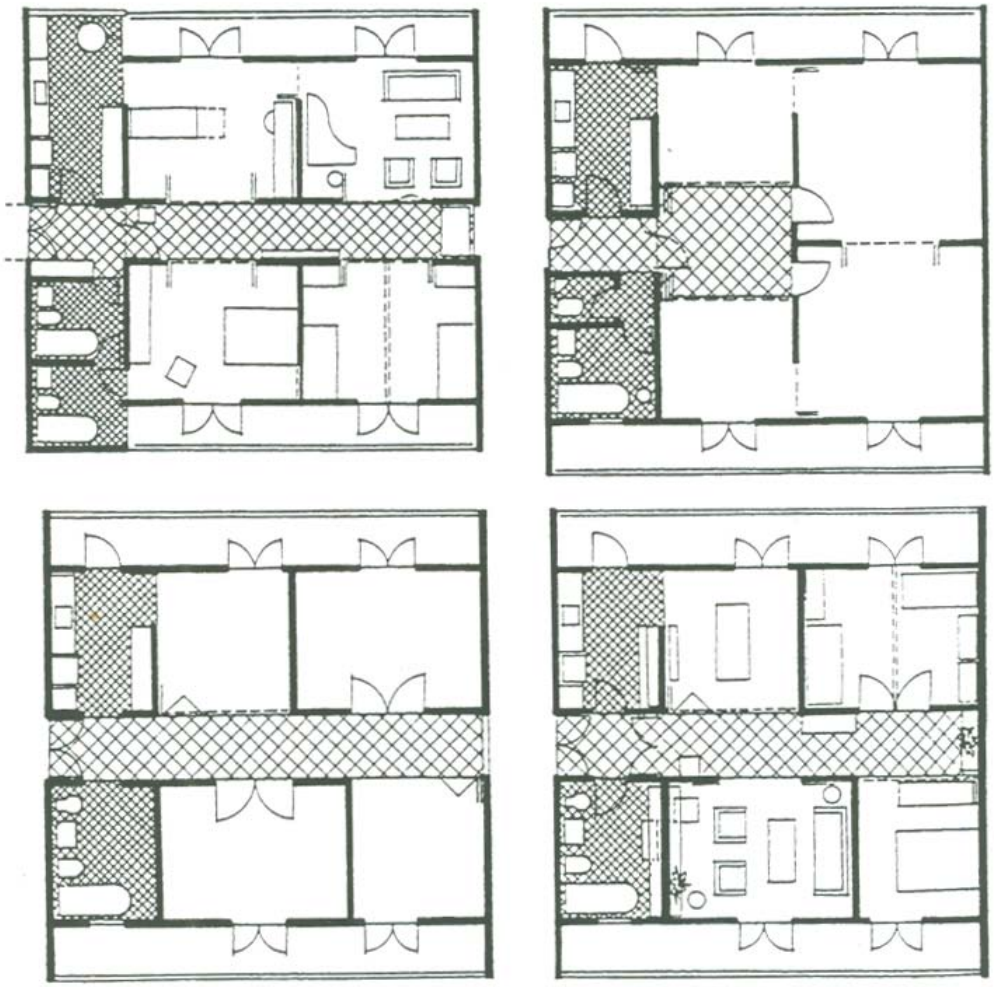


Figure 2.11: Adaptable housing concept (Source: Friedman, 1996).

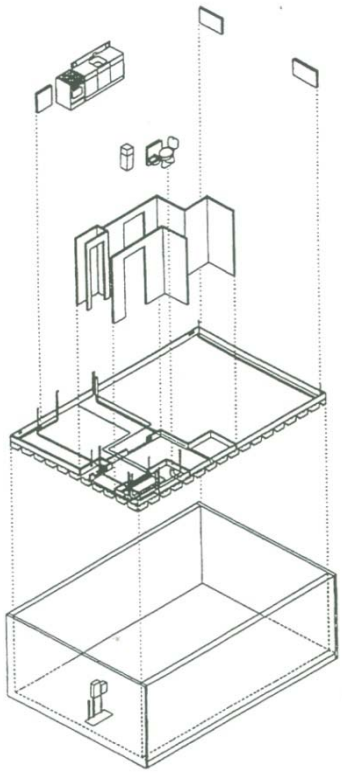


Figure 2.12: Open housing approach: dwelling organized on concept of base building / fit-out (Source: Friedman, 1996).

2.4.3 AFFORDABLE INTERIOR SPACE

The simplest way to reduce housing cost is to use a smaller space. Smaller space requires less energy for heating and cooling, a smaller lot for building, and shorter infrastructure length per unit, which increases efficiency (Friedman, 2005). Architects need to understand that the design and efficient use of interior spaces can allow smaller dwelling units to be both comfortable and functional. Since the conceptual sense of small space varies from culture to culture, the concept of ‘size’ and ‘small’ needs to be understood before the design of small space is undertaken (Friedman, 2005). For example, in North America a single-family detached house is usually larger than 139 square meters, whereas a house for a single family in Korea is commonly around 93 square meters.

A good, affordable interior design can only be achieved if the function of the space integrates with the sense of the space (Friedman, 2005). In terms of improving functionality, careful

observation of lifestyle and the way that users use the space is required. Creating a sense of space is also important to the success of small space design. The two different aspects of a design for small space may seem to contradict one another, but there are some essential design principles that make it possible, such as zoning of interior space, access and circulation, spatial configuration, space-making devices, and finishes (Friedman, 2005).

The interior space can be divided into public, semi-public, and private zones. The individual functions or rooms can be organized according to the three zones or a single function can be separate from other functions. In a space for a single person, a mix of all other functions is also possible in a small unit. Once the zoning in the space has been positioned, the spatial procession has to be considered in order to maximize the comfort and efficiency of the space. At the same time, the distance of circulation has to be minimized and the circulation needs to be multi-purpose, allowing for both movement and other functions. The shape or perimeter of the envelope wrapping the space needs to be minimized in order to reduce the cost of both interior and exterior walls that demand materials and labor. One way to reduce interior walls and make small spaces feel larger is to have an open floor plan or minimize interior partition walls according to the zoning and careful manipulation of ceiling heights for different types of activities. Also, there are many devices that make space based on lifestyle changes and functions, such as pocket doors, demountable wall systems, portable partition systems, sliding screens, furniture partitions, and built-in storage. After creation of the interior space, finishing materials, furniture, and lighting contribute to its comfort, efficiency, and, most importantly, affordability (Friedman, 2005). Even though the principles described above are neither a new concept nor an innovative method, implementation of the interior space design methods for small space plays a significant role in achieving housing affordability.

2.5 INNOVATIVE DESIGN FOR AFFORDABLE HOUSING

There is a skeptical view toward technical innovation for affordable housing. Technical innovation only has limited power to reduce housing development cost (Schmitz et al., 2005). In contrast, design innovation can contribute to bringing housing cost down in many ways, especially with regard to affordable housing development. The building construction industry's concern for liability issues regarding the use of new technologies has led to a conservative relationship with its client base. Architects who see affordable housing as an important area of their practice will always try to find innovative design methods and applications for affordable housing. Often the production of affordable housing design therefore has greater success than market housing; often a very limited budget forces designers to reach outstanding creativity (Schmitz et al., 2005).

There are many obstacles that affordable housing has to overcome in terms of innovation; however, affordable housing must produce outstanding design results which demonstrate an efficient use of space and material, and it must serve the community as a tool for overcoming the barrier that affordable housing is faced with. Good architectural affordable housing design is the ultimate everlasting tool for changing negative views of affordable homes in our society (Schmitz et al., 2005). For good design, many architects think that technical and design innovation must be followed.

2.5.1 PREFABRICATED HOUSING

One of the innovative affordable housing design methods is '*prefabricatio*n' or '*prefabricated housing*.' Prefabricated housing is commonly regarded as a construction method; however, before its actual assembly, a unique design process must be followed from the form to the detail. Therefore prefabricated housing can fall in the category of architectural design. In

North America the concept of prefabricated housing is not new, whereas in Korea the prefabricated housing industry does not exist except for steel container boxes for temporary field offices on construction sites. The central government of Korea does not allow prefabricated housing systems for permanent multi-family housing; however, a recent movement for prefabricated housing has grown, and the government is looking to use it to positively support the growing demand for affordable housing in urban areas. As prefabricated housing is generally constructed almost 90 percent offsite, it minimizes the fieldwork affected by climate changes and site conditions through the construction process (Winter, 2006). This shortens the duration of construction and makes it easier to supply the quantities of materials that the housing market demands. Figure 2.13 shows that prefabricated construction reduces construction schedules by more than four weeks, at least 35 percent time saving compared with conventional construction, and it leads to a significant decrease in project cost (McGraw-Hill Construction, 2011).

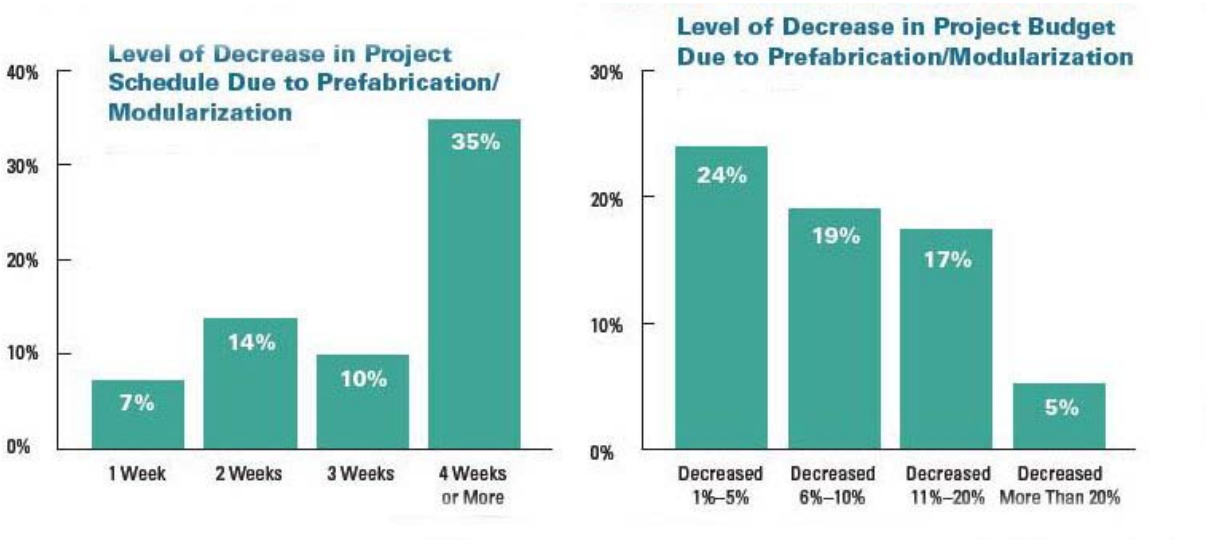


Figure 2.13: Construction time and cost reduction percentage of prefabricated construction compared with conventional construction (Source: McGraw-Hill Construction, 2011).

Figure 2.14 illustrates the fundamental difference between conventional building construction which assembles every building component on-site and prefabricated construction. Prefabricated housing assembles standard manufactured building components in a factory, which offers builders to have total control of production quality. The downside of

prefabricated housing is that this system is not inexpensive when compared with conventional building construction methods, which are applied largely on-site. Today's technological improvement, however, has been reducing the cost of prefabricated housing (Badanes, 2004). Another drawback of prefabricated housing is that it is not easy to comply with different clients' needs and design choices for clients are limited.

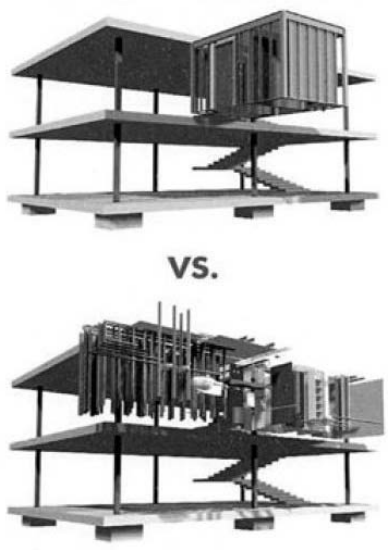


Figure 2.14: Conceptual image of prefabricated housing compared with traditional approach to building (Source: Winter, 2006).

2.5.1.1 PANELIZATION

The concept of '*panelization*' in affordable housing design can be described as a hybrid between prefabrication and conventional methods. It is a way of assembling a variety of building components off-site that might include panelized walls and chunks that are to minimize the components, joints and parts to bring them together on the project site (Winter, 2006). Therefore, the concept of panelization belongs to the prefabricated housing method discussed above, but the essential difference is that the panelization method only produces building components in a factory before shipping the components to the construction site where they are finally assembled, whereas the prefabrication method assembles the building components off-site (Figure 2.15), then transports the prefab house to the project site that already has a foundation and infrastructure. The main advantage of panelization over

prefabrication in terms of design is that this method has more responsive design freedom to arrange the building components according to function, space and form that reflect the client's mandate while maintaining faster construction speed compared with traditional construction methods (Winter, 2006). In addition, the size of the panelized or chunk building parts is smaller than prefabricated housing so that, even though the access to the construction site is limited, it is relatively easy to transport the components.

Figure 2.15: Image of panelization design method during construction (Source: http://www.slenderwall.com/panelization.shtml, 2012).

2.5.2 SUSTAINABLE DESIGN FOR AFFORDABLE HOUSING

Sustainable design for affordable housing is one of the new design innovations for achieving affordability. Before any discussion of green design and sustainable design for affordable housing, the definitions of both terms have to be clarified, because they are often used interchangeably to describe the same situation. According to the Green Development Service arm of the Rocky Mountain Institute, green development is "a field in which pursuit of environmental excellence produces fundamentally better buildings and communities-more comfortable, more efficient, more appealing, and ultimately more profitable (Bradshaw et al.,

2005).” The 1987 report ‘*Our Common Future*’ by the United Nations World Commission on Environment and Development (WCED) introduced the most commonly used definition of the concept: “Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (Berke and Conroy, 2007).” Green design or sustainable design in the world of housing affordability does not necessarily mean additional cost for construction; in some cases the cost of green housing can remain lower than that of standard construction. Green buildings not only improve efficiency of operating cost and associated maintenance costs in the long term but also improve the durability of a building, so that it will last for a long time without frequent replacement, without compromising comfort, which is achieved through a healthier environment including natural light, natural ventilation, fresh indoor air, and natural heating (Bradshaw et al., 2005). According to the cost analysis report ‘The Costs and Benefits of Green Affordable Housing’, which analyzes the development cost of affordable green projects in the USA, the average green development premium is 2.42 percent, and the median value is 2.94 percent of total development cost (Bradshaw et al., 2005). Figure 2.16 demonstrates that the green cost premium ranges from as low as 18.33 percent less than conventional construction cost to as much as 9.09 percent above conventional construction cost in given conditions. This cost increase, however, can usually be offset by energy saving and low-maintenance since initial construction cost normally accounts for only 20 percent of the total lifecycle cost of a building.

	First Green Cost Premium	Premium without Photovoltaic
Twentieth Street	3.17%	3.17%
Arroyo Chico	0.74%	0.74%
Betty Ann	1.92%	1.92%
Brick Capital	1.64%	1.64%
CAST	0.62%	0.62%
Colorado Court	9.09%	4.68%
Erie Ellington	-18.33%	-18.33%
Emeryville	2.95%	2.95%
Johnson Creek	7.25%	7.25%
Linden	0.18%	0.18%
Melrose	2.51%	2.51%
New Homes	8.15%	4.14%
Positive Match	2.93%	2.93%
Riverwalk	6.24%	6.24%
Traugott	4.67%	4.67%
Woodlawn	5.02%	2.32%
Mean	**2.42%**	**1.73%**
Median	**2.94%**	**2.72%**

Figure 2.16: Total development cost premiums for greening (Source: Bradshaw et al., 2005).

2.5.2.1 GREEN ROOF

There are many potential cost-saving and environmental benefits of green roof application within affordable housing design. The green roof system extends the lifespan of a roof by protecting roofing members from UV light, frosts and extreme heat gain; a roofing system with a green roof can double the roof life from 30 years to 60 years (Livingroof.org, 2004). This green roof protection will save the clients' cost in long-term building maintenance.

According to Zinco International, a German green roof manufacturer, the green roof could reduce the cost of heating and cooling fuel or electricity consumption by two liters per square meter within a single year in Frankfurt, Germany. This means that the green roof can recover the cost of installation through reduced heating and cooling costs within two to three years (Livingroof.org, 2004). An example in London reveals the effectiveness of the green roof. An industrial plant installed a green roof; as a result, the top floor underneath the roof did not have to use any heating and cooling units for a year after the installation, and the company saved 25.9 MW of electricity which is equivalent to £4,300 ($6,800 CAD) a year

(Livingroof.org, 2004).

There is also a potential saving in terms of roof drainage and storm water drainage at the ground level. The green roof absorbs water in plants and soil when it rains, and then it releases water back into the air and the bodies of the plants, reducing the amount of storm water runoff. Many engineers and quantity surveyors have a tendency to separate the costs of roof and drainage. If, however, the reduction of the storm water reduces numbers of drainage outlets and spouts, the cost of which relates to the height and roof size of the building, the cost benefit of the green roof ought to be applicable as a cost reduction strategy (Livingroof.org, 2004).

Reusing existing on-site aggregate for green roof construction is highly suitable for reducing roof construction cost since the major opposition to the green roof is that it is believed to be an expensive method compared with conventional roofing methods; however, this is not necessarily true. On-site soil and reused aggregate from existing building material reduce the cost of transportation, grade and screening to be used for the green roof material. In the case of inverted roof insulation, hard landscaping is required to weigh down the insulation, but the weight of the green roof can be substituted for hard landscaping. A 1,000 square meter green roof can save the developer up to $15,800 CAD of the cost of the roof (Livingroof.org, 2004).

Obviously there are factors that affect the cost of the green roof such as its size, height, and type, initial maintenance, type of waterproofing and insulation, and installation method. Involvement of all project participants in the early stages of project development also reduces the cost of the green roof. The charts below provide a cost comparison between green roof construction and conventional roof construction. Many forms of roof construction are practiced; however, the basic roofing systems associated with the green roof are either

the ‘single-ply roof’ or the ‘inverted roof.’ The single-ply (Figure 2.17) has insulation beneath the waterproofing and the inverted roof (Figure 2.18) has insulation above the waterproofing, in which case the insulation needs to be weighed down (Livingroof.org, 2004). Figure 2.19 proves the inverted insulation green roof with biodiversity does not necessarily cost more than conventional roofing construction methods. It can be cheaper and environmentally healthier than normal roofing; moreover, it will also reduce maintenance cost over time.

Single-Ply Insulation

Components	Conventional Roof		Green Roof	
	Low-Cost	High-Cost	Low-Cost	High-Cost
Standard	$ 55	$ 90	$ 55	$ 90
Moisture Mat, etc.			$ 27	$ 54
Plants			$ 18	$ 54
Total	**$ 55**	**$ 90**	**$ 100**	**$ 198**

Figure 2.17: Cost comparison table, excluding the cost of structure, between the conventional roof and the green roof system with single-ply insulation (Source: Livingroof.org, 2004).
(The cost table above is based on the currency exchange rate between the UK pound and CAD.)

Inverted Insulation

Components	Conventional Roof		Green Roof	
	Low-Cost	High-Cost	Low-Cost	High-Cost
Waterproofing	$ 36	$ 45	$ 36	$ 45
Insulation	$ 27	$ 29	$ 27	$ 29
Hard Landscaping	$ 22	$ 45		
Growing Medium			$ 18	$ 22
Plants			$ 18	$ 54
Total	**$ 85**	**$ 116**	**$ 99**	**$ 150**

Figure 2.18: Cost comparison table, excluding the cost of structure, between the conventional roof and the green roof system with inverted insulation (Source: Livingroof.org, 2004).
(The cost table above is based on the currency exchange rate between the UK pound and CAD)

Biodiversity Inverted Insulation with Green Roof

Components	Conventional Roof		Green Roof	
	Low-Cost	High-Cost	Low-Cost	High-Cost
Waterproofing	$ 36	$ 45	$ 36	$ 45
Insulation	$ 27	$ 29	$ 27	$ 29
Hard Landscaping	$ 22	$ 45		
Growing Medium				
Plants				
Fleece			$ 2	$ 9
Seeds				
Total	**$ 85**	**$ 116**	**$ 65**	**$ 83**

Figure 2.19: Cost comparison table, excluding the cost of structure, between the conventional roof and the biodiversity green roof system with inverted insulation (Source: Livingroof.org, 2004).
(The cost table above is based on the currency exchange rate between the UK pound and CAD.)

2.5.2.2 NATURAL VENTILATION AND LIGHTING

Natural ventilation systems depend on the power of nature including wind, pressure, and temperature differences between spaces to bring fresh air into a building. The fundamental principle of airflow is that air moves from areas of high pressure to areas of low pressure and hot air moves up whereas cool air moves down. Natural ventilation systems are not often used as the only means of ventilation; they are usually combined with a mechanical ventilation system. Most ventilation systems used in a building are hybrid or mixed mode ventilation systems (Sustainability Vitoria, nd).

Since Canadian buildings and homes have become more airtight after the Second World War, some argue that, compared with full mechanical ventilation systems, natural ventilation is less predictable in terms of indoor environments (Fugler, 2008). There are, however, more benefits from the appropriate use of natural ventilation with a mechanical ventilation system. The main benefit of natural ventilation is a substantial amount of energy-saving by decreasing or eliminating the use of mechanical cooling to reduce maintenance costs in the long term. It also improves indoor air quality, which can provide a very pleasant and comfortable interior environment for users. Natural ventilation systems increase their efficiency up to 40 percent when applied to narrow buildings with minimal exterior air and noise pollution and an open floor plan (Sustainability Vitoria, nd).

Natural ventilation systems are divided into three types: cross-ventilation, stack ventilation, and night ventilation (Baker, 2011). Cross-ventilation (Figure 2.20 left) uses air-pressure differential by means of wind power. This mode of natural ventilation strongly depends on wind availability and direction. To increase ventilation efficiency, the depth of a building should not be more than five times its ceiling height (Sustainability Vitoria, nd). Stack

ventilation (Figure 2.20 center) uses buoyancy of air caused by the temperature differences between hot and cold air. Night ventilation (Figure 2.20 right) uses cold night air to cool down the structure of a building so that it can absorb heat gains in the daytime; it also prevents the daytime temperature rise of a building. Benefits of all modes of natural ventilation include maintaining minimum air quality, removing heat, and thermal comfort through movement of air (Baker, 2011).

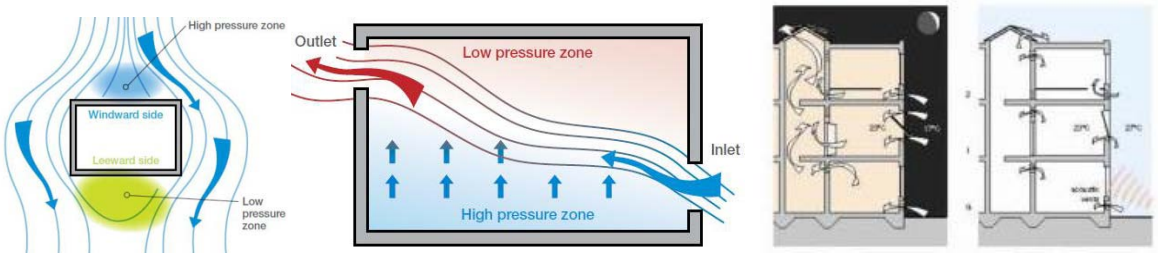


Figure 2.20: Modes of natural ventilation systems; cross-ventilation (left), stack ventilation (center), night ventilation (right) (Source: Sustainable Victoria, nd).

Daylighting is controlled admission of direct or indirect natural light through windows and skylights to increase living comfort and to reduce energy consumption for artificial lighting during the daytime (Ander, 2011). There is a more important benefit, however. Daylighting has a huge psychological effect on human activities by influencing hormonal levels and biological rhythms. The success of daylighting depends on three major factors: the shape of the space, the building orientation and direction of windows, and the condition of the interior surface (Robertson, 2011). Types of daylighting technologies are exterior shading and control devices, glazing materials, aperture location, reflectance of room surfaces, and integration with electric lighting controls; integrating these daylighting technologies with passive daylighting design can save from $ 0.05 to $ 0.20 per square foot annually (Ander, 2011).

2.5.2.3 ACHIEVING NEW GREEN HOUSING AFFORDABILITY FOR THE FUTURE

It is obvious that no single sustainable or green design strategy can fully attain cost reduction and housing affordability. Sustainable affordable housing requires multi-disciplinary approaches, including clients, developers, consultants, engineers, architects and communities, and strategies to reach its goal of green affordability. The concept of green affordability not only relies on the home itself as a community to save construction and maintenance costs but also on the residents' adoption of a healthy lifestyle. For example, urban agriculture is introduced in this concept as a way to fight the food crisis of the urban poor and as an inspiration for other citizens to implement this healthier lifestyle (Kimmelman, 2011). In order to achieve green affordability it is also necessary to facilitate access to the knowledge of green design benefits for both developers and low-income households.

2.6 CONCLUSION

In terms of achieving affordable housing, government support programs and policies play a huge role. Without the government’s financial support and funding by financial institutions, affordable housing development is nearly impossible. Among the many kinds of government financial support, government subsidy is the most effective means of boosting affordable home projects for low-income families in urban areas. Also, urban zoning regulations and land use policies affected by urban planners and policy-makers are key elements in housing affordability.

In order to reach the goal of affordability, several development methodologies must be taken into account, such as multi-family, high-rise, and high-density development, especially in areas where the cost of land is high. In fact, these methods of development are not new

approaches. Also, the biggest benefit of high-density development is its prevention of the spread of urban sprawl, which also reduces environmental impact. Another important tool is mixed-use development. It is actually turning back to old urban street scenery, which relies on the coexistence of retail spaces and residential space. Mixed-use development also has cross-relationships with the revitalization of old urban areas, which brings life back to these areas and, moreover, creates healthy environments and an economic boost for the neighborhood.

Innovative affordable housing design methodologies do not increase housing cost; rather they bring down housing cost in many ways. Owing to the nature of affordable housing development, architects have to be creative to provide the best design solution to overcome negative preconceptions of affordable housing. This means that the design must be excellent it is to maintain and increase the value of the building. Green design or sustainable design for affordable housing development is relatively new, and green design also suffers from preconceptions as an expansive design approach, which leads to increasing costs of development. Green building, however, does not necessarily cost more than conventional building. Especially in the long-term perspective, it not only helps to reduce unnecessary maintenance and replacement costs but it also enhances affordability through increasing the durability of the building and eventually leads to cost reduction in the long-term. Most of all, the greatest benefit from making affordable housing green is providing a healthy lifestyle for its residents and surrounding neighbors.

CHAPTER THREE

CASE STUDIES

3.1 INTRODUCTION

This chapter will introduce different types of high-rise affordable housing projects including social housing projects in North American metropolises to illustrate how to achieve housing affordability and the kinds of affordable development and innovative low-cost design strategies that were applied. The projects introduced in this chapter are carefully chosen and regarded as successful affordable housing projects under the given urban conditions; they also constitute well-known projects among the local and architectural society.

Since these projects were recently constructed, they represent new trends in innovative affordable housing design strategies such as mixed-use development, high-density housing and, especially, sustainable residential design. Almost every government in North America sees these development and design approaches as basic concepts for future affordable housing programs which reduce the affordable gap between low-income families and relatively wealthier households to maintain economic growth and social stability.

After a review of the literature describing many possible projects suitable for the case study, recently completed and relatively large-scale affordable housing projects in the Canadian and American metropolises where cities are highly populated and industrialized were selected to draw relevant comparisons in a similar urban context to that of Seoul and to produce creditable recommendations.

The study of the projects is mainly conducted by analysis of related literatures and illustrations and site visits. The cases are analyzed under two main categories, affordable development strategy and affordable design strategy. The main categories are divided into several sub-categories: support programs, development type, density, space organization, building material, construction method, and sustainability. Cases may share some common

affordable strategies for dealing with new urban environments, and also have specific architectural design approaches and tactics to solve housing affordability dependent on specific criteria set by local government, residents and municipalities. Some cases focus on the more social and urban aspects of affordability such as urban revitalization and income generation for the residents and their neighbors; other cases emphasize green and sustainable affordable design to lower long-term cost for the residents and generate income through green applications. Some try to achieve a balance between making building green and cost-reduction design strategies through effective space organization. Hence, each case listed in this chapter describes its own affordable housing strategies that put more emphasis on a specific area for achieving housing affordability in their given circumstances and urban context.

3.2 WOODWARD'S REDEVELOPMENT PROJECT

3.2.1 PROJECT DESCRIPTION

Location: 100 west Hastings in Vancouver, BC, Canada

Architect: Henriquez Partners Architects

Developer: Westbank Projects / Peterson Investment Group

Community advisor: PHS Community Services

Development Type: Mixed-used residential housing

Numbers of Units: 536 market units / 200 low-income non-market units

Project Budget: $400 million

Size: 111,484 square meters

Estimated Cost per Square Meter: $ 3,588 per square meters ($ 333 per square foot)

Status: Completed in 2010

Woodward's redevelopment project (Figure 3.21) is located in the East Side downtown in Vancouver (Figure 3.22). The redevelopment project program comprises multi-use spaces including 536 market and 200 low-income affordable housing units (75 non-market family units and 125 non-market single units), food and drug stores, retail, urban green space, public plaza, federal and civic offices, a daycare center, and the Simon Fraser University (SFU) downtown campus, the School for Contemporary Arts (Henriquez Partners Architects, nd). The oldest part of the complex was restored and designated as non-profit community space including civic offices and non-profit organizations' offices. The Woodward redevelopment project is one of the largest mixed-use projects in the history of Vancouver (Henriquez Partners Architects, nd). Woodward's complex architectural and urban design program demonstrates many aspects of a healthy, livable and affordable neighborhood. Henriquez Partners Architects assembled a project team, including developer Westbank Projects / Peterson Investment Group and community adviser PHS Community Services, to

enter the competition and was selected for the project in September 2004 (Henriquez Partners Architects, nd).

Figure 3.21: Woodward's redevelopment project in Vancouver, BC by Henriquez Partners Architects (Source: http://henriquezpartners.com, nd).

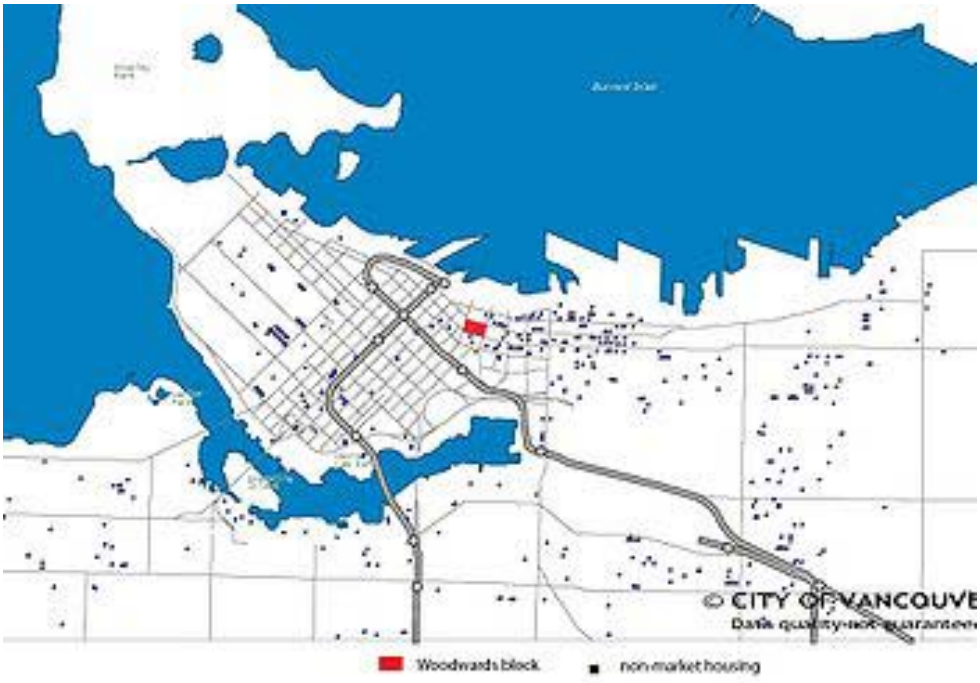


Figure 3.22: Location of Woodward redevelopment project (Source: City of Vancouver, nd).

3.2.2 BACKGROUND OF THE PROJECT

The Woodward's department store was originally built on the corner of Hastings and Abbott Streets in 1903, and it grew to take up half the block of Hastings, Abbott, Cordova, and Cambie Streets (City of Vancouver, 2007). For many decades, Woodward's was one of Vancouver's major commercial destinations (Figure 3.23). According to the City of Vancouver, in 1993 Woodward's closed down the Hastings Street department store, and the property was sold to Fama Holdings for redevelopment as a mixed-use project, consisting of condominium units, commercial space and retail space. Fama Holdings' development plan generated substantial resistance among the downtown low-income communities, however. In fact the Fama Holdings' plan did not include any social affordable housing for low-income families (City of Vancouver, 2007). Then in 1996 the Province agreed to fund 200 low-income affordable rental units in the redevelopment; however, Fama Holdings and the Province failed to reach consensus. In 2001 the Province bought the property for $22 million and then finally it was sold to City of Vancouver for $5 million in 2003. The architectural competition for redevelopment was launched in 2004 (City of Vancouver, 2007).

Figure 3.23: Historic picture of Woodward Department Store (Source: City of Vancouver archives, nd).

3.2.2.1 PROJECT GUIDELINE AND DESIGN CONCEPT FOR COMPETITION

The City of Vancouver set redevelopment guidelines and design principles for the urban revitalization projects whereby all participants had to submit a design solution that met the following requirements (City of Vancouver, 2007).

> *"•be an urban revitalization catalyst.*
> *•maintain and enhance the existing community.*
> *•incorporate the talents, visions and desires of the Downtown Eastside community.*
> *• incorporate the talents and ideas of people throughout the city.*
> *•provide employment opportunities for local residents in both the construction and operation of the new building.*
> *•provide opportunities and create synergies for local owners and businesses.*
> *•incorporate user group involvement in the design process.*
> *•celebrate the symbolism of the historic building.*
> *•be financially viable and self-sustaining.*
> *•be developed in a timely manner.*
> *•include at least 100 units of non-market housing.*
> *•be open and inclusive.*"

According to City of Vancouver, the original Woodward's building on the corner of West Hastings and Abbott Streets includes community non-profit space and a proposed child development center. The original "W" Tower is replaced on the roof (Figure 3.24). The Abbott Street mixed-use building comprises retail, offices, family non-market residential and market residential units. The West Hastings Street building houses retail, the SFU downtown campus, and single non-market units (Figure 3.24). The 'W' building is located at the corner of Cordova Street; the 40-storey building comprises 330 market units with 36 Vancouver Resource Society (VRS) accessible units (Figure 3.24). This building demarcates the urban park and public open space along with the West Hastings Street building to the south (City of Vancouver, 2007).

Figure 3.24: Study models for the competition (Source: City of Vancouver, nd).

3.2.3 AFFORDABLE DEVELOPMENT STRATEGIES

According to Statistics Canada, the median total annual income level of all households in Vancouver was $ 67,090 in 2010 (Statistics Canada, 2012). The market units' housing price varied from as little as $350,000 for one-bedroom units (52 square meters) to as much as $810,000 for two-bedroom units (108 square meters) and the median price is approximately $ 580,000 in 2012 (Peterson and Twarog, nd). If someone with an AMI of $ 67,000 bought a one-bedroom unit costing $ 350,000 with a 30-year mortgage at a 3.8 percent fixed interest rate, the monthly cost would be $ 1,300 mortgage repayment with a $276 maintenance fee. As a result, the monthly housing cost would remain below 30 percent of the purchaser's income. The same household buying a two-bedroom housing unit, however, would spend

more than 30 percent of its income.

Even though these results suggest that the market units are probably unaffordable, comparison of current housing prices in Vancouver reveals the fact that the current housing prices of Woodward's market housing units are relatively affordable since the average housing cost is $ 2.4 million for Vancouver's West Side and $ 943,000 for the East Side (Wood, 2012). In addition, the average housing construction cost in Vancouver is roughly $ 3,230 per square meter ($ 300 per square foot) (*The Vancouver Sun*, 2010). In comparison with the average housing construction cost per square meter in Vancouver and Woodward's construction cost per square meter, the Woodward's redevelopment construction cost is slightly higher than the average. Woodward's, however, includes the community and the commercial areas construction costs. Thus the actual construction cost per square meter for residential units is lower than the average.

An important thing to remember, however, is this project focused on providing non-market affordable rental units for the low-income households in the neighborhood. The monthly rent is $ 425 for non-market family units and $ 375 for non-market single units for those who earn less than 30 percent of median household income with Government Transfer Payment receipt (Woo, nd). Thus, affordable housing development and design strategies of high-profit organizations need to focus on achieving both large-scale commercial urban renewal projects and affordable social housing programs.

3.2.3.1 MIXED-USE DEVELOPMENT

According to Gregory Henriquez, his design team's goal for the Woodward's project was to use "architecture as a container for social development and shape our cities physically and socially" (Grdadolnik, 2006). To achieve this broad view, the main strategy for the project

team meant creating a mixed-use urban context where commercial, community, and residential spaces co-existed in close proximity to each other so that it became a secondary urban commercial core providing employment opportunities and economic benefits for the neighbors including the residents.

Grocery outlets and a variety of mixed retail shops not only meet the needs of the local residents including those who live in the Woodward's, but also attract shoppers and tourists into the area to generate positive economic activity in the neighborhood (Figure 3.25). The building also includes employment opportunities which local community residents are able to access and they also have the opportunity to invest and found their own small businesses; there are public and community services such as daycare, meeting rooms and space available for public use, and space for non-profit organizations (Figure 3.26) (Pérez-Gómez et al., 2006). After completion of the project, the city witnessed the revival of the surrounding neighborhood with small private retailers and restaurants nearby streets. The large chain stores including TD Canada Trust Bank also agreed to hire and train local workers in the area (Weder, 2011). Cultural uses of the building provide a wide range of activities as well, including art galleries, theaters and artists' work studios (Figure 3.26); the emphasis is on cultural performance spaces in the building and multi-functional spaces which provide a stage / amphitheater for an attractive variety of shows, presentations, plays, and concerts. The mixed-use strategy also reduces travel time for the residents and the necessity of driving cars; it leads to a saving on transportation and related costs that have been rapidly increasing and are expected to increase even more owing to global energy cost. In other words, the mixed-use development strategy helped to achieve housing affordability for low-income residents by providing the necessary economic stability to insure their housing for the long term.

Figure 3.25: The Woodward's atrium was transformed into a dining room (Source: Henriquez Partners Architects, nd).

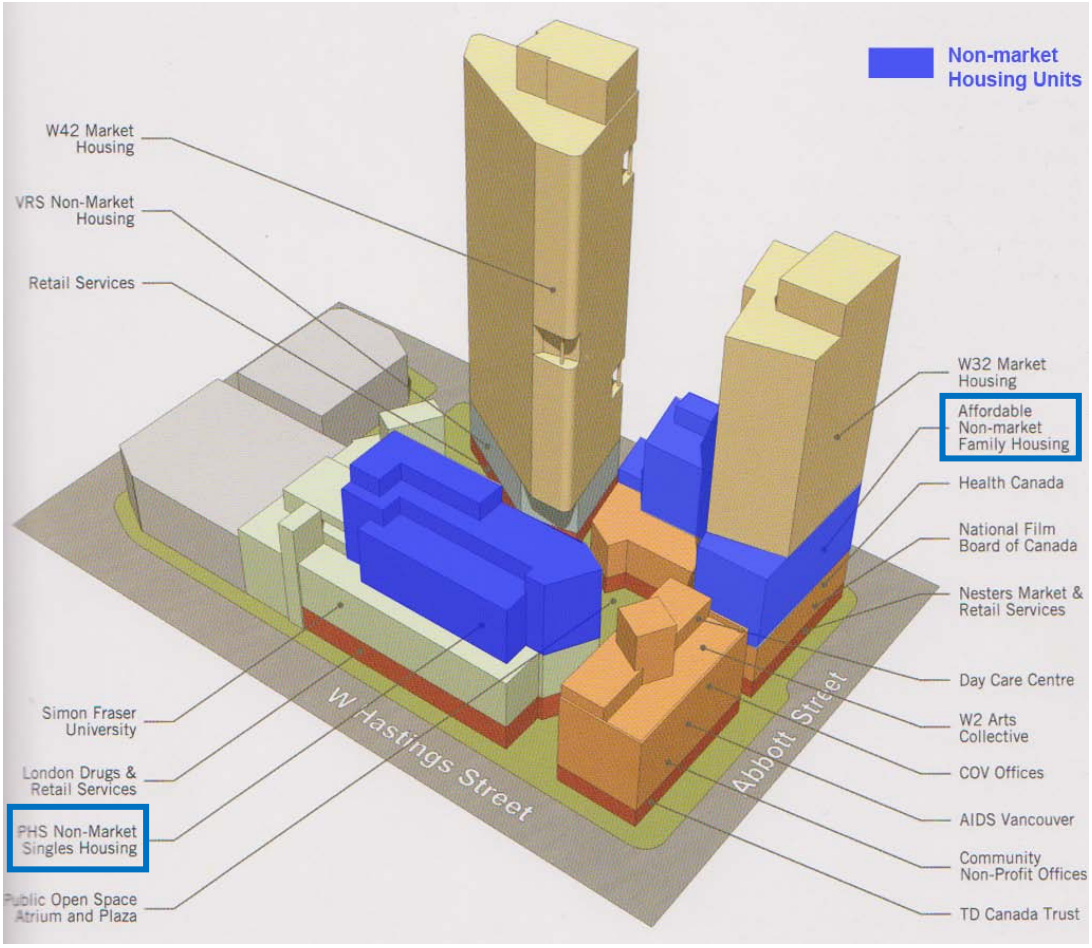


Figure 3.26: Woodward's mixed-use space program (Source: Enright, 2010).

3.2.3.2 HIGH-DENSITY AND MIXED-INCOME DEVELOPMENT

Mixed-income, high-density development for a variety of family styles and residential life was a key success factor for the Woodward's redevelopment. In fact, the main reason for the failure of Fama Holdings was that they did not reach agreement on 200 non-market housing units because they had not allowed enough building density, which is a key element of financial viability and self-sustainability for most large-scale development projects (City of Vancouver, 2007). After the City of Vancouver purchased the property, the city agreed with the project team to include 200 non-market public housing units in exchange for extra building height and density for the redevelopment to guarantee financial feasibility and self-sustainability, as the project guideline set by the city indicates (Weder, 2011). At the final stage of the design, the design team decided sufficient density was 9.5 FSR (originally 7.3 FSR) per 134 meters of building height, and the city accepted the final scheme (Enright, 2010). According to the administrative report in March 2006, 'Woodward's Heritage Revitalization Agreement,' increase in building height and higher FSR acquired bonus density of 17,373 square meters (187,000 square feet) which equates to $ 11,395,000 in private value (McGeough, 2006); it led to a significant reduction in the construction costs.

Mixed-income development literally means that the rich and the poor live in the same neighborhood, building, or complex. In many cases, including the Woodward's redevelopment project, the developers sell market housing units for profit and then they build low-income non-market affordable units with the resulting profit. Buyers of the market housing, however, want high levels of privacy and security, so the project team introduced zoning of market housing and non-market housing by building height, separated building mass and building access, yet keeping close proximity (Figure 3.27). Even though, City of Vancouver allowed the developer to pursuits 15 percent of development profit from market

units and commercial spaces as a part of total compensation ($ 23.6 million) for non-market affordable housing units, the development profit is not the only financial factor for the private developer to participate in achieving affordable social housing (McGeough, 2006). Indeed, government and public sector financial support also play an important role. However, without the development profit from selling market units, it is nearly impossible to recognize this sort of scheme in the real world owing to lack of financial viability.

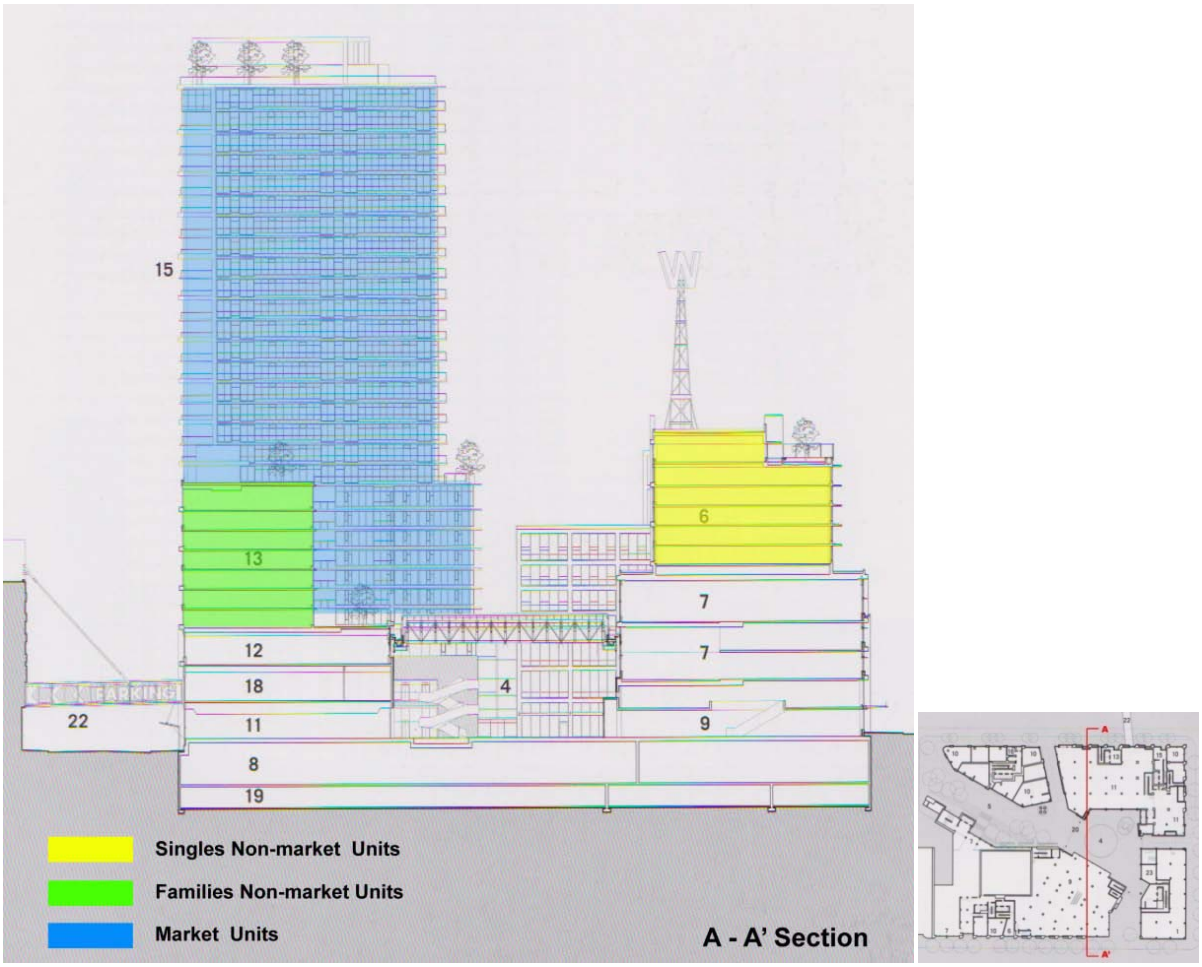


Figure 3.27: North-South Section and Ground Floor Plan (After: Enright, 2010).

The drawing below (Figure 3.28) illustrates self-sufficient units with a variety of unit types, including market and non-market units for families, singles, and the disabled. Cooperative living is a favorable housing model, providing access to common areas, including a kitchen.

A mix of both market and non-market housing (public rental housing) in the building received high ratings as well (Weder, 2011). A flexible design for a studio or loft layout was planned to accommodate lifestyle changes in the units and allow for maximum space utilization.

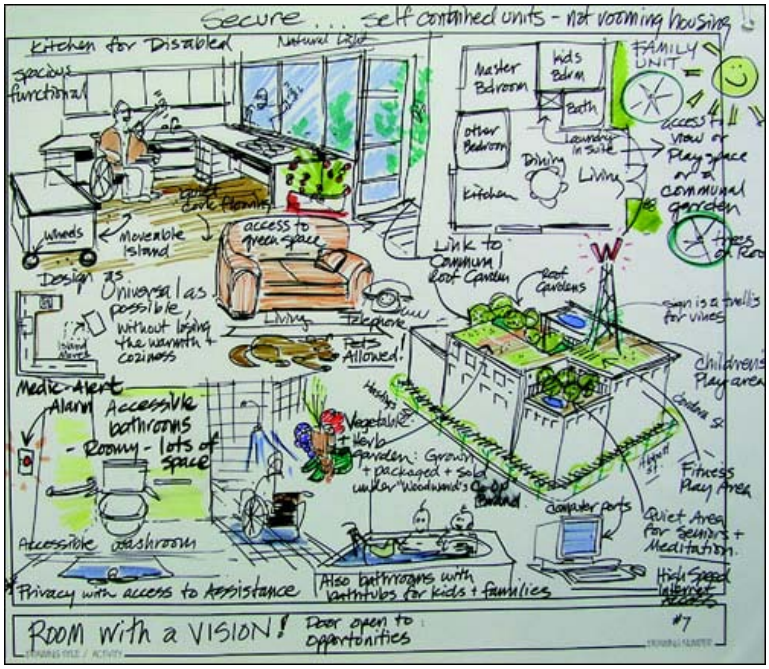


Figure 3.28: Sketch of residential units (Source: Henriquez Partners Architects, nd).

3.2.3.3 GOVERNMENT SUPPORT PROGRAM

Most cities in North America have maintained various zoning regulation systems or policies to control the usage and density of urbanized areas. The City of Vancouver also has a zoning system for urban development. The original Woodward's department store was part of the Downtown District (DD) zone; however, if the project team had observed the DD zone regulation, the mixed-use development strategy would have not been possible. In 2006 during the design process, the city rezoned the project site as a Comprehensive Development District (CD-1) so that the project team could precede the proposed large and complex mixed-use high-density development scheme which the city required two major public amenity qualities (Enright, 2010). The first one was mixed-use development

containing non-profit space as the community wanted. Another component was to purvey a major public gathering space, open to everyone and various ranges of activities that promote a healthy community culture (Enright, 2010). Rezoning also allowed floor space ratio to 9.5 and 134 meters building height (originally 45 meters building height) increasing which consequently led high-density development with affordable low-income public housings. The 200 non-market public housing was the key planning principle of revitalization program which was to redevelop without displacement of existing low-income neighbors (Enright, 2010).

Financial support, excluding development profit, for the Woodward's redevelopment was the Vancouver Agreement in March 2000. The agreement was signed between urban development initiatives of the government Canada, the Province of British Columbia and the City of Vancouver to promote economic development in the Downtown Eastside of Vancouver and to ensure healthy, safe and sustainable life for all residents. Under the agreement, the three levels of government fund supplied for the Woodward's redevelopment project (Enright, 2010).

3.2.4 AFFORDABLE DESIGN STRATEGIES

3.2.4.1 SMALL INTERIOR SPACE

Making use of less interior space and using space efficiently is not only the easiest way but also a fundamental principle of pursuing housing affordability. In the major metropolises in Canada, where the average size of a studio apartment is normally accepted as between 37 square meters (400 square feet) and 47 square meters (500 square feet). In the USA it is normally between 47 square meters (500 square feet) and 56 square meters (600 square feet). In the Woodward's redevelopment project, the key issue of the non-market housing program was providing affordable housing for single households working in Vancouver's

downtown area. The design team limited the size of the non-market single housing units to 33 square meters (357 square feet); meanwhile, interior partition walls were minimally installed and built-in furniture including a single bed provided space efficiency and optimization (Enright, 2010).

Small amounts of interior space require small amounts of construction materials including finishing, plumbing and electric installations, which naturally leads to a saving on total construction cost per unit. As Figure 3.29 illustrates, the length and location of the interior partition walls is minimized to reduce interior construction cost and the kitchen and bathroom are zoned within a unit and the unit next to it in order to shrink the length of utility lines which cost more than living spaces.

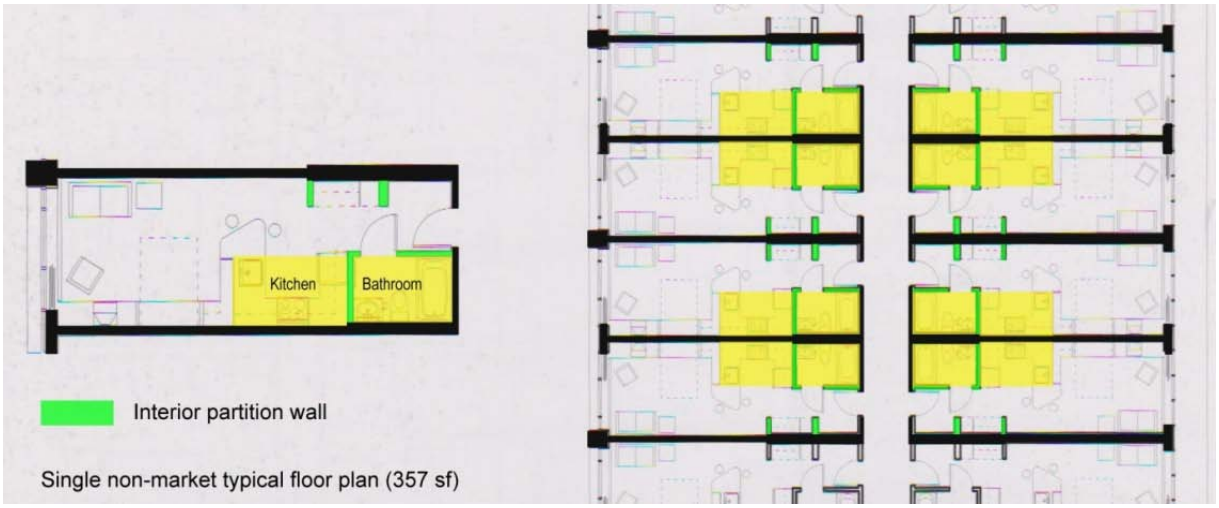


Figure 3.29: Single non-market unit floor / unit plan (After: Enright, 2010).

There are also downsides in designing smaller space. The steps and processes of small housing construction are exactly the same as for normal-sized housing construction; in consequence, the construction cost is higher. Utility spaces including laundry and community spaces in the small unit are very limited owing to its size. As Figure 3.30 explains, in the Woodward's project, the design team placed amenity, public utility, and social activity space between the single non-market residential floor and the commercial floor as a transitional

floor so that the downside of small studio housing, at least partially, was compensated. In addition, the amenity floor provides an opportunity for the single residents to build up a strong community network through using this space. Cities with high housing costs, like Vancouver, mean that small but cheap housing is more and more popular than ever before. For example, near the Woodward's project site (Downtown East Side) small single apartments between 21 square meters (226 square feet) and 27 square meters (291 square feet) attract young single households who desperately need affordable apartments (CBC News, nd).

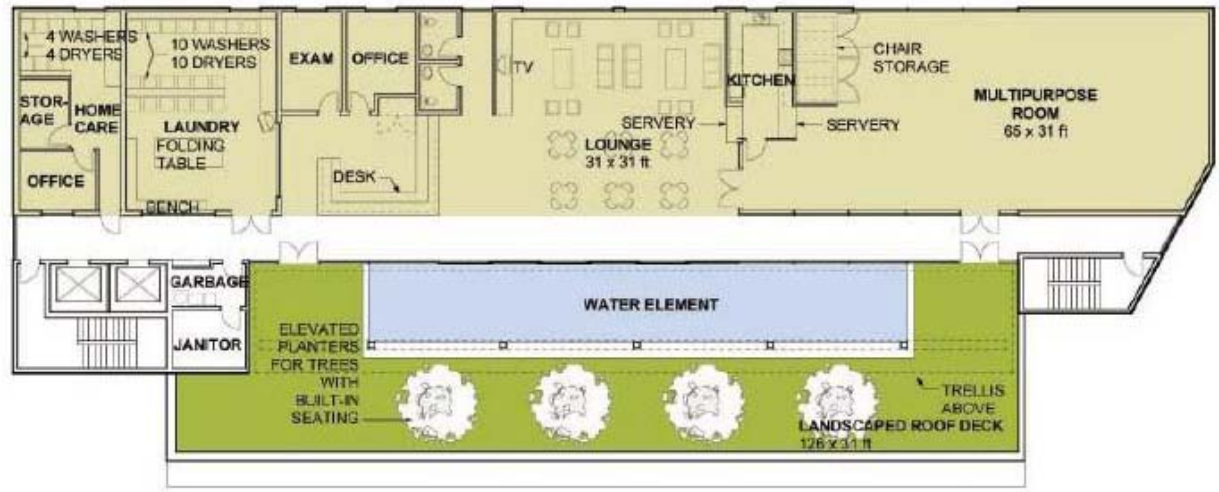


Figure 3.30: West Hastings Street - Singles Non-Market Residential: Amenity Floor Plan (Source: Henriquez Partners Architects, nd).

3.2.4.2 FLEXIBILITY AND ADAPTABILITY

To respond to future changes of lifestyle including changes in family membership, Henriquez Architects provided a level of flexibility in their housing unit design, including market housing. For the one-bedroom units, the design team provided only minimal interior partition wall installation for the bathroom and closet space, a key element in terms of dividing and organizing all the interior space in response to users' lifestyle changes (Figure 3.31). As Figure 3.31 suggests, the original one-bedroom unit can be designed to accommodate many

user needs and lifestyle changes. It can be changed into a two-bedroom unit, when a household adds to its number; in this case, the use of built-in furniture can be very helpful to increase the efficiency of the small space. If a single household uses the unit, it can have a larger bedroom in exchange for living-room space, and it can also be used as one large space for studio-type housing or as a home office in the prestigious Vancouver downtown area.

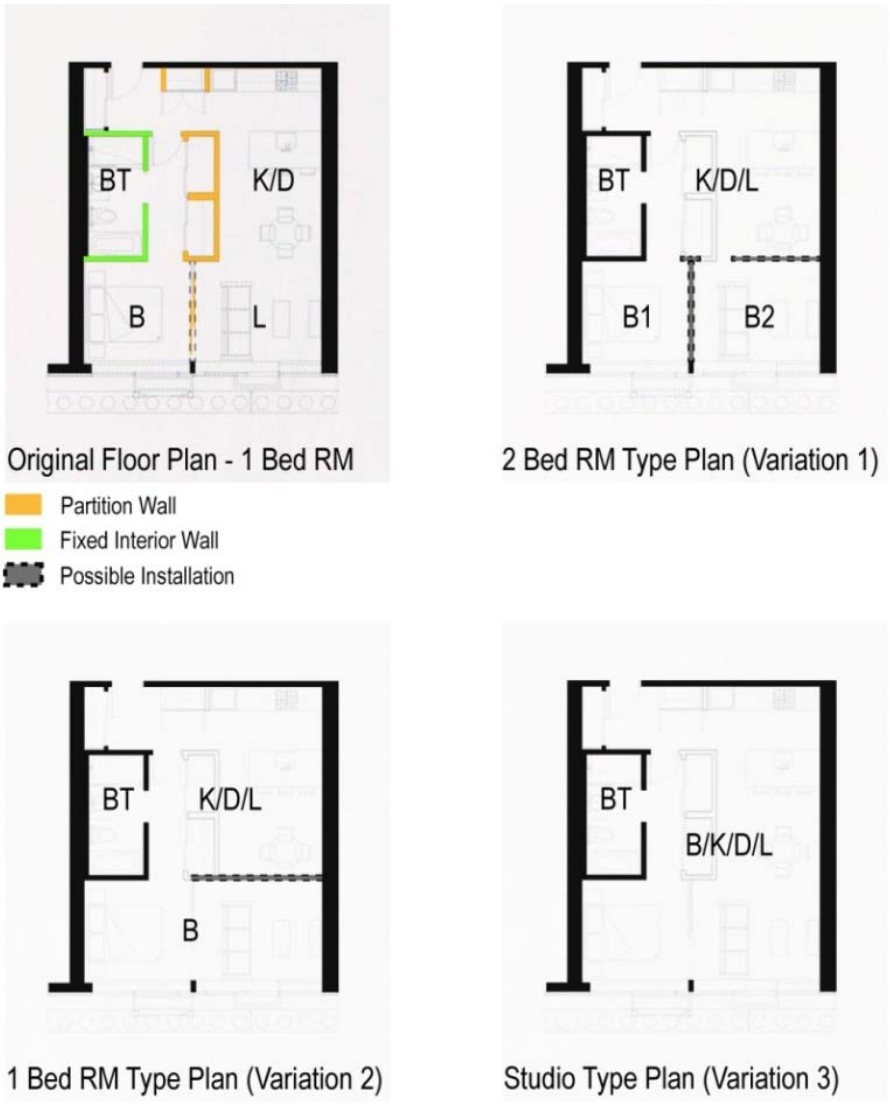


Figure 3.31: Typical one-bedroom unit plan and its possible variations according to users' lifestyle changes (After: Enright, 2010).

3.2.5 SUSTAINABLE AND GREEN STRATEGIES FOR AFFORDABLE HOUSING DESIGN

In terms of sustainable and green design strategies for affordable housing, Henriquez Architects did not consider the green design elements as a key principle for the Woodward's redevelopment project; however, they applied basic simple sustainable features to reduce the long-term maintenance cost which the residents and tenants have to pay and which can be a burden for low-income residents.

3.2.5.1 GREEN ROOF SYSTEM

The Woodward's redevelopment design team suggests a green roof system on the residential units' towers (Figure 3.32). Providing the green roof has become a basic not only sustainable but widely practiced architectural design feature to reduce heat gaining related to cooling cost and rain water runoff related to environmental cost. The green roof creates an amenity space that provides a roof garden for the residents to socialize and relax; it also offers an opportunity to organize a small social network of urban farmers. Nevertheless, some suggest that the green roof systems for affordable housing mean a higher construction cost compared with conventional roofs. The multi-vegetated green roof garden is not necessarily expensive, however, and offers many more benefits than conventional roofs, as discussed. Depending on the roof insulation method the green roof system can actually lower the roof construction cost including the cost of drainage (Livingroof.org, 2004). Prevention of intensive heat gain and frost by the green roof not only expands the lifespan of the roof but also saves energy for cooling and heating for the top floor; therefore, the green roof system needs to be considered as low-tech green design strategy for affordable housing.

Figure 3.32: Green roof gardens on the top of the Woodward's complex (Source: Enright, 2010).

3.2.5.2 NATURAL LIGHTING AND NATURAL VENTILATION

The public courtyard at ground level in the Woodward's complex is divided into two parts; one side has a glass-topped light roof arching the space between the commercial complex zones, and the other side is an open public courtyard hosting a variety of community activities. Since the Woodward's complex takes up the entire block, the interior open courtyard surrounded by the retail stores and public offices is a deep space that inevitably requires a large amount of lighting load which requires unnecessary electricity. The architects applied a large top light to the space so that during daytime the sun lights up the courtyard to reduce lighting load and to create a healthy open space to support a variety of public activities and events (Figure 3.33 left). The uncovered open courtyard lets the air flow through the complex and lets the natural light in to the other side of the complex (Figure 3.33

right). It reduces the energy cost on air circulation and heat gain within the core of the Woodward's complex. It therefore automatically offers the users a pleasant experience and a healthy environment.

Figure 3.33: The interior courtyard (left) and exterior public courtyard (right) at ground level of the Woodward's complex (Source: Westbank.com, nd).

3.2.6 CONCLUSION

Since the Woodward's redevelopment project included commercial private party developers Westbank Projects / Peterson Investment Group to launch the downtown revitalization project (including affordable social housing) planned for decades (City of Vancouver, 2007). Woodward's revitalization project vastly had to stress on mixed-use and mixed-income affordable development strategies guaranteeing commercial and financial feasibility to obtain at lease minimum revenue out of the urban revitalization project. The mixed-use strategy applied for the Woodward's consisted of variety ranges of commercial, community, and cultural uses on a podium space at ground level.

In fact, the success of the urban revitalization mainly depended on the mixed-use program placed in the podium. The main reason that the old Woodward's Department store faded out was that the store did not satisfy the new needs of shoppers and new urban condition due to its own size of business. One big department store cannot easily follow up new shopping

trends, and one misjudgment of the trends leads critical failure affecting on an entire business system. The old Woodward's department store followed the step leading to the end of the business. Learning from the past, the project team planned the program of the podium to be a hybrid mix of business types, scales, usages, business hours and activities. Small retail stores and restaurants could easily respond the changes in shopping trend, and the large scale businesses could bring everyday necessities and groceries. The TD Canada bank financially supported the commercial spaces owners' business. The cultural programs on 3rd floor met the all-in-one shopping trend. The contemporary Art School continuously provided new cultural events. The civic offices and the non-profit organizations offices served both the users' in the building complex and the neighborhood's convenience. These mixtures of different variety could also bring the commercial success of the market housing units, which sold in a day. Shortly after the completion of construction, Woodward's became one of the major shopping destinations in the city and as well as an attractive tourist destination. This success of the commercial program eventually implemented the success of the affordable social housing units for low-income households.

Therefore, this project demonstrates the fact that a private party leading affordable housing project can be successfully accomplished if multi-levels of governmental support including land use policy changes and allowing high-density development can be provided to ensure the feasibility of development. An Affordable housing development solely financed and funded by public sector is not easy to reach the goal of affordability in terms of economy and quality of living. Public decision making process takes many steps that require the longer time to reach a final agreement; it increases the project costs due to the time delay. Moreover, the public funding for affordable housing is usually limited, so the scale of the project consequently becomes smaller; it increases the construction cost per square meters. In contrast, private parties' decision making process is normally faster when they forecast financial feasibility of development. Even more, they have variety of financial sources that

can lead to a large scale housing development reducing unit costs by the economy of scale. In conclusion, the ideal approach of affordable development is a cooperation of public sector including multi-level of government and private commercial developers to reach higher level of housing affordability.

3.3 VIA VERDE (THE GREEN WAY) CO-OP HOUSING

3.3.1 PROJECT DESCRIPTION

Location: Brook Avenue in South Bronx, NY, USA

Architect: Grimshaw Architects (Schematic Design), Dattner Architects (Production Architect)

Developer: Phipps Houses / Jonathan Rose Companies, LLC

Project Budget: $ 99 million USD

Development Type: Mixed-used social housing

Number of Units: 222 units (71 co-op units / 151 low-income rental units)

Size: 26,942 square meters (290,000 square feet)

Estimated Cost per Square Meter: $ 3,675 US per square meter ($ 341 US per square foot)

Status: Completed in 2012

Sustainability: LEED Gold Certification

Via Verde (Figure 3.34) is an area of about 1.5 acres located in the Melrose neighborhood on Brook Avenue, five-minutes' walking distance from local amenities such as convenience stores, restaurants and mass transportation systems. A site visit was conducted to acquire accurate project information and documents during the construction period (Figure 3.35) in December 2011. The project is divided into three interconnected building masses (Figure 3.36), but it is connected through terraced roof gardens and bridges, offering different types of housing for a variety of income levels; 151 rental apartments are provided for low-income households and 71 co-op units for middle-income households, giving a total of 222 housing units (Grimshaw Architects, nd).

Figure 3.34: Via Verde (the Green Way) coop housing in South Bronx, NY designed by Grimshaw Architects (Source: Architectural Record, 2012).

Figure 3.35: Construction of Via Verde rescheduled for completion in early 2012 (Source: ArchDaily, 2011).

Figure 3.36: Space diagram of Via Verde (After: Phipps Houses, nd)

The ground level offers home-office spaces where the resident of the unit can establish his/her office or business. At the center of the complex, a public open space acts as a community space of 883 square meters (9,500 square feet) comprised of a series of gardens with a shared plaza for community gathering and an outdoor amphitheater attached to the green roof farm. The roof of the complex is also designed to collect rainwater which is used to irrigate the fruit and vegetables on the roof farm. Via Verde was envisioned to exceed LEED GOLD standards as an environmentally responsible, affordable and energy-efficient design for residential building (Horizon International, 2011). The complex was also expected to benefit from natural factors, depending less on expensive mechanical systems to obtain a certain degree of comfort. Strategies like solar shading, cross-ventilation, planted green roofs, photovoltaic panels and energy-conserving appliances were implemented.

3.3.2 BACKGROUND OF THE PROJECT

In recent years, “the rebirth” of the South Bronx as New Yorkers term it has demonstrated innovative design concepts in social housing practice. Three-story single-family town houses, mid-rise duplex unit complexes and a 20-story modern apartment tower (Figure 3.36) merge with highly advanced active and passive green technologies (Kimmelman, 2011). Via Verde (the Green Way), an affordable housing project, started from the necessity of urban renewal

after the burning of the Bronx in the 1970s when the South Bronx was mostly affected. In 2004 an affordable housing design competition, New York's first competition for affordable housing design, was organized by Shaun Donovan, former Commissioner of New York City Department of Housing Preservation and Development and today's United States Secretary of Housing and Urban Development (Kimmelman, 2011). The objective of this competition was to urge developers, including profit organizations, to work with first-class architects to devise the latest green design concepts with high-quality sustainable materials for a housing project offering affordability (Kimmelman, 2011). The winning teams combined with two developers, the Jonathan Rose Company (commercial developer) and the well-known Phipps Houses Group (non-profit developer), and two architectural firms were brought in; Grimshaw Architects (high-profit design firm but expert in sustainable design) from London and Dattner Architects (much experience of affordable housing projects) from New York (Kimmelman, 2011).

The design team asked the neighborhoods what kind of residential building they wanted to live in. The answer was that they wanted to have a healthy place to live (Kimmelman, 2011). The team came up with an idea of green design that provided healthy living place physically and socially. Green design was not just a marketing tool for the building. It rather aimed at environmental benefits and lower maintenance costs in terms of energy; however, healthy living is not just green living (Kimmelman, 2011).

The South Bronx has high rates of asthma and obesity, and the area also has limited access to green products, in common with other low-income neighborhoods, with few supermarkets; indeed, the number of Korean vegetable shops in the city, for example, has been decreasing. Generally, as regards large residential development, new housing development in towns goes hand in hand with new educational facilities and grocery shops that sell fresh fruits, vegetables, meats and seafood. But for Via Verde the question was what a housing

development on its own could do to shape and change neighborhoods' behavior (Kimmelman, 2011).

As a result, the developers and architects created an innovative approach to green and healthy living. Creating a "healthy place to live" was the chosen theme in order to give a spiritual identity to the community (Kimmelman, 2011). A series of green roofs was designed with a variety of levels intended to be walked from the ground floor to the highest rooftop. People who know the Bronx might not anticipate the 20-story façade with a slick combination of aluminum, cement and wood panels that has never been seen in the South Bronx neighborhood before (Figure 3.37). The good-looking design represents the future of high-quality, affordable, and sustainable housing for the people in the Bronx.

Figure 3.37: Façade of the Via Verde complex (Source: Grimshaw Architects, nd).

3.3.3 AFFORDABLE DEVELOPMENT STRATEGIES

3.3.3.1 MIXED-USE DEVELOPMENT

In New York, affordable social housing had comprised single-use development until the Via Verde project. As the Pruitt-Igoe apartment in St Louis demonstrated the failure of the single-use living machine for low-income only social housing projects, the previous affordable social housings in New York were inevitable to become slums; New York had experienced enough of that. Mayor Bloomberg's 'New Housing Marketplace Plan' attempted to change the course of the USA's affordable housing development tradition which applied tired strategies. His aim was to provide high-quality affordable housing to ensure livable life (NYC Department of Housing Preservation and Development, 2012). The focus of affordable housing projects, therefore, has been to provide stable, self-sustainable and community-based affordable housing.

The Via Verde housing is located at Brook Avenue and E 156th Street and benefits from all of the amenities of 'The Hub' (Figure 3.38), being only two stops way from Manhattan by subway. The Hub is the commercial heart of South Bronx and extends from East 149th Street, Willis Street, Melrose Street to Third Avenue. The Hub is known as the Broadway of the Bronx. The Hub also has high traffic and building density. It resembles Times Square, which functions as a spatial bond created by the geometry of the street (Via Verde Homes). The area is also part of Bronx Community Board 1.

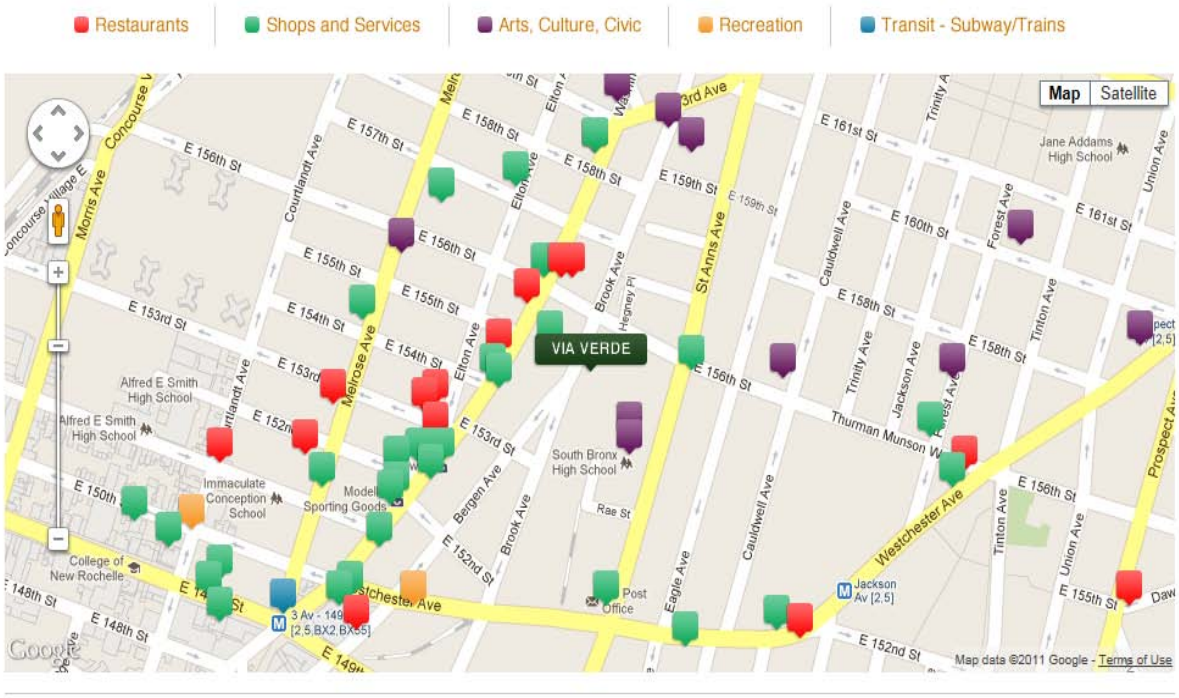


Figure 3.38: Location of the Via Verde and surrounding amenities near the project site (Source: Grimshaw Architects, nd).

To maximize the benefits from the site the project team proposed a mixed-use affordable housing development scheme through competition. They placed retail space at the corner of Brook Avenue and East 156th Street where the most commercial activities take place and live-work units along Brook Avenue. According to the sales manager at Phipps Houses, one of the retail stores will sell fruits and vegetables grown on the roof farm and produced by the residents; the profit from the roof farming products will be used for community support. This system of on-site living, working and sales enhances economic stability and promotes community bonds between the residents. It promotes social stability and sustainability of the surrounding neighborhood.

A medical center was housed in the ground floor retail space to provide medical services for the residents and neighborhoods. Staircases were located before elevators in the hallway with large windows to make people walk more. Also, a fitness center was located on the roof terrace with natural sunlight and natural ventilation. Including a medical center, fitness center

as a community space and all other retail space on the ground level (Figure 3.39), mixed-used housing development can offer a healthier living environment. With mixed-use development and physical elements like fresh air, natural light and green roofs, healthy design is a feasible design method for affordable housing.

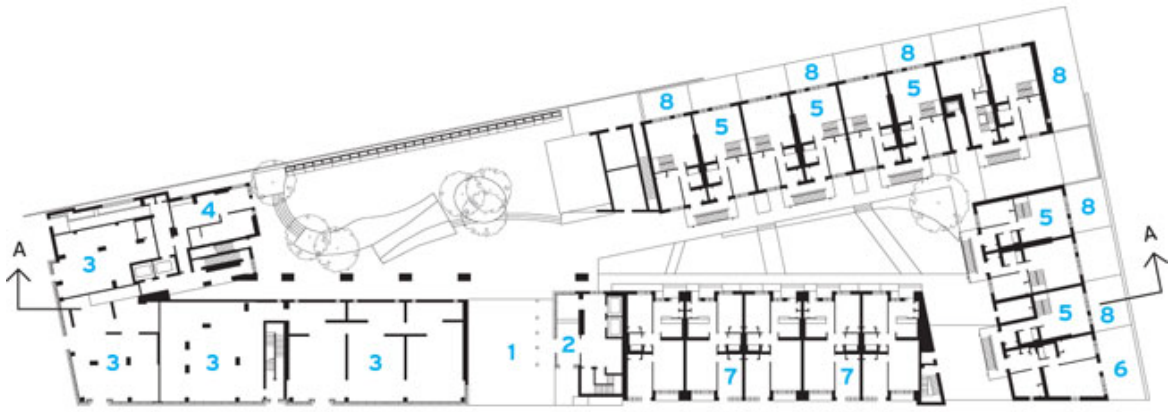


Figure 3.39: First-floor plan of the Via Verde affordable housing project shows co-existence of commercial, community and residential space (Source: Architectural Record, 2012).

The open courtyard between the duplex zone and retail / live-work zone (Figure 3.39) provides a safe stage for community gathering, parties and playground that connect urban life with the nature on the top of the roof. It will naturally make the complex the core of neighborhood activities which maintain the image of high-quality affordable housing, guaranteeing the success of the project over time. It is actually very close to the mission statement, developing healthy communities through affordable housings, of Phipps Houses.

3.3.3.2 HIGH-DENSITY AND MIXED-INCOME DEVELOPMENT

The housing unit distribution plan reflects its mixed-income development strategy to provide high-quality living for low-income households. Among 222 units, 151 units are reserved for low-income rental units and 71 co-op units priced from $ 78,894 US to $ 192,750 US (Figure 3.40) are reserved for government subsidy co-op market units for households with middle income or above (80% AMI). The 71 mid-income household units prevent the Via Verde co-op housing complex from becoming a slum area. Those who are relatively wealthier than low-income households bring vital commercial activities to the neighborhood including the retail stores in the complex; they buy fresh organic daily products from the roof farm on the site which helps money-flow within the community. The mixed-income development supports a variety of today's family lifestyles by providing a mix of different housing plans from studio housing to three-bedroomed housing, attracting more home buyers. Without a high-density development approach it would be impossible to accommodate this variety.

Unit Size	Unit Availability	Estimated Price	HH Size	Min. Annual Income	Max. Annual Income	Min. Assets	Max. Assets
1 Bedrm.	5	$ 78,894	1	$ 36,850	$ 44,350	$ 9,000	$ 133,608
			2	$ 36,850	$ 50,700	$ 9,000	$ 133,608
1 Bedrm.	2	$ 134,585	1	$ 54,200	$ 95,100	$ 13,000	$ 133,608
			2	$ 54,200	$ 95,100	$ 13,000	$ 133,608
2 Bedrm.	37	$ 146,032	1	$ 56,250	$ 95,100	$ 13,000	$ 180,290
			2	$ 56,250	$ 106,950	$ 13,000	$ 180,290
			3	$ 56,250	$ 118,800	$ 13,000	$ 180,290
			4	$ 56,250	$ 118,800	$ 13,000	$ 180,290
2 Bedrm.	17	$ 179,446	1	$ 62,250	$ 110,950	$ 16,250	$ 180,290
			2	$ 62,250	$ 124,775	$ 16,250	$ 180,290
			3	$ 62,250	$ 138,600	$ 16,250	$ 180,290
			4	$ 62,250	$ 138,600	$ 16,250	$ 180,290
3 Bedrm.	9	$ 192,750	2	$ 72,000	$ 124,775	$ 17,200	$ 276,874
			3	$ 72,000	$ 138,600	$ 17,200	$ 276,874
			4	$ 72,000	$ 138,600	$ 17,200	$ 276,874
			5	$ 72,000	$ 160,825	$ 17,200	$ 276,874
			6	$ 72,000	$ 160,825	$ 17,200	$ 276,874

Figure 3.40: Availability and eligibility according to income level and the price range for the market units (Source: Phipps Houses, nd).

In terms of mixed-income property development, amenities including intangible aspects for

residents are considered as attractive values that provide comfort and convenience for the residential community, especially for the market unit residents; they want to enjoy the amenities that they pay for. Physical amenities range from decent guest rooms, dining, parks, swimming pools, golf courses, health club, party rooms, and theater or media rooms, to bike paths and community centers. Intangible amenities are nice views of the city, neighborhood activities, good schools and safety of the neighborhood; all of these tangible and intangible amenities constitute the desirability of a property.

The lists of amenities in the Via Verde are as follows (Phipps Houses, 2011):

- *"Attended Lobby*
- *Amphitheater*
- *Landscaped Courtyard*
- *Green Roofs*
- *Tree Orchard*
- *Resident Gardening Beds*
- *Fitness Center*
- *Penthouse Community Room and Terrace with Manhattan Views*
- *Bicycle Storage*
- *Stainless Steel Appliances*
- *Dishwasher*
- *In-unit Washer and Dryer*
- *Ceiling Fans*
- *Hard-wood Floors*
- *Luxury Kitchens*
- *Porcelain Tile Bathrooms*
- *Internet and Cable Ready*
- *Panoramic Views*
- *Balconies in Select Units*
- *Backyards in Select Units."*

These amenities are provided for every unit in the complex including non-market affordable units and some features are open to the neighborhood to function as an urban core, which creates community-based activities of the area.

The Via Verde housing complex consists of a 20-story high-rise housing tower with a 2-4-story duplex townhouse zone terracing down to the ground courtyard (Figure 3.41). The Via

Verde is built on 1.5 acres of a former brownfield site with a floor of 27,314 square meters (294,000 square feet) , so the FSR (floor space ratio) of the complex is about 4.5 FSR, which can provide enough density to maximize efficiency of the development under the given budget and conditions. Normally building height can be translated as population density, which influences development strategy; therefore, a high-density development plan is the basic requirement for an affordable public housing development program.

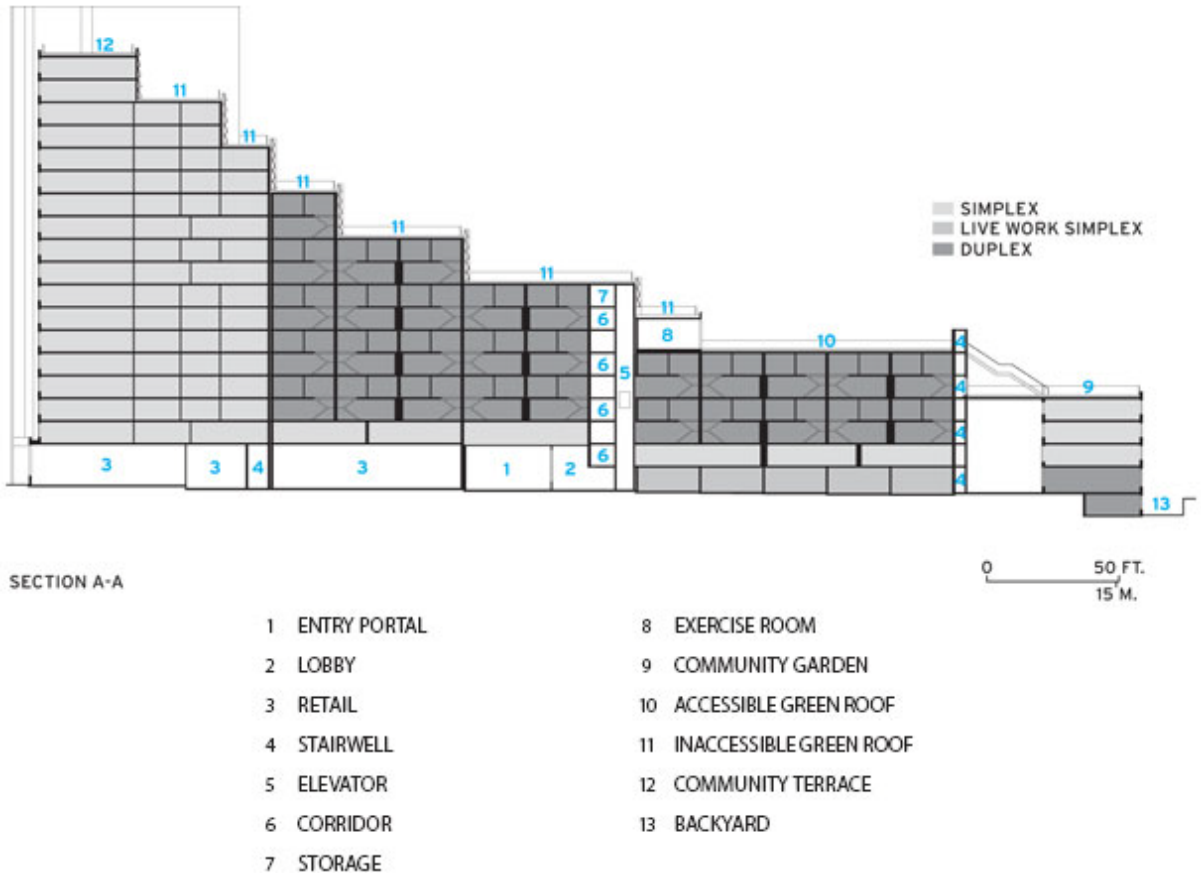


Figure 3.41: The Via Verde has various building heights from a 20-story tower zone to a town home zone terracing down to the ground courtyard (Source: Architectural Record, 2012).

3.3.3.3 GOVERNMENT SUPPORT PROGRAM

The building has been developed under supervision of the New York City Department of Housing Preservation and Development's Low Income Rental Program (LIRP), the New York City Housing Development Corporation's New Housing Opportunities Program (NHOP) and

the New York State Homes and Community Renewal's New York State Low-Income Housing Tax Credit Program (SLIHC). Moreover, municipal, state, and federal government subsidy is provided for those with an annual income which is lower than the average median income level (NYC Department of Housing Preservation and Development, 2012).

Figure 3.42 illustrates the size, average rent and targeted income distribution of the 133 rental apartments. Applicants have to meet the income and additional criteria to be accepted and will be selected through by lot. Preference will be given to New York City residents. Current and entitled residents of Bronx Community Board 1 will obtain 50% of the units. Eligible households that include people with mobility handicaps will receive preference for 5% of the units; 2% of the units will be reserved for qualifying households that include people with visual and/or hearing disabilities; and 5% of units are reserved for qualifying City of New York Municipal employees (Phipps Houses, 2011).

Figure 3.42 also shows the availability of certain units in November 2011. It describes the minimum and maximum income level for each unit as an adjustment measure for different household sizes. For example, a one-bedroom apartment is offered in two different rental prices according to the AMI (Annual Median Income) of the client. Figure 3.43 is one of the three models for one-bedroom units which Via Verde has for AMI 80% applicants. Mrs. Eleanor, a Phipps Houses representative, explains that Via Verde tries to provide high-quality affordable housing in contrast to the existing low-quality affordable housing in New York, and the company has actually provided such housing including high-quality finish material (not expensive) and functional space distribution in its apartments (Phipps Houses, 2011).

Subsidized rental apartment

No.of Units	Unit Size	Family Size*	Monthly Rent (USD)**	Total Gross Annual Income Range*** Minimum- Maximum (USD)
1	Studio	1	$461	$17,589 - $22,920
4	One Bdrm	1 2	$493	$18,754 - $22,920 $18,754 - $26,200
6	Two Bdrms	2 3 4	$596	$22,354 - $26,200 $22,354 - $29,480 $22,354 - $32,720
2	Three Bdrms	3 4 5 6	$688	$25,989 - $29,480 $25,989 - $32,720 $25,989 - $35,360 $25,989 - $37,960

Non-Subsidized rental apartment

No. of Units	Unit Size	Family Size*	Monthly Rent (USD)**	Total Gross Annual Income Range*** Minimum- Maximum (USD)
11	Studio	1	$731	$26,846 - $34,380
36	One Bdrm	1 2	$781	$28,629 - $34,380 $28,629 - $39,300
61	Two Bdrms	2 3 4	$942	$34,217 - $39,300 $34,217 - $44,220 $34,217 - $49,080
12	Three Bdrms	3 4 5 6	$1,087	$39,669 - $44,220 $39,669 - $49,080 $39,669 - $53,040 $39,669 - $56,940

*****subject to occupancy standards **includes cooking gas ***income guidelines subject to change

Figure 3.42: Size of subsidy level and rent according to income level (Source: Phipps House, nd).

Figure 3.43: One-bedroom market unit plan for 80% AMI applicants (not to scale) (Source: Phipps Houses, nd).

3.3.4 SUSTAINABLE AND GREEN STRATEGIES FOR AFFORDABLE HOUSING DESIGN

3.3.4.1 GREEN ROOF

The Via Verde project is an inspiration to the South Bronx neighborhood to expand its environmentally progressive concepts. Via Verde, unlike other buildings, was designed to encourage people to stay outside, get to know people and enjoy fresh air. The 3,720 square meters (40,000 square feet) of green roofs are the main attraction of the complex. Each resident will use 17 square meters (180 square feet) of their rooftop building for urban

agriculture (Horizon International, 2011). These communal gardens will let the tenants grow their own fruits and vegetables (Figure 3.44). Also, this may provide a destination for walkers in the neighborhood who could start their tour from the courtyard and continue all the way up. The whole concept of green affordability not only relies on the home itself as a community but also on the adoption of a healthy lifestyle by the tenants. Urban agriculture on the green roof is introduced in this concept as a way to solve the urban food crisis and as an inspiration to other citizens in the City of New York. In order to achieve housing affordability it is also necessary to facilitate the meeting of basic needs such as food in this case.

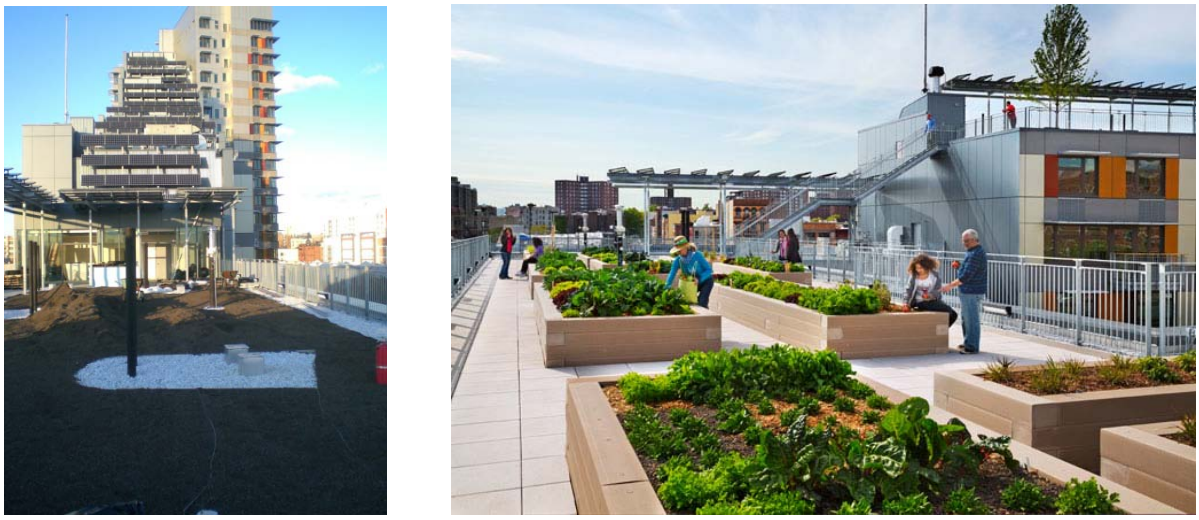


Figure 3.44: Construction of the green roof (left) and the green roof used for urban agriculture (Source: Kwon (left), Architectural Record, 2012 (right)).

Another benefit of the green roof is that it can prevent the heat gain produced by the units beneath it, the sunlight and the city itself. It can cool buildings by insulating and shading them. Therefore, using the green roof for an urban garden can help to reduce the amount of energy used to heat or cool the building, as well as purify the air of the city. Reduced energy usage also reduces greenhouse gas emissions. In winter time, the plants on the roofs will reduce the heating cost by protecting the buildings from the wind and frost. Since fruits and

vegetables are evapo-transpiring systems which trap rainwater underneath the soil, during summer the plants will process and diffuse the heat rather than reflecting or absorbing it (Low Impact Development Center, 2007).

Figure 3.45 demonstrates how the rainwater is captured to be reused for irrigation. Also, the different implemented layers help to provide an additional insulation effect for the residential units below. As rainwater falls on the rooftops, it is absorbed by a series of layers that filters water which is stored for reuse as irrigation water for the roof garden.

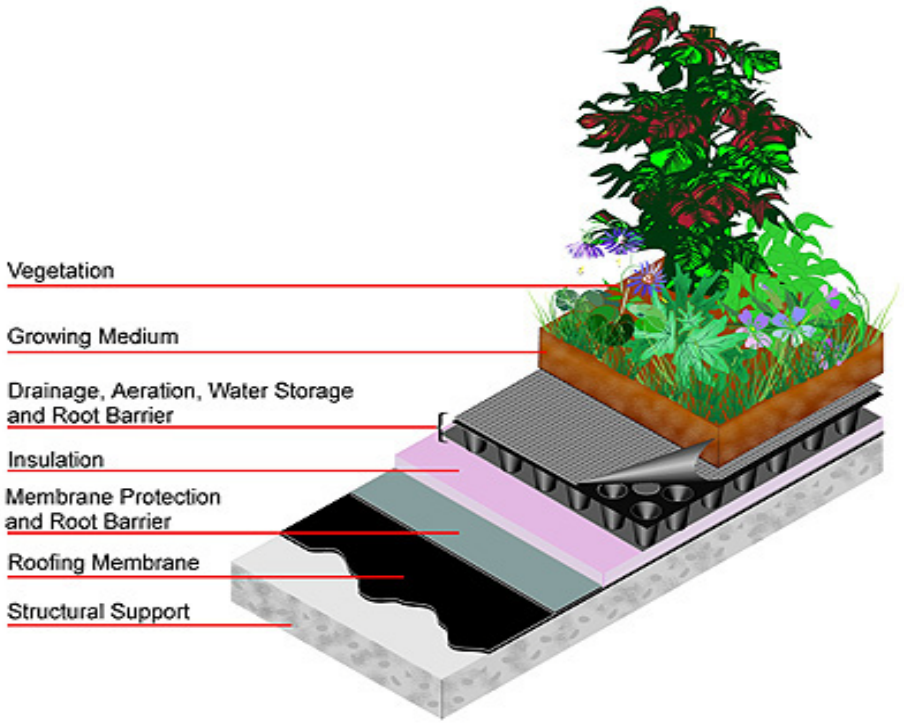


Figure 3.45: The evapo-transpiring system for the green roof installation. (Source: Low Impact Development Center, 2007).

The conceptual diagram Figure 3.46 shows the different recreation spaces in order to give the sense of a walk in the park as it naturally cascades down to the courtyard at the ground

level. Every space was chosen to satisfy the needs of a different range of ages and uses. From children to older adults, the rooftop garden and the courtyard embrace all sorts of activities to insure social interaction within the Via Verde community. Figure 3.37 illustrates the actual construction of the green gardens.

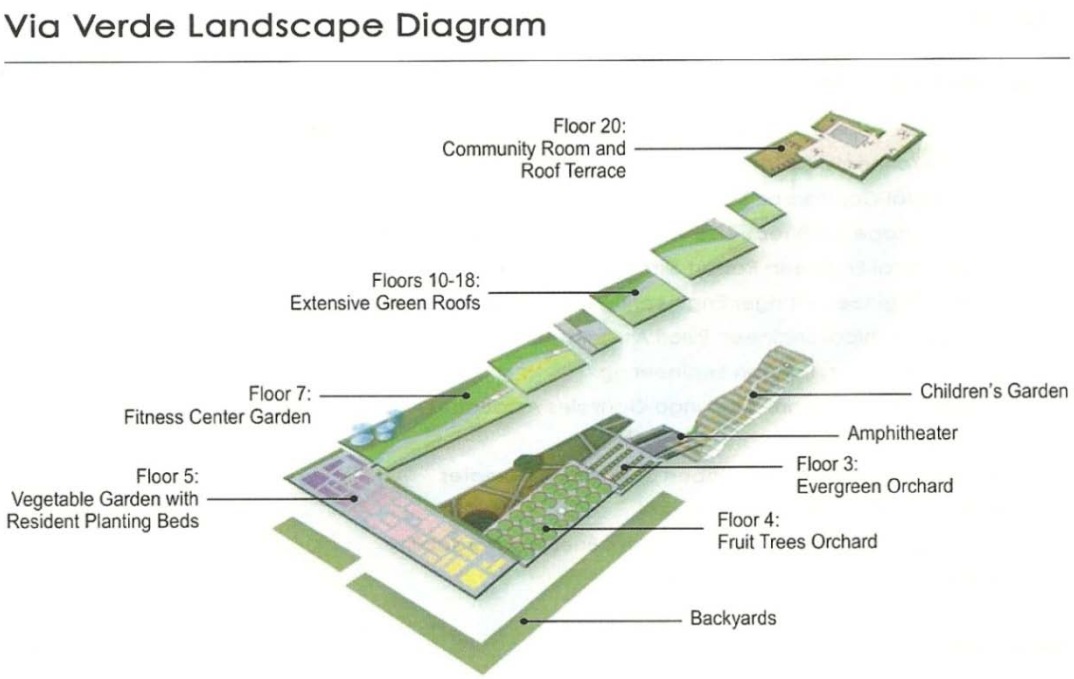


Figure 3.46: Via Verde's terraced landscape plan including the green roof garden (Source: Phipps Houses, 2011).

Figure 3.47: Construction of terraced green roof garden before application of base soil.

3.3.4.2 SOLAR ENERGY

Via Verde is fitted with nearly 300 solar panels which will produce 15 to 20 percent of the energy needed to run the building's appliances, including the elevator, water pumps, and air conditioning in some areas (Dailey, 2011). In order to keep costs down, the architects chose solar panels available from merchandise in stock and placed them along the spiraling rooftops orientated to the south where there is more sun exposure (Figure 3.48).

The solar energy system has a capacity of 66 kilowatts and possesses a grid where energy will be stored when the building does not need it (Dailey, 2011). The panels are implemented on the complex's exterior wall which is divided into six vertical façades (Figure 3.48), all oriented from north to south. Also, the panels are mounted over two horizontal metallic beams on the rooftops which permit the flow of people walking underneath (Figure 3.48). Not only will they provide shade for visitors and the gardens but they add considerable esthetic value to the buildings (Txchnologist, 2011).

Figure 3.48: The 300 solar panels installed on the rooftop toward the south.

“The traditional [layout] is the big, flat, industrial roof where you can just lay out row after row of panels in a cookie cutter way,” in the words of Andrew McNamara, who is now the Vice-President of New Construction at Bright Power, a sustainable energy consultant in New York, who were selected to provide the design team energy consultants for the project. Without doubt, the conceptualization and distribution of these panels are quite exceptional (Dailey, 2011).

In order to preserve the architectural vision of the project, Grimshaw assigned architect Robert Garneau to work with MCNamara and Dattner Architects to arrive at a design that would maximize the efficiency of the panels. About 2.5 percent of the building’s total power usage will be supplied by the solar panels including the residential units (Dailey, 2011). This feature of Via Verde should guarantee it qualifies for the LEED (Leadership in Environmental and Energy Design) Gold Certificate.

According to Bright Power, the solar panel system will recoup the cost of the solar installation in approximately 15 years. The residential units will benefit from a renewable energy system which has been given rebates from different levels of government including municipal, state and federal government; this means that applying the photovoltaic system does not cost much as some think (Bright Power, nd). They were fully installed by the end of 2011, the panels kept producing energy and most of the required power during the summer.

3.3.4.3 NATURAL VENTILATION AND LIGHTING

As Figure 3.49 shows, the central courtyard is surrounded by a narrow apartment with a shaded building with ceiling fans which discourage the use of air-conditioning in all units and the building has a north-south orientation. Cross-ventilation and sun exposure are maximized for interior space, which reduces energy consumption during peak times. To make healthy living possible, staircases with large windows are placed before elevators, and

the fitness center located on the building's terrace roof (Figure 3.49), so the residents are able to enjoy the skyline of the city. For healthy eating, the architect has designed a large communal roof garden to grow vegetables and fruits. Moreover, the l roof garden reduces heat gain during the summer and retains storm water as well.

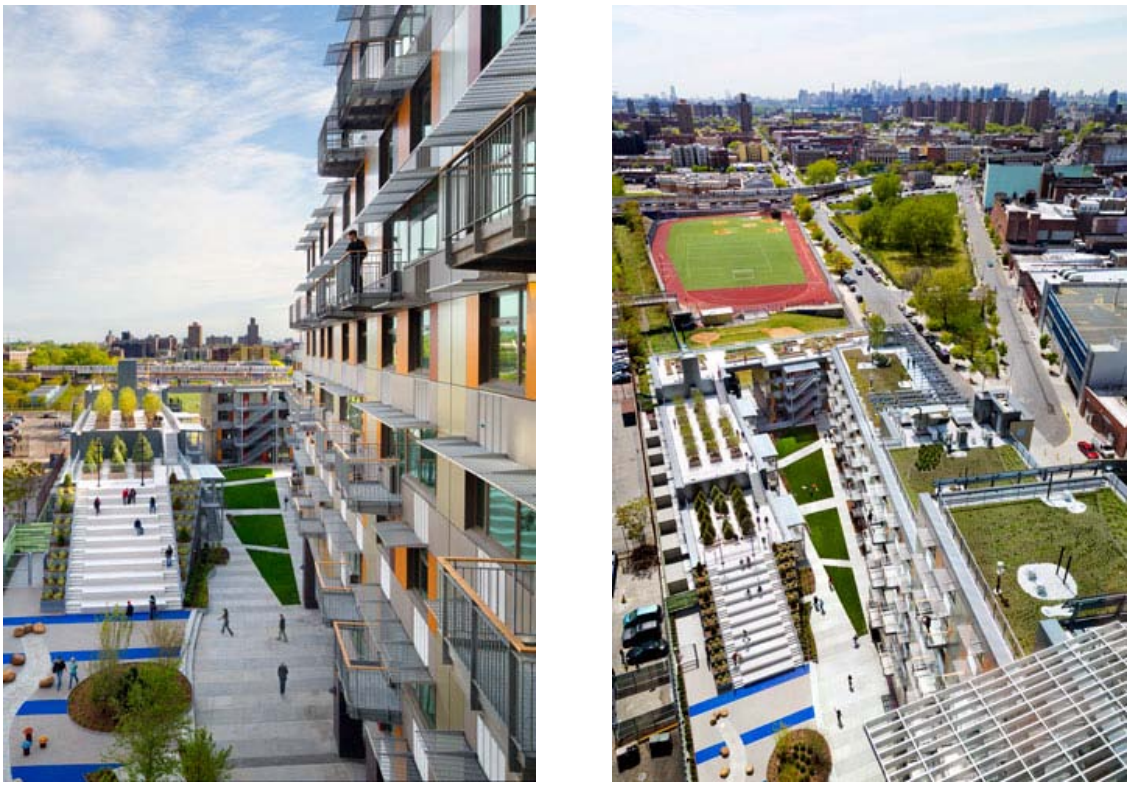


Figure 3.49: Courtyard at ground level that leads to the green roof garden (Source: Architectural Record, 2012).

3.3.5 OTHER AFFORDABLE DESIGN STRATEGIES

In order to achieve green affordability many strategies were implemented by the design team; the mostly depended on recycling and using local materials. The following is a list of cost reduction strategies in the Via Verde co-op housing project that achieved housing affordability (Phipps Houses, 2011):

- "*Over 20% recycled materials used in construction.*

- *Over 20% of building materials were locally manufactured, minimizing cost of transportation energy and supporting economy.*
- *Over 80% of construction and demolition waste was recycled.*
- *Rooftop gardens dissipate heat and absorb rainwater runoff.*
- *Storm water reclamation system recycles water for on-site irrigation.*
- *Building-integrated photovoltaic panels produce electricity from the sun's energy.*
- *Exterior sunshades allow for passive heating in the winter when the sun is lower in the sky and passive shading in the summer when the sun is higher in the sky.*"

A '*Living Green Guide*' will be offered to each resident with information on how to achieve green healthy living (Phipps Houses, 2011). Via Verde will not only provide all the facilities and equipment for a sustainable and healthy life but also a social program to insure public participation and teach them how to live in Via Verde.

3.3.6 CONCLUSION

City of New York launched a new affordable social housing program, which had been reduced since 1980s, after the new mayor of New York elected to the office. The goal of the new affordable social hosing was to provide high-quality housing and life for low-income households. Before the Via Verde project, the affordable housing buildings in New York looked like they were affordable. The building were poorly constructed with low-quality cheap building materials which made the buildings look bad, and even the poor did not want to live in the place. This bad cycle had created the low-income slum neighborhoods in New York. Following the rebirth of Bronx after the 1990s the municipal government realized that to solve the urban poverty issue they needed to relaunch the social housing program providing high-quality life (Kimmelman, 2011).

The goal of the first affordable housing competition in New York by American Institute of Architects (AIA) was to collect new ideas and set new milestones for the affordable social housing program. Grimshaw Architect's proposal won the competition with a concept of

‘healthy life’ through a green sustainable design that created a positive effect in the neighborhood. In other words, by introducing the green design the residents formulated community-base activity including the production of green organic goods and sales of the goods. Then this activity made the Via Verde housing the core of the neighborhood. Finally it brought positive effects including public health improvement and economic stability to the neighborhood, as well as lowering maintenance costs to improve housing stability. In order to achieve this process of creating healthier housing, the project team suggested mixed-use development to support the community activities, such as a vegetable retail store to sell the green products from the roof garden, a medical center for the neighborhood and a fitness center.

The architect applied green sustainable design strategies including both passive and active sustainable design, not only to lower the initial construction cost but also to save the long-term building maintenance cost, which often becomes a financial burden for low-income households. The green design created a place for residents to naturally engage with community activities for good. This approach demonstrates the architects’ idea on housing affordability. Affordable housing architecture ought to be a tool ensuring economic and physical affordability in order to provide healthier high quality life for greater good. Green design for affordable housing is just one of the many ways to reach his goal.

In other words, architecture does not change or solve our social problems, and it does not make our society better either. However, their life with a good architecture can be distinguished through their places that they care and love. The greatest architecture has been conserved because the users wanted and needed them for their life and community. Bad housing projects could not be lasted for long time; they were demolished in short period of time such as the demolition of Pruitt-Igoe in St. Louis.

Architecture is not just mix of its skin, structure and needs. Moreover, its formal and special

beauty is not separable to its function. The true beauty of architecture is not just as public objects to watch but rather to serve for people who live with it. The success of the Via Verde project will be announced after the residents have settled whether its original goal, which is having green healthy living, is achieved or not. However, one thing already has succeeded is that the economic distribution for the neighborhood, and it is on right direction.

3.4 60 RICHMOND CO-OP SOCIAL HOUSING

3.4.1 PROJECT DESCRIPTION

Location: 60 Richmond, Toronto ON, Canada

Architect: Teeple Architects

Client: Toronto Community Housing Cooperation (Non-Profit Housing Cooperation)

Contractor: Bird Construction Company

Development Type: Mixed-used affordable non-market housing

Numbers of Units: 85 units

Project Budget: $20.4 million

Size: 9,250 square meters (99,565 square feet)

Estimated Cost per Square Meter: $ 2,805 per square meter ($ 260.40 per square foot)

Status: Completed in 2010

Sustainability: LEED Gold Certification

Located at Richmond Street and Church Street in the downtown Toronto, the project is a house for 85 low-income workers in the hospitality industry in downtown Toronto. Among the 85 units, 59 units are reserved for former Regent Park residents displaced from the demolished buildings in the urban renewal area, and the rest are for other low-income Toronto households. This project planned and developed mid-rise and mixed-use affordable housing to meet the demand of the residents' group ‘Unite Here 75’ (Kolleeny, 2010). The 60 Richmond affordable housing expresses the idea of the future urbanism as an environmentally responsible urban form engaging with social demand (Figure 3.50); as a result, the design team achieved the goal of sustainability, which was one of the major demands of the TCHC (Toronto Community Housing Cooperation) and Unite Here 75 through LEED Gold certification.

Figure 3.50: An exterior elevation of 60 Richmond co-op social housing by Teeple Architects in Toronto, ON (Source: Teeple Architects, nd).

3.4.2 BACKGROUND OF THE PROJECT

The main purpose of 60 Richmond social housing was to provide shelters for displaced residents, mostly hospitality industry workers and their families, by means of the Regent Park revitalization project which is the largest in the history of Toronto and retrofits old urban contexts by providing affordable housing (Kolleeny, 2010). For an understanding of the nature of the 60 Richmond social housing the Regent Park urban renewal project needs to

be explained first.

Regent Park, a 69-acre mid-rise apartment residential area in the heart of Toronto, has been a transitional place for immigrants since the 1940s; however, like other mega-cities, it has marginalized downtown Toronto. The city of Toronto and the TCHC agreed to redevelop the isolated old part of the city. The plan concludes that the area needs to be an open urban grid to interact with other parts of the neighborhood and accommodate a variety of commercial, community and affordable housing of the highest architectural quality. Its green credentials will characterize the community. The residents originally living in the area needed to find homes near the redevelopment. Richmond Street is on the outskirts of the urban renewal district, so the TCHC chose the site to home displaced people, mostly hospitability industry workers, in the downtown area. The TCHC selected Toronto-based Teeple Architects, one of the finest innovative architects in Canada, to design the affordable social housing project for the displaced families. At the beginning of the design process the TCHC and Unite Here 75 set two main guidelines for the project; low-cost construction and low-cost maintenance. The architect succeeded (ArchDaily.com, 2010).

3.4.3 AFFORDABLE DEVELOPMENT STRATEGIES

3.4.3.1 MIXED-USE DEVELOPMENT

Unite Here 75 is a union for workers in the food and hospitality sector, and the TCHC's program for the 60 Richmond social housing project inspired the design in-cooperating social spaces dedicated for urban agriculture and its processing. The result is a small-scale but full-cycle economic and eco-system within the community called "Urban Permaculture" (ArchDaily.com, 2010). Urban permaculture applies a small-scale full-cycle eco-system whereby fruits and vegetables from the roof garden on the sixth floor go to the resident-

owned restaurant and the training kitchen which take up about 280 square meters (3000 square feet) at the ground level. Finally, the organic waste from the commercial spaces on the ground floor goes back to the roof garden as organic fertilizer (Figure 3.51) (Kolleeny, 2010). This cycle of socio-eco system naturally defines the vertical space function of the complex as a non-profit, mixed-use and affordable social housing complex. The distinctive difference between most mixed-use affordable housing and 60 Richmond is that the idea of mixed-use in the Teeple project comes from residents creating small self-sustainable society, whereas the conventional market's mixed-use affordable housing development approaches from retailers' and market housing owners' point of view. In other words, in the conventional development, the economic stability of low-income residents depends on commercial activities generated by retail shop owners and relatively wealthy shoppers.

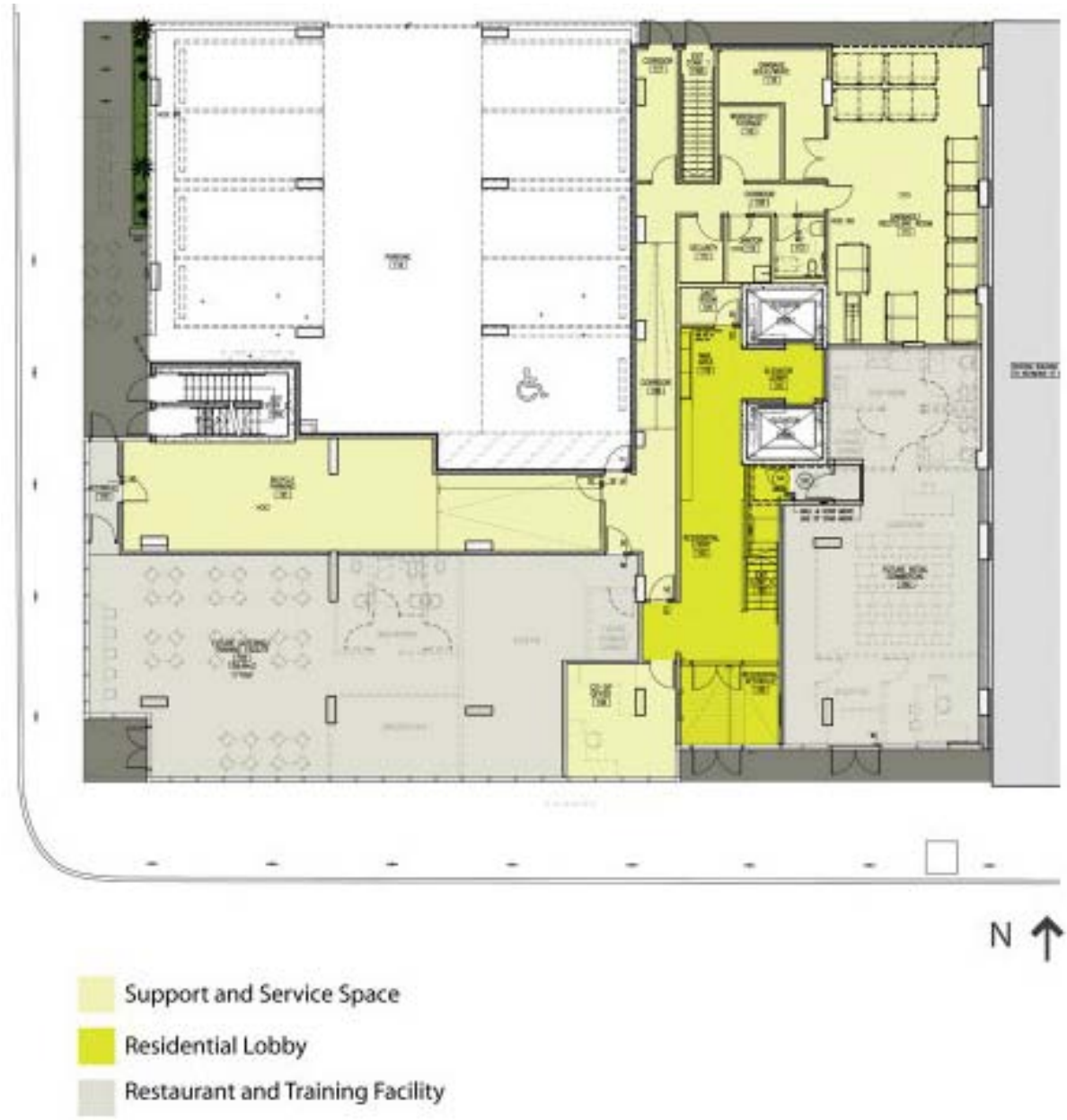


Figure 3.51: The ground floor plan of 60 Richmond designed by Teeple Architects; the restaurant and training kitchen (280 square meters) are operated by the residents (Source: ArchDaily, 2010).

The residents in the complex generate revenue for building maintenance; it lowers their housing cost by the profit from the self-employed restaurant, and re-educate themselves through the training kitchen program as well as seizing opportunities to be small business owners in the future. The concept fully applies the mixed-use development strategy as a community-based self-sustainable strategy to escape from poverty. Consequently, the scale of affordable housing development does not have to be larger, and also does not have to

depend on large-scale commercial developers who decide affordability level as profit changes; it may be an easier way to achieve many efficient small-scale affordable housing schemes rather than one big development which requires a complex program, negotiation among many different stakeholders and a huge amount of funding from many sources. Indeed, the scheme is a way of keeping people's dignity and integrity intact by acting as the main player in the decision-making process on behalf of the community.

3.4.3.2 HIGH-DENSITY AND MIXED-INCOME DEVELOPMENT

A high-rise structure is defined as a building over 35 meters or 12 stories in height. According to this definition, 60 Richmond belongs to mid-rise housing building category. However, since it was built on a relatively small urban in-fill site, it is more likely to be on the border between mid-rise and high-rise. Therefore, it is believed that the design team found some appropriate building height to maximize development density level under the given construction budget of $ 20.4 million. The architect was only asked to design affordable housing for 85 households; therefore, there was no reason to design high-rise housing which substantially increases construction costs because of the structural and mechanical challenge including vertical circulation, firefighting equipment, HVAC system, and plumbing. Indeed, the 85 households can provide enough population density to operate the building and sustain their community.

The main purpose of the project was to absorb those households displaced by the nearby Regent Park renewal project. The displaced households received 56 units and the rest of the units were made available for other low-income households in the town. In other words, mixed-income development as an affordable housing strategy was not a consideration for this project from the beginning so that the Teeple architects tried to provide an opportunity to create a community organization among the residents that helped them to escape from

poverty by exercising socio-ecologic sustainability through physical urban form and space.

3.4.3.3 GOVERNMENT SUPPORT PROGRAM

Until the 1990s, like other developed Western countries, such as the USA and UK, the Canadian government had reduced funding of social housing programs and other publicly sponsored affordable housing programs (Boddy, 2010); however, owing to rapidly increasing housing costs which became a major social issue in the Canadian metropolises in the 2000s, every level of government started to rethink launching affordable housing programs to maintain social stability.

As described in 2.4.2 Background of the Project, 60 Richmond was part of the Regent Park urban renewal project, the biggest urban revitalization project to include non-market affordable housing and market housing in Canada. According to the 'Staff Report' (2008) by Sue Corke, deputy city manager of Toronto, the AHP (Canada-Ontario-Toronto Affordable Housing Program, co-founded by the federal and provincial governments) agreed to invest in the project with the Ministry of Municipal Affairs and Housing and CMHC. Subsequently the TCHC took charge of the urban renewal project, working with non-profit and private sectors to construct more than 2,000 rental homes and to generate 5,000 jobs (Corke, 2008). Government support consists of property tax exemption on the TCHC's affordable units for 15 to 25 years, $ 71.2 million from the AHP fund, $ 15.6 million from the TCHC, $ 9.1 million from TCHC West Donlands, $116 million from provincial government, and $ 27.7 million from municipal government (Figure 3.52) (Corke, 2008). As a result, the funding from various sources benefited every affordable unit an average of $ 70,000 combining with the housing mortgages provided by CMHC.

The site was originally used for a Toronto homeless center owned and operated by the City

of Toronto; it was rented to the TCHC to build an affordable housing absorbing the displacement from the Regent Park redevelopment. The 60 Richmond project received $ 20.6 million budget from various sources including AHP grants and a TCHC equity contribution from the Regent Park redevelopment, TCHC equity, and financing based on the net operating income of the building; however, the actual project cost exceeded the original budget by $ 1.4 million (Figure 3.52) owing to the site conditions and delay of labor, site staff and crane towers (Nakamura, 2010).

Sources of Funding		Leasehold Mortgages	
Grants	$3,681,000		
Long Term Debt (NOI) Long Term Debt (Corporate Debt)	$8,642,500 $3,060,000	First Mortgage Second Mortgage	$8,642,500 $3,060,000
TCHC Cash Equity (RP) TCHC Cash Equity	$4,020,000 $2,641,500	Third Mortgage	$6,661,500
Total	$22,045,000	Total	$18,364,000

Figure 3.52: Source of funding and securities for 60 Richmond social housing project (Source: Toronto Community Housing, 2010).

3.4.4 AFFORDABLE DESIGN STRATEGIES

3.4.4.1 BUILDING MATERIAL

The exterior of the 60 Richmond housing is wrapped by highly insulated cement rain-screen cladding covering 60 percent of the building volume, and 40 percent of the building envelope is reserved for a glazed area providing just enough natural light for the interior space (Canadian Architect, 2007); the current trend in commercial high-rise condos in metropolises is for all-glass façades, which are very expensive and require much more skilled labor to install properly. Cement panel cladding is commonly known as a relatively inexpensive, very durable, low-maintenance, and easily installable material which helps to achieve cost-reduced construction.

Another cost-reduction strategy in terms of building material is to use on-site recycled materials such as brick and concrete as backfill during construction and paint the structural components with white paint as a finish, minimizing use of interior materials. The original building's concrete foundations were also retained to function as shoring. Indeed, no expensive material was applied to either the interior or the exterior (Figure 3.53); there were no carpets in the hallway, cheap wood veneer (but not a cheap look) and exposed concrete (not silky concrete). The only luxury the residents had was a rough hardwood floor which could be sanded several times to extend its lifetime over decades (Bozikovic, 2010).

Figure 3.53: The architect minimized use of different materials and recycled existing building material (Source: Bozikovic, 2010).

3.4.5 SUSTAINABLE AND GREEN STRATEGIES FOR AFFORDABLE HOUSING DESIGN

3.4.5.1 GREEN ROOF

Unite Here 5 and the TCHC set a project guideline for 60 Richmond social housing to be a low-cost building in terms of maintenance, environmentally responsible and economically

buildable; as an icon of the future affordable housing. To achieve the program requirement, Teeple Architects suggested a full-cycle eco-system, 'Urban Permaculture,' within the building program (ArchDaily, 2010). Fresh fruits and vegetables are produced on the green roof garden on the sixth floor, and then the agricultural products are processed in the restaurant and the training kitchen on the ground floor (Figure 3.54); finally, the food wastes from the ground floor are used as organic fertilizer for the green products of the roof garden.

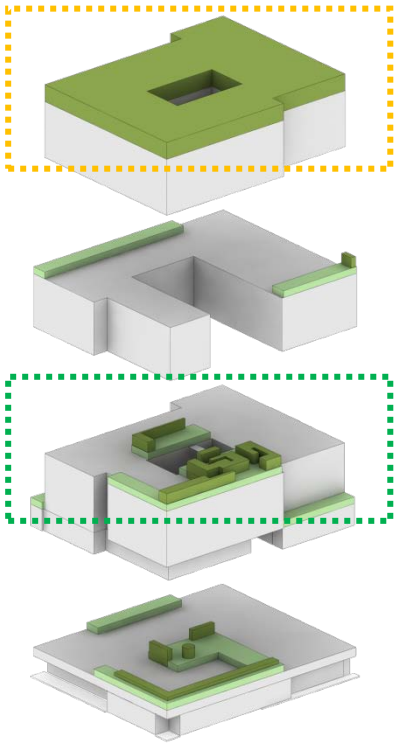


Figure 3.54: Vertical space diagram of 60 Richmond; the green roof garden (the green boxed area) on the sixth floor and a multi-vegetation green roof (the orange boxed area) on the top of the roof (Source: Bozikovic, 2010).

Even though 60 Richmond was conceived as a big solid mass, it was carved into an inner core to create open terraces on various vertical levels. The carved mass broke down the whole into an irregular series of dimensions that define its urban spatial condition as a corner site, and provide fresh air and light to internal housing units (Lam, 2010). The open terraces have become sustainable features such as a roof farm and an elevated park, and products from the garden save on long-term maintenance cost.

As Figure 3.55 illustrates, all the passive sustainable design strategies were applied to the

project. The green garden on the sixth floor functions not only as a roof garden but also as roof protection for the roofing membrane from heat gain during the summer and frost during the winter, supplementing the roof insulation. The rooftop has a multi-vegetated green roof that mainly protects the top floor from heat gains and losses, and it extends the lifetime of the roof membrane. As a result, it saves fuel energy consumption for heating and cooling. Also, the green roof acts as an evapo-transmission installation system which increases cooling efficiency for the roof, and stores rainwater underneath the planting soil to provide irrigation for the vegetation. The filtered rainwater is stored on the top floor, and reused as irrigation water for the fruits and the vegetables in the roof garden and the green wall.

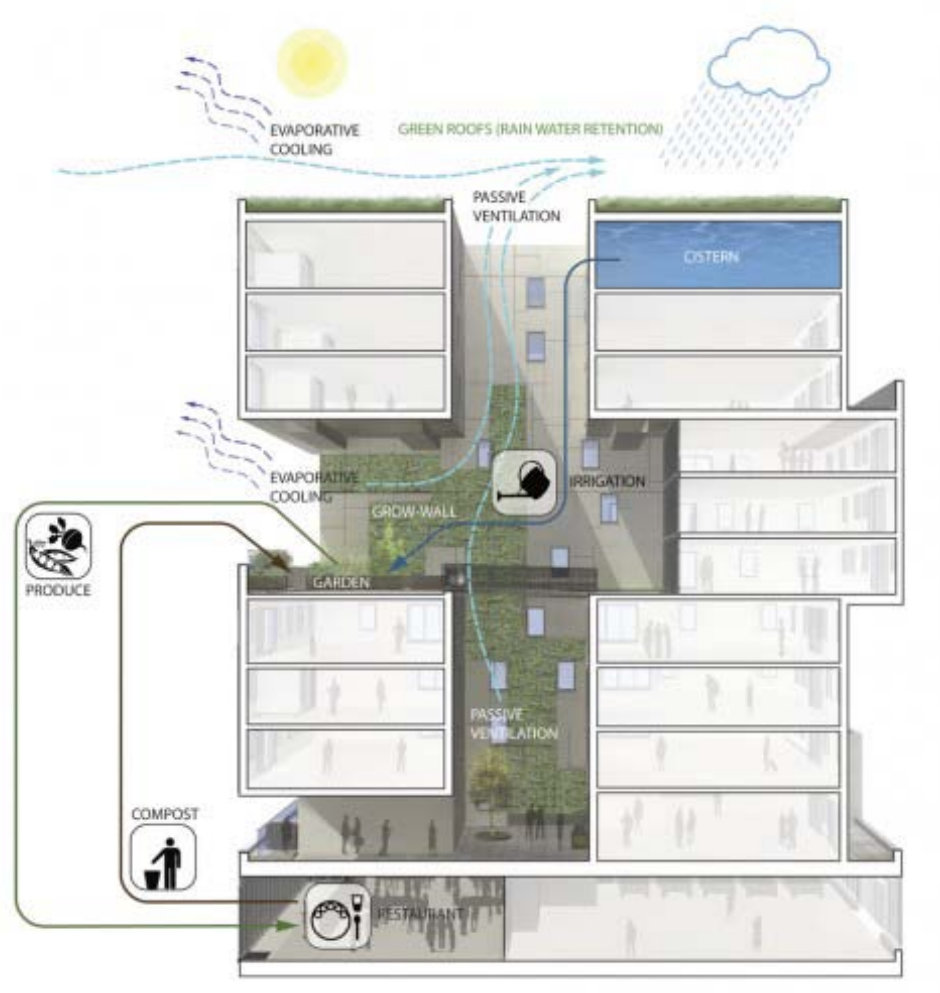


Figure 3.55: Sustainable concept diagram for 60 Richmond (Source: ArchDaily, 2010).

3.4.5.2 NATURAL VENTILATION AND LIGHTING

The open terrace on the second floor and the roof garden on the sixth floor take natural breeze into the central void which functions as a passive ventilation shaft bringing heated air from the interior out to the top by means of the stacked ventilation effect (Figure 3.55). The natural ventilation system in the core of the building means the energy consumption for cooling and mechanical ventilation can be minimized. Also, the inner corridor wraps around the void ventilation area which opens to its full building height, and has operable windows with a fiber-glass insulated frame. It allows the fresh air into the units that are located deeper inside the building, and lets cross-ventilation reduce interior air pollution (Figure 3.56). Moreover, 60 Richmond is located near the shore of Toronto so that the natural ventilation system is more effective.

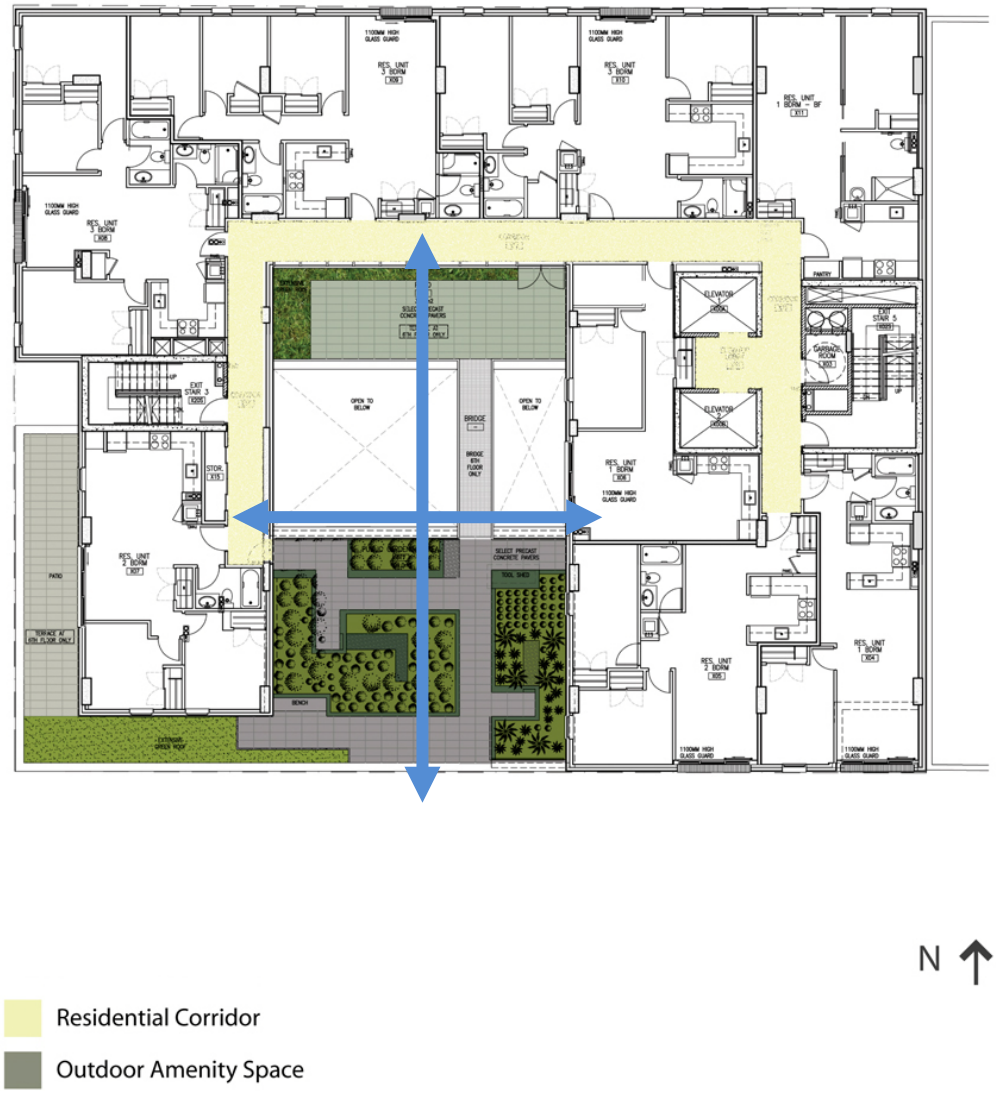


Figure 3.56: The sixth floor plan; the open terrace garden allows cross-air circulation and brings daylight into the abyss (Source: ArchDaily, 2010).

The void core also brings natural light (Figure 3.57) into the raised courtyard, the inner hallway that wraps around the central void and the rooms facing inside. As a result, daylight is equally distributed throughout all the housing units, which have highly insulated Low-E glazed windows of just the right size (Canadian Architect, 2007). Windows are generally considered to be the thermal weakness of a building; thus, the architect allowed window area only 40 percent with the argon-filled glazing and highly insulated window frames (Enermodal Engineering, nd).

Figure 3.57: The void core opening from the second floor to the building's full height brings natural ventilation and light into all units (Source: ArchDaily, 2010).

3.4.5.3 OTHER SUSTAINABLE DESIGN STRATEGIES

To reduce the maintenance cost the design team proposed several other energy and resource-saving strategies. The architect introduced low-flow water fixtures for all housing units and community spaces including the restaurant and the training kitchen. The low-flow fixture saved indoor portable water to the tune of 7.5 million liters per year which is a saving of $ 187,500 per year (Enermodal Engineering, nd). To control indoor climate, an in-suite heat recovery ventilation system was used in the residential units to reuse existing interior hot and cool air for heating and cooling during extreme weather, and it also improves insulation and weather-stripping which eventually leads to cost reduction for energy (Kolleeny, 2010).

According to the results of the case study (Figure 3.58) conducted by Enermodal Engineering, a LEED sustainability counselor, the green sustainable technology and design strategies reduced water usage by 50 percent, energy cost saving by 38 percent and material cost saving by 16 percent (Enermodal Engineering, nd). The reduction in raw material costs is a reduction in initial construction costs which have a huge effect on housing affordability programs. Some may still argue, however, that the raw material saving is just a small part of construction costs, and applying green design costs more than conventional design and construction methods. Figure 3.59 demonstrates the fact that use of sustainable green designs for affordable housing does not necessarily increase total construction cost.

Gross Floor Area: 7865 (m^2)
Energy Density: 196 (kWh/m^2)

Category	% Performance
Water Savings	
Irrigation	50 %
Indoor Use	50 %
Energy Savings	38 %
Waste Diversion	90 %
Recycled Content	16 %
Regional Content	31 %
Daylighting	76 %
Views	91 %
	LEED® Gold

Figure 3.58: Energy and building cost saving by sustainable feature (Source: Enermodal Engineering, nd).

Even though the actual total project cost and the construction cost (Figure 3.59) exceeded the projected cost, the final construction cost per square foot, including costs of sustainable features, is lower than the average mid-rise or high-rise housing construction cost in the most Canada's metropolises. Indeed, this cost table proves that reduction of affordable housing construction cost is not just about making smaller space or type of development; it is more about innovation and ingenuity in terms of designing strategy according to the given

social and physical urban conditions.

	Board Approved Budget	Per Square Foot Cost (projected)	Projected Budget	Per Square Foot Cost (final)
Land	$ 705,000	$ 7.69	$ 280,000	$ 3.31
Site	$ 834,000	$ 9.09	$ 606,000	$ 7.16
Hard	$ 17,408,000	$ 189.74	$ 19,928,000	$ 235.39
Soft	$ 1,661,000	$ 18.10	$ 1,231,000	$ 14.54
Total	**$ 20,608,000**	**$ 224.62**	**$ 22,045,000**	**$ 260.40**

Figure 3.59: A comparison of the actual construction and the projected construction costs from the closing report of 60 Richmond co-op housing documented by the TCHC (Source: Toronto Community Housing, 2010).

3.4.6 CONCLUSION

The 60 Richmond co-op affordable social housing project is relatively smaller-scale project than the other two cases. In fact, the project is actually a complementary project from Regent Park urban renewal project under the supervision of the TCHC (Toronto Community Housing Cooperation). The Regent Park redevelopment project is considered the biggest urban renewal and affordable housing project in the history of Canada. The urban renewal project created displacement of original residents, mostly member of ‘United Here’, the hospitality industry workers’ union, who had jobs in the downtown area (Kolleeny, 2010). As a result, the TCHC and United Here needed a place that could contain those displacement households.

The TCHC chose Teeple Architects for the project which required self-sustain and economically buildable social housing in an urban infill site which used to be a homeless center owned by the City of Toronto and located outskirt of the Regent Park area about 10 to 15 minutes from the residents’ workplace. Buying land from the municipality was one of the government’s financial supports for the project which helped to reduce the project cost. Due to the size of the site, the project team decided to build the social housing 11 stories high, i.e. somewhere between mid-rise and high-rise, but it ensured enough density to encourage

community activities. But the challenge was how they could provide self-sustainable space in an urban form.

The answer from the architect was ‘urban permaculture’, creating a full-cycle ecological system within the building program including growing agricultural products, consuming and waste management on site by the displaced residents (ArchDaily.com, 2010). As consequences, the design team proposed sustainably designed affordable housing without increasing initial project cost projected at $2,417 per square meters ($ 224.62 per square foot) (Toronto Community Housing, 2010). The sustainable design concept was applied to all steps of the project process, from development planning strategy to interior finishing materials.

To achieve a self-sustainable program, the green roof garden was proposed on the 6th floor open terrace to grow green products for the residents-owned restaurant and the training kitchen. The restaurant and training kitchen were operated by residents’ organization to generate revenue to re-educate them. It naturally led to small-scale mixed-use commercial, education and residential development. The existing building materials were reused for a structural supporting medium to reduce structure construction costs as well as minimizing environmental impact. The empty green garden area on the façade brought natural fresh air for cross ventilation and daylighting to the deeper side of the building, with the central abyss functioning as ventilation and lighting shaft. On the rooftop, another multi-vegetated green roof with an evaporative cooling system was installed to save energy for heating and cooling the top floor; the rainwater is filtered and collected to use for irrigation, which also save over $ 180,000 per year (Lam, 2010). Cement panels are used for exterior wrapping material with a rain screen and have a high level of insulation; they cover 60 percent of building mass to optimize a balance between energy losing and daylighting through glazed windows that are equipped with fiberglass insulated frame. The interior finish materials were also minimized

for cost reduction.

Although this project was equipped with many green and sustainable design features, the actual construction cost was relatively affordable. It proved that up to a point the conventional affordable design method can effectively reduce building cost; however, with a carefully planned green sustainable design it can force the construction cost further down. Indeed, the green design reduces building maintenance cost which will eventually exceed the construction cost; the maintenance costs are a big burden for the low-income residents.

CHAPTER FOUR

CONCLUSION AND RECOMMENDATIONS

4.1 OVERALL REVIEW

In this chapter a short overall review of the case studies is presented, with a conclusion, and a recommendation for the future of affordable housing design strategies in Seoul will be illustrated. In the conclusion, noticeable projects' characteristics by influences of social and physical requirements relating with the given site and corresponding architectural idea to approach the projects will be presented. Also, the conclusion will illustrate the final outcome of the research. At last a recommendation contributing to the feasible development strategies and innovative design strategies to achieve housing affordability for Seoul's social and urban context will be formulated for future study.

The cases analyzed in the Chapter Three demonstrate the fact that there is no universal way to figure out housing affordability issue which crystallizes specific socio-economic situations through a physical form projected in urban space. These cases are considered outstanding affordable social housing projects, comprising various ranges of commercial and community spaces and successfully dealing with exclusively given social and physical conditions. All three projects share common affordable strategies – mixed-use, high-rise, high-density, financial support, innovative use of building materials and sustainable design - even though the outcome shows differences in scale, program and operation of the spaces.

4.2 CONCLUSION OF THE CASE STUDIES

All these three cases illustrate that achieving housing affordability takes multi-level planning and design strategies. Developing affordable housing is not necessarily only carried out by governments or non-profit organizations either. Private parties can play an important role in the affordable housing market, if governments offer compensational benefits such as multi-function land use, higher density bonuses, and tax exemption in exchange for affordable units in the development through policy changes. Also, since the most needed affordable

housing projects are launched in urban cores or in close proximity to urban cores of metropolises, buildable land becomes a major initial construction cost as important as government subsidies. Providing government-owned land can be a big step toward a social affordable housing program regardless of location and culture.

Among many affordable development strategies from the case studies, a mixed-use high-density development method plays a major role in rebuilding a community and its activities, including commercial, educational and cultural ones. The two major development strategies are actually complementary to each other, so that without one strategy, the other one cannot be possible either. However, as the author analyzed through many related sources, one rule that must be kept is that mixed-use commercial activities must be occupied by low-income residents up to a certain employment level to ensure economic stability for them.

Making the space small can obviously lower the unit cost of the affordable housing so that building small affordable housing can provide more affordable units for low-income households. However, one question arose was: ‘Is making the space small always good for affordable housing?’ In Chapter Three, Woodward’s redevelopment project in Vancouver and Via Verde in New York show a very different approach in terms of unit size. In Woodward’s project, the majority of non-market affordable housing was distributed to single studio units (125 units among 200 total affordable units) which are 33 square meters in size. This seems to be a result of exchange of non-market affordable housing and commercial development by private parties. It is always good to have commercial revitalization along to enhance an affordable housing program in a high-cost housing city; however, in terms of living quality, small housing obviously has the disadvantage for responding to the varieties of living events. The main goal of Via Verde was to provide high-quality living for low-income households. This is primarily the reason that New York experienced extensive urban slums in which the living quality of the period was extremely low and created many disputes which cost society

dear in the 20th century. The new affordable housing program set by the City of New York was to ensure high-quality and healthy living for the urban poor and low-income citizens to stabilize the society and to lower social cost-solving problems caused by urban poverty. Therefore, Via Verde provided enough space for each unit type and many amenity spaces including roof gardens and a fitness center, which are not usually seen in affordable housing. As a result, Via Verde co-op housing just looks like one of those in the luxurious residential areas which make the residents feel that they are well treated. So, Via Verde became an icon of New York's affordable housing program, and the next affordable social housing projects will follow the path of the icon. In conclusion, the two approaches both have advantages and disadvantages for achieving housing affordability. Thus, it is a choice between different values: quantity and quality. The choice should therefore rest upon the given socio-urban conditions and urgency.

All three cases applied green sustainable technologies up to a certain level according to the design concept and project guidelines. Via Verde shows intensive use of both passive and active sustainable green design strategies. Active sustainable technologies have usually been considered relatively expensive building technologies until now. Meanwhile, the passive system costs a lot less than the active system; indeed, it does not necessarily cost more than conventional construction. If the current rate of energy costs continues to increase, intensive use of active sustainable systems is also well worth considering, like the 'Masdar City' (Figure 4.60) located near Abu Dhabi in the United Arab Emirates, designed by British architecture firm 'Foster and Partners' (Pohl, 2009).

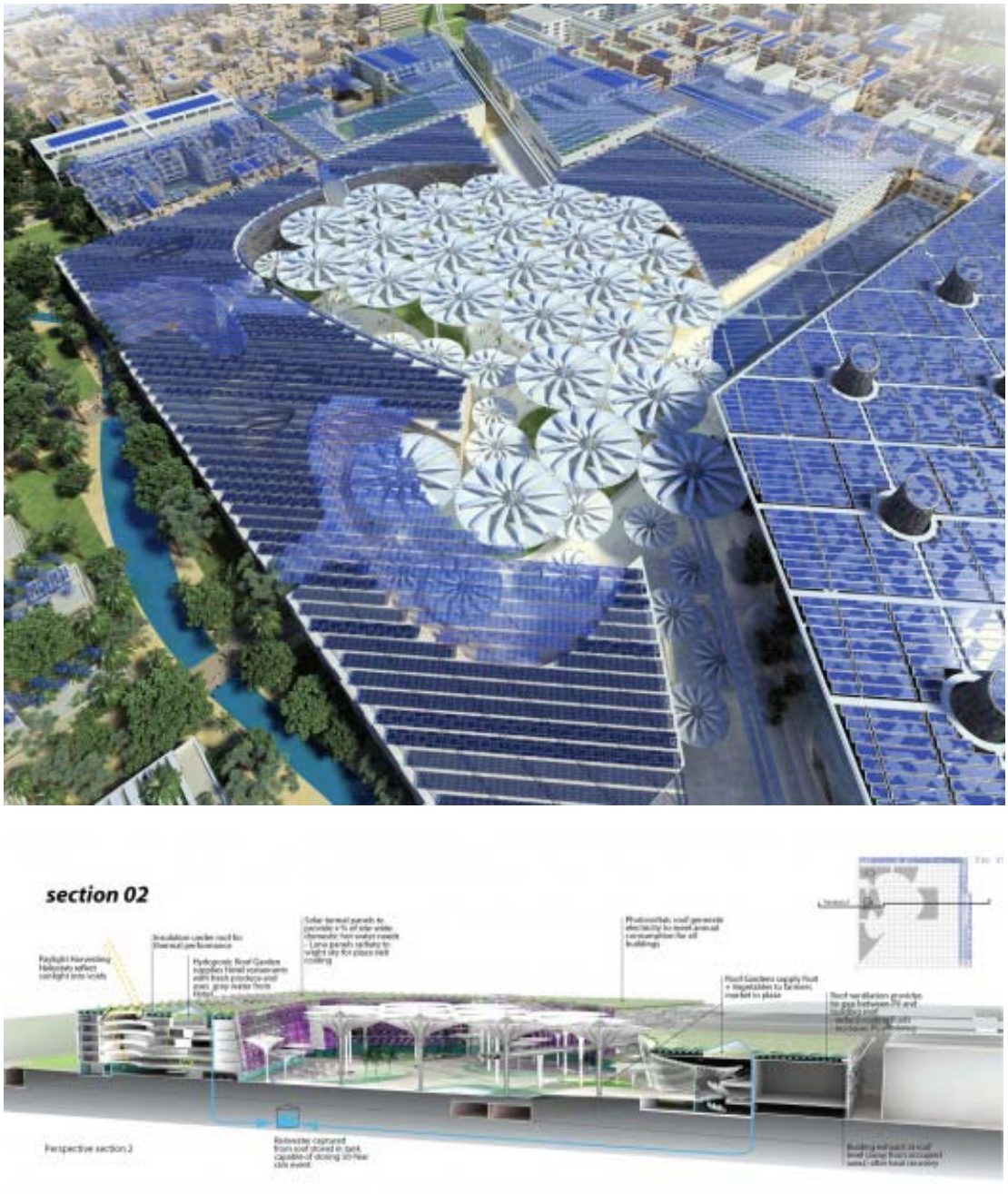


Figure 4.60: A bird's-eye view (top) and a conceptual section (bottom) of the Masdar City in Abu Dhabi, United Arab Emirate (source: ArchDaily, 2009).

Introducing an active sustainable system, however, requires relatively higher initial construction costs, which is a big obstacle for affordable housing to overcome. Therefore, the passive sustainable system which does not bring construction costs up as much as the active system can be an alternative design strategy to reduce both short- and long-term

housing costs. South-facing building orientation and narrow building mass do not increase building costs; furthermore, recycling existing building materials such as bricks, concrete and steel reduces construction costs by using fewer raw materials. A green roof system with rainwater recycling system, depending on roof insulation methods, does not increase building costs. Regulating size, direction and insulation of the window area on a building facade also reduces both construction and maintenance costs. In conclusion, passive green design strategies can actually help to minimize initial construction costs for affordable housing, but they also more effectively save the long-term building maintenance costs to reduce the economic burden for the low-income residents who need to save their income for a better future.

4.3 RECOMMENDATIONS FOR THE FUTURE URDAN RENEWAL AND HOUSING DEVELOPMENT PROJECTS IN KOREAN CITIES

The objective of this section is to transform the results and the finding from the case studies into a framework of affordable design strategies that can be used as a tool to provide a new affordable housing design approach for the urban context of Korea. The idea is to offer an outline of concepts that would assist various levels of government officials engaging in affordable housing policies, commercial housing developers and architects in their planning and design of social affordable housing, which has become one of the major urban issues in the Korean context. The real examples may provide a newly adopted trend and a view toward the design of affordable housing for future urban renewal projects in Seoul.

4.3.1 GOVERNMENT SUPPORT PROGRAM FOR AFFORDABLE HOUSING

Korea does not have a long history of affordable social housing and the amount of well equipped rental housing is very limited compared with state-developed market housing which is not affordable. Also, Korea’s basic housing strategy has essentially been based on

the filtering concept: expansion of the supply of market housing by the private sector will eventually improve housing availability to low-income households and reduce the rate of increase in housing prices in the market. However, in fact, the filtering-down housing policy concept has not worked well because the housing price increase rate exceeded the average income increase rate with economic growth, and the rich invested their extra capital mostly in the housing market until now; this boosted the housing price increase rate even more (Ha, 2002). In short, housing policies in Korea have been ineffective. Therefore, the Korean government, including local government, has to employ a new housing policy including affordable market and non-market housing.

The government needs to take an active role in the affordable housing program for both social rental housing and market housing for low-income communities with non-profit housing organizations. To encourage the development of affordable housing, government can take several strategies. Since high land costs are one of the major obstacles, the government could offer or lend government-owned land to non-profit developers and commercial developers in exchange for additional affordable housing units to compensate for the development costs. In the case of landlord-driven redevelopment, tax exemption for a certain period of time for the landlords in exchange for including affordable rental units is also a useful policy to encourage supply of affordable housing for the urban poor. For private sector developers, the government can ease land use regulations for expansive mixed-use development and allow higher FSR development with affordable market and non-market units. Furthermore, the government needs to think again about direct government funding for affordable housing systems, since government financing has declined since the 1990s. Spending tax money on low-income housing is not a waste or unfair for those who are relatively wealthy; indeed, it is an investment for both economic growth and social capital for the future. Moreover, the government needs to consider providing the affordable social housing as entitling the constitutional right of equal opportunity for the weak.

4.3.2 MIXED-USE AND MIXED-INCOME DEVELOPMENT STRATEGIES

The Korean government has practiced a very strict urban development regulation, zoning system and building code which meant preventing illegal urban development during the industrialization period of the 1960s to the 1990s. Today these regulations have become a barrier for mixed-use affordable housing development. According to the zoning regulation, urban residential area is divided into three zones: zone 1 only admits single detached housing, zone 2 only permits low-rise multi-family housing, and zone 3 allows high-rise housing development. Also, residential zone 1 and zone 2 do not allow any commercial buildings including basic amenities. Even in zone 3 the zoning regulation only permits very basic amenities and limits up to certain size. Conditional easement of this zoning and density regulation will lead to mixed-use development with exchange of affordable housing in the development program. Indeed, as discussed in Chapter Two, mixed-use and mixed-income development is a critical part of low-income affordable housing strategies.

Even though, mixed-use housing development projects introduced in the Korean cities, most of the projects have failed in terms of housing affordability. The main goal of mixed-use housing development is to revitalize the development area by attracting commercial investment. The Households in the complex provide basic numbers of shoppers to ignite commercial activities within the mixed-use complex. Yet, in the Korean context the housing units in the mixed-use complex were planned as luxury condos like other high-rise housing development in wealthy neighborhoods; moreover, the numbers of retail shops and other services in the commercial space were limited, and the kind of services were usually basic daily amenities which can be found everywhere. In short, the housing and commercial program was not integrated into the program since the well-to-do does not spend much money in the neighborhood; whereas, min-income families and low-income households have a tendency spending their money relatively more in their neighborhood. As a consequence, it

was inevitable architectural failure of both commercial and housing program from the beginning.

Hence, the private developers undeniably need to consider affordable housing units in a mixed-use housing development since the low-income households will become most frequently visiting guests for the retail stores and small restaurants generating economic activities with employment within the neighborhood. It will lead commercial success of affordable mixed-use housing development compensating the developers' fee.

4.3.3 INNOVATIVE DESIGN STRATEGIES

In the Korean construction industry, the most commonly practiced construction method and design for housing buildings is the RC (reinforced concrete) load-bearing wall system, regulated by the building code, including both interior and exterior walls. This construction method provides less opportunity to engage in innovative design to lower housing costs. The concrete load-bearing wall construction requires that most of the building processes will be executed on site, which opens up many chances for construction delay due to site conditions and weather changes. If the government allows other construction methods to be applied, such as prefabricated systems, construction time can be saved by reducing on-site works. This will lead to a reduction in construction costs and will provide various design opportunities. For example, architects can generate various ranges of housing type designs according to household size and lifestyle, and then clients can order a housing type they need from a housing design catalog. Contractors will fabricate building components in a factory and then ship them to the construction site. Finally, the prefabricated building components are assembled on the site. This will reduce construction costs by saving time and provide more design choice for both the clients and the architects.

For the urban large scale renewal projects in the major Korean cities, displacement of low-

income families generated social disputes and substantial resistance. The low-income households cannot afford the new homes and they usually have jobs in close proximity to their homes. Displacement from their old homes can be translated to unemployment. Thus, providing temporary housing during the urban renewal period is the most important thing that the developers and the government must solve prior to the construction of the project. Mid-rise steel container affordable housing can be an alternative of the temporary housing issue.

Steel container housing as a modular housing for multi-family building can provide many benefits if it is used for temporary shelter. Steel containers have many variations in size (Figure 4.61); therefore, architects and developers can support variety of households' size, as well as housing styles. Since steel containers employ tubing structure system, it is unnecessary to reinforce for structural integrity. Steel containers can be stacked up to 5 stories without any additional structure support (Figure 4.62). Construction of the container housing can be done in a factory in which can minimize construction disturbances and time. For the site construction, a concrete structural foundation for the container housing units and utility connections will only be needed, and the container housing units can be lifted up by a crane and stacked on top of each unit. Some may argue that it is ugly housing, which is not necessarily true; carefully arranged container houses can express its architectural aesthetic (Figure 4.63). Using shipping containers for housing construction can achieve very high level of environmental sustainability by recycling old shipping containers and minimum environmental impacts on the site. Best of all, by combining all of the benefits discussed, housing construction costs can significantly reduced. Therefore, the container housing can be considered as the most suitable strategy for temporary affordable housing of the low-income displacements especially in the Korean urban condition.

Unit					
Container Length	2.42m (8ft)	3.05m (10ft)	6.06m (20ft)	9.12m (30ft)	12.19m (40ft)
Container Width	2.17m	2.44m	2.44m	2.44m	2.44m
Container Height					
Standard	2.26m	2.59m	2.59m	2.59m	2.59m
High cube		2.89m	2.89m	2.89m	2.89m

Figure 4.61: Standard external container dimensions (Source: S. Jones Container Services, nd).

Figure 4.62: Container housing can be stacked up to 5 stories without structural reinforcement; Container City in London (Source: http://www.choices.co.uk, 2012).

Figure 4.63: Container housing can be beautifully implemented and can be used for permanent housing; Shipping Container Apartment in Le Havre France (Source: http://containerhome.info, nd).

4.3.4 GREEN DESIGN FOR AFFORDABLE HOUSING

From the author's professional design experience, there is no report of green or sustainable design applied to multi-family housing in Korea. There are several reasons for that. One reason is that clients and developers believe that green design costs much more than conventional design, even though passive sustainable design does not cost more as discussed. The other reason is that the green design strategy is a relatively new concept for most developers; they are usually resistant to using new technologies that they do not know. When a new technology or design is applied to building construction, developers usually charge more. The last reason is government policy and the building code. For example, according to the building code, the only building types that green roof construction is allowed for office buildings and shopping center buildings; moreover, recycling of existing building material is prohibited by the building code due to the bogus environmental concern.

Reuse of existing building material can reduce use of raw aggregate, which travels long distance and requires more energy input, for concrete and support building structure, which reduces the construction cost of structure and the environmental impact on nature. Also, using recycled concrete does not weaken strength of building structure. A green roof system can minimize energy consumption for air conditioning, roof drainage systems, damage to roofing membranes, and roofing installation costs, depending on insulation method. The green roof can also be used as a roof garden where residents can grow agricultural products to compensate the home economy for low-income residents; moreover, the green roof garden can function as a community daily base gathering place where residents can rebuild the sense of community value destroyed by urban renewal projects. Rainwater recycling systems also save on costs for building maintenance and home utility bills by using stored rainwater for irrigation and toilet water, since Korea is considered as a water shortage country, and they reduce the social cost of the environmental impact by minimizing storm

water and flooding in high-density urban areas. Applying a design for natural ventilation and daylighting does not push up the construction cost either. As Korean municipalities spend many resources on roads and street, changing pavement materials and design can bring cost reduction for building and maintaining circulatory infrastructures.

For example, water-infiltration paver bricks can replace asphalt pavement, which cannot absorb rainwater and leads to flooding in urban areas, for streets slowing down vehicular traffic to save social costs. For residential streets, curbs do not necessarily elevated to divide pedestrians from vehicles, and the pavement material for the curbs can be switched with recycled bricks or the water-infiltration paver bricks. Also, using the paver bricks reduces road maintenance costs as the paver bricks are relatively easier to construct and replace damaged area without use of heavy machines. Best of all, well designed roads and streets with recycled brick pavement create desirable urban landscape, which affects on psychological health of citizens. Indeed, most passive sustainable green design has been used for building for centuries; we just did not realize and forgot the importance of using existing nature, which can reduce building costs and ensure high-quality healthy living.

4.4 RETHINKING OF AFFORDABLE HOUSING IN KOREAN CITIES FOR THE FUTURE

For Koreans, affordable housing is not a familiar concept. However, providing affordable housing for both low-income and middle-income households is critically important, especially in the current climate of the worldwide economic crisis. Those people are the backbone for supporting Korean society; therefore, providing affordable social housing and market housing should be considered as a national investment to sustain the future society. Furthermore, to achieve housing affordability, all those methodologies and strategies have to be considered, not only to reduce building construction costs but to maintain and improve living quality. Therefore, based on the results of this research, the focus of the next study will

emphasize affordable design strategies and methodologies for creating a physical urban form to maintain self-sufficient and environmentally responsible affordable living for low-income households.

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