ENVIRONMENTALLY SUSTAINABLE HOUSING DESIGN AND PLANNING THROUGH THE APPLICATION OF SUSTAINABLE URBAN FORM PRINCIPLES IN THE CONTEXT OF A SELECTED CASE STUDY SITE IN SAN JOSE DEL MONTE, BULACAN, PHILIPPINES

By
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To my supportive parents
To Paolo
To the people of my country
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My utmost gratitude goes to Mr. Yap Weng Seng, who has inspired me to pursue a life-long learning path towards sustainable architecture.

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<th>Description</th>
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<tr>
<td>DU</td>
<td>Dwelling units</td>
</tr>
<tr>
<td>FAR</td>
<td>Floor area ratio (also similar to gross plot ratio)</td>
</tr>
<tr>
<td>GPR</td>
<td>Gross plot ratio</td>
</tr>
<tr>
<td>BCA</td>
<td>Building and Construction Authority (Singapore)</td>
</tr>
<tr>
<td>HDB</td>
<td>Housing and Development Board (Singapore)</td>
</tr>
<tr>
<td>URA</td>
<td>Urban and Redevelopment Authority (Singapore)</td>
</tr>
<tr>
<td>HUDCC</td>
<td>Housing and urban Development Coordinating Council (Philippines)</td>
</tr>
<tr>
<td>MERALCO</td>
<td>Manila Electric Railroad and Light Company (original acronym, now Manila Electric Company)</td>
</tr>
<tr>
<td>NHA</td>
<td>National Housing Authority (Philippines)</td>
</tr>
<tr>
<td>SJDM</td>
<td>San Jose del Monte (Bulacan, Philippines)</td>
</tr>
<tr>
<td>PHP</td>
<td>Philippine Peso</td>
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<tr>
<td>USD</td>
<td>US Dollar</td>
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This research aims to discover the physical shape of a housing development that foremost exudes environmental sustainability, is sensitive to the unique context of its climate, place and people, and is able to fulfill these purposes despite the financial limitations of a low-cost housing scenario. Principles of sustainable urban form, of density, compactness, sustainable transport, mixed-use development, diversity, greenery and passive design, strongly influences the direction of both the research and the design, in that, these are used in evaluating existing conditions of the case study neighborhood, in affirming and learning from environmentally sustainable features and lessons from a
selected precedent site, and in improving the physical conditions of the existing site, so that it can be more sustainable, and hopefully, livable as well.
Background and Significance of the Study

Housing affordability within the framework of sustainable planning and design remains nonexistent in the Philippines; moreover, the lack of support and initiative from the government to address urban environmental poverty in housing is still a persistent national issue that has yet to be addressed. In the city of Manila, Philippines alone, an estimated 37% of the population, that is approximate 4.0 million people, live in slums (2010). With an annual population growth rate of 8%, the projected slum population is 9.0 million people by the year 2050 (Ballesteros, 2010). The country’s key housing agencies, Housing and Urban Development Coordinating Council (HUDCC) and its implementing arm, the National Housing Authority (NHA), have effected decades of gradually progressive public housing provision and slum resettlement. Although vast improvement can be observed throughout the country’s provision of housing for the poor, basic neighborhood facilities such as developed and well-planned road networks, storm water drainage systems, sewerage systems, water supply, electricity, and other important infrastructure and key community facilities are either lacking, insufficiently designed, or haphazardly implemented (Ballesteros, 2002).

People seek, not only sufficient government subsidies, security of tenure, and flexible, income-based financial home ownership schemes, but also a broader, and more encompassing scale of housing provision that also looks at the interest of urban development (Ballesteros, 2009).
Sustainable housing technologies and urban design schemes that are effective in reducing housing consumption throughout its lifecycle, are a singular part of the larger housing issue, but nonetheless hold an immense significance, since these sustainable schemes chart the direction of housing’s physical and environmental dimensions.

Buildings account for more than 40% of the world’s global energy use and as much as one-third of global greenhouse gas (GHG) emissions, including both developed and developing countries (UNEP, 2009). The same “Summary for Decision-Makers” by the UNEP (United Nations Environmental Programme) indicated a greater contribution of residential developments to the total primary energy consumption, as compared to non-residential buildings. In a study conducted by Janda (2009) on “Worldwide Status of Energy Standards for Buildings”, the Philippines was categorized under a group of surveyed countries with voluntary or non-mandatory building energy standards for non-residential occupancies only. This massive contribution of housing developments to GHG emissions, and consequently to climate change, augmented by the lack of residential energy standards in the Philippines, poses a severely environmentally-relevant issue that must be addressed.

**Research Question**

In light of the above circumstances and issues raised, in the context of today’s global movement towards environmental sustainability, and in the constant effort to provide affordable and cost-effective homes to the low-income sector of the country, what form and shape should sustainable
housing take? How acceptable is this form to its end users? This research explores the environmentally-sustainable features, typology and urban form of a low-cost housing development, while taking user preferences and residents’ housing satisfaction into consideration.

**Research Objectives**

Central to the research project is a case study site, to which urban form principles will be applied and studied. Through this actual and existing housing site, located along the city’s fringe, this study makes a concrete comparison between standard and sustainable building practices. Chapter 3 (Research Methodology) discusses a more comprehensive description of the study methods. Meanwhile, the work is guided throughout by the following research objectives:

1. Identify the most suitable housing form in the context of the case study locale, that exudes the most environmentally-sustainable plan and design, based on the key principles of sustainable urban form;

2. Ensure cost-efficiency of the proposed housing design, by keeping to minimum initial building costs as possible, in accordance to the budgetary standards of low-cost housing in the Philippines; but not, in any way, compromising on any valuable sustainable design feature that will support buildings and the neighborhood, throughout its life cycle; and in that, such additional costs are justified;
3. Design towards a more people-oriented, humanistic approach, by ensuring a positive impact to end-users: enriching people's lives, instilling a sense of pride in their homes and neighborhoods, and fostering a better sense of community through a sustainable housing design.

Research Roadmap

Subsequently, Chapter 2 (Literature Review), lays the fundamental groundwork for the study, contributing significantly in the focusing of the research problem and refinement of the study's methodology. Chapter 3 (Research Methodology) gives a clear and detailed description of the research instrument, data collection strategies used, and the sample selection process.

The main body of the paper begins with Chapter 4, and is further subdivided into the following parts, including: criteria-setting – the principles of sustainable urban form and the LEED Location and Transportation (LT) Version 4 (V4); the case study site and its existing conditions; Singapore public housing as a precedence study; the project design proposal; and cost presentation. Discussions and analysis are also included in this section.

Chapter 5 (Conclusions and Recommendations) summarizes valuable findings from this study, as well as identification of further areas of research that may support and advance the outputs of this research work.
CHAPTER 2
LITERATURE REVIEW

Introduction

This chapter expounds on selected literature that have contributed to the development of the research problem, the discovery and refinement of methods, and a deeper realization of the study’s significance - most glaringly, under the specific setting and circumstances of its context. The Philippines’ housing handbook, *Batas Pambansa Bilang 220* (BP 220) was reviewed, in order to achieve a better understanding of the pertinent building standards and regulations on housing in the country. Central to the research project are the concepts of sustainable urban form that have been a popular subject among several contemporary studies, of which, Jabareen’s (2006) article on the subject, has been extensively used. Literature on user preferences helped to identify elements of housing and the neighborhood that contribute to user satisfaction.

Overall, the following literature present foundations and definitions – a springboard and ground-setting of the study, introducing the concepts of housing affordability, defining the low-income sector as end-users, sustainable urban forms, Leadership in Energy and Environmental Design (LEED), and the relationship among these subjects.
Table 2-1. Classification of population in the Philippines by income group (Albert, Gaspar & Raymundo, 2015)

<table>
<thead>
<tr>
<th>Income Class</th>
<th>Definition</th>
<th>Range of Monthly Family Incomes (for a Family Size of 5 members)</th>
<th>Size of Class (i.e. Number of Hholds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>Per capita income less than official poverty threshold</td>
<td>Less than PHP 7,890 per month</td>
<td>4.2 million</td>
</tr>
<tr>
<td>Low income (but not poor)</td>
<td>Per capita incomes between the poverty line and twice the poverty line</td>
<td>Between PHP 7,890 to PHP 15,780 per month</td>
<td>7.1 million</td>
</tr>
<tr>
<td>Lower middle income</td>
<td>Per capita incomes between twice the poverty line and four times the poverty line</td>
<td>Between PHP 15,780 to PHP 31,560 per month</td>
<td>5.8 million</td>
</tr>
<tr>
<td>Middle class</td>
<td>Per capita incomes between four times the poverty line and ten times the poverty line</td>
<td>Between PHP 31,560 to PHP 78,900 per month</td>
<td>3.6 million</td>
</tr>
<tr>
<td>Upper middle income</td>
<td>Per capita incomes between ten times the poverty line and fifteen times the poverty line</td>
<td>Between PHP 78,900 to PHP 118,350 per month</td>
<td>470 thousand</td>
</tr>
<tr>
<td>Upper income (but not rich)</td>
<td>Per capita incomes between fifteen times the poverty line and twenty times the poverty line</td>
<td>Between PHP 118,350 to PHP 157,800</td>
<td>170 thousand</td>
</tr>
<tr>
<td>Rich</td>
<td>Per capita incomes at least equal to twenty times the poverty line</td>
<td>At least PHP 157,800</td>
<td>150 thousand</td>
</tr>
</tbody>
</table>

Housing the “Lower Income Groups” of the Philippines

Defining Income Groups in the Philippines. Income groups in the Philippines are not very clearly delineated, in such that, numerous government offices, as well as independent research have attempted to define such groups. While the 12th National Convention on Statistics (NCS) attempted to officially establish nine clusters of Socioeconomic Classifications in 2012 (Cluster 1 to Cluster 9, ranging from the least to highest spending households, respectively), this system was barely recognized. A simpler, and yet more effective system uses descriptive terminologies, bounded by ranges of monthly family incomes that are calculated based on the Philippine Statistics Authority’s (PSA) 2012
Family Income and Expenditure Survey (FIES) (Albert, Gaspar, Raymundo, 2012). Table 2-1 summarizes this system and contains an indication of each income class; a brief description of each group, using poverty line as the main reference value; a range of monthly family incomes (for a standardized five-member household); and the total number of households for each class (as per 2012 survey report by PSA).

This research will focus on the two lowest tier of income categories from the table: poor and low income, and their unique housing requirements.

Low-Cost Housing Definitions and Standards. Low-cost housing and resettlement housing in the country, and as defined in the study, are often used interchangeably or inappropriately. Resettlement housing falls under the broader umbrella of low-cost housing, and specifically caters to the poor, as defined above. This type of low-cost housing is mostly initiated and implemented by the government and its corresponding housing agencies; but are at times facilitated privately or through non-governmental organizations (NGOs). Resettlement homes have very specific residents, who are mostly pre-identified informal settlers from various areas of the country. They are entitled to low-cost homes of a specific minimum, government-set standards, and with a uniquely and appropriately
tailored housing tenure. Low-cost housing in general, however, has no strict
definition nor a restricted clientele; but in that, these are developed to offer
“affordable” homes that can be availed, despite financial limitations of the low
income group. On the other hand, while the said group may be the practical target
for low-cost housing developments, there are no limitations as to who can avail of
this type of homes.

A minimum set of prescriptive standards for socialized and economic
housing in the country has been authored by the Housing and Land Use
Regulatory Board (HLURB), the country’s rule-making and standard-setting body
for housing and land use, via Batas Pambansa Bilang 220 (BP 220, revised in
2008). The general scope and definition of socialized and economic housing is
stated in the following quoted texts from BP 220: “It is a policy of the government
to promote and encourage the development of economic and socialized housing
projects, primarily by the private sector in order to make available adequate
economic and socialized housing units for average and low income earners in
urban and rural areas” (HLURB, 2008). The implementing rules and regulations of
the code are imposed upon prospective developers of the above defined housing
types, and thus cover low-cost housing projects in general.
The BP 220 functions as an all-encompassing rule book, written in the manner of broad generalizations for most parts, and which would have been more meaningful with the inclusion of details. As an illustration, under the code’s Rule II, Sect. 5, Par. A/3 (Site Criteria / Physical Suitability), “A potential site must have characteristics assuring healthful, safe and environmentally sound community life. It shall be stable enough to accommodate foundation load without excessive site works. Critical areas (e.g., areas subject to flooding, landslides and stress) must be avoided” (HLURB, 2008); while this clause is suggestive of a practical and reasonable guideline, it requires further details such as extensive definitions, elaboration of suggested implementation strategies, identification of potential site scenarios and indications of physically suitable sites through well-defined criteria. Overall, while BP 220 may be generally improved by transforming its content into a robust and comprehensive set of design standards, it has failed completely, to include that valuable criteria of sustainable housing design and planning.

**Low-Rise / Mid-Rise Living and User Preference**

Architectural design and planning faults, poor location, tenancy controls and property management, lack of maintenance, unavailability of social services, and unsuitable mix of tenants have mainly contributed to the known failures of
high-rise living in countries such as the US (Fuerst & Petty, 1991). Preferential studies and interviews, such as that conducted in Bangkok (Usavagovitwong et al., 2013), proved that several occupants, currently in low-cost, mid-rise housing (Fig. 2-1), will still prefer to reside in low-rise, row house or single-family dwelling units over apartments, if given a choice. But while there has been no compelling reason for apartment living to be willingly favored over owning a house on a plot of land, there has not been many choices offered, especially to those residing in central city areas, such as Bangkok, where the demand for land is high, and land value appreciate exponentially over time. The case is similar in other Southeast Asian cities, such as Jakarta, Kuala Lumpur and Phnom Penh, where upsurge of development land values is evident (Knight Frank, 2014).

Residents’ Perception on Low to High-Rise Housing Provision. Several studies have been conducted and written in order to identify the successes of mostly high-rise housing developments, highlighting the many features that justify their functionality, cost-effectiveness, and in most recent times, sustainability, despite their long known infamy among residents. Anne Stevenson, in her study of low-income, high-rise housing in Melbourne, has unveiled positive findings, whereby a majority of occupants expressed their satisfaction, and praised the
maintenance and amenities of the development (Fuerst & Petty, 1991). The study in Bangkok (Usavagovitwong et al., 2013) on low-cost, mid-rise housing, highlighted interviewee’s responses to satisfaction-related inquiries; whereby some take pride in the cleanliness and orderliness of their current dwellings on the higher floors, as opposed to previously residing on the ground level that is often cluttered and characterized by disarray. However, there are of course equally opposing sentiments on spaces being inadequate for some households, and interactions being too restrained or limited. The study also presented several factors such as density, open spaces and neighborliness that affect residents’ housing satisfaction.

Residents’ Perception on Housing Aesthetics. Form and outlook are also key components of housing that need to be carefully studied. Marcus (1982) indicated in her article, “The Aesthetics of Family Housing”, that many case studies have realized the significant contributions of aesthetics to housing satisfaction among residents. It was found that pleasing appearance is associated with “variety in building height and facades, color, good landscape, pleasant views from dwellings, a non-institutional appearance and high levels of maintenance” (Marcus, 1982, p.9). Residents have been found to appreciate medium to high density
dwellings that are able to incorporate as much features of single family dwelling units, such as private open spaces in the form of gardens, yards and balconies; individualized facades and opportunities to personalize; and an architectural language that strongly conveys an image of a house. Architectural complexity, as commonly exuded by a variety of forms and materials, as opposed to overly monotonous and institutional facades, is a desirable housing feature. Architectural integrity can be potentially established through a sense of uniqueness against a blanket of identical homes. Disorientation and feelings of indifference towards their neighborhood, among residents and visitors, due to the common and replicated schemes of undistinguishable blocks, can be addressed by introducing landmarks, landscapes, central public areas and other strong and unique outdoor or building treatments. Residential exteriors must be perceived, not merely as a reflection of the designer’s vanity and ego, but a way to instill a sense of belongingness in neighborhoods, a sense of ownership to one’s home and a feeling of self-worth and uniqueness.
Environmentally Sustainable Housing and Urban Form

Sustainable Urban Form. Jabareen (2006) identified seven design concepts that have been recurring themes of sustainable urban forms: (1) compactness; (2) sustainable transport; (3) density; (4) mixed land use; (5) diversity; (6) passive solar design; and (7) greening. In the study, these concepts have given rise to four (4) models of sustainable urban form: neo-traditional development; compact city; urban containment; and, eco-city, of which, the eco-city and compact city models emerged to be most sustainable, based on a points system assessment.

The eco-city focuses on environmental and ecological management, using greenery and passive design concepts as means to achieve urban sustainability. The eco-city model is not very particular with density, variety, or any physical form and urban shape, so that it tends to be rather formless and “eco-amorphous”. Urban management and well-placed environmental policies are at its core. However, while being comprehensive and “formless” in nature, it is interesting to find a definition of the eco-city’s physical shape as it unfolds in the urban context, and how the model fits into the more specific setting of low-cost housing developments.
The compact city accumulated the highest mark among all four models presented (Jabareen, 2006). The compact city is characterized by a high-population density and a mixed land usage, for greater transportation sustainability. It favors the re-use and re-development of urban lands instead of sprawled, outward developments that infringe into rural areas. The model aims at shorter travel distances, in order to reduce transportation carbon emissions. Such are the more popular features of a compact city.

The possibility of incorporating greenery and passive design strategies in the compact city model has been explored, in order to potentially achieve greater sustainability and a more holistic urban design. In fact, the marrying of the two urban models, of the eco-city and the compact city, have given rise to a hybrid urban form that is gaining recent popularity – the eco-compact city (Fig. 2-2).

**Housing Density.** Alexander, Reed and Murphy (1988) highlighted the significance of density measures as an “integral part” of the design profession. Relationship between density measures and urban form has long been a subject of various urban design discourses and research studies, as density can be both calculable and perceptive at the same time. The authors aimed to establish a clearer and more quantified relationship between density and urban form by
investigating four main dwelling types: single family detached housing units; row-houses; low-rise garden apartments; high-rise multi-family dwellings, and exploring variations of these main types, together with other relevant variables such as floor area ratio, site coverage, unit size, block size and configuration (Fig. 2-3). The final outputs are density ranges for each of the dwelling typology presented. These measured outputs are a reliable source of base information for assigning density values to varying types of housing forms that are investigated in this research work.

The concepts of plot ratio (the total building floor area over the total site area and more commonly referred to as the floor-area ratio) and site coverage (ratio or percentage
of area of land covered by buildings over the total site area), as the key measures for densification and urban compaction, have been studied closely by Zhu (2012) in the context of high-density, low-income housing in rapidly urbanizing Vietnam. The author studied four combinations of plot ratio and site coverage intensities: (1) Low-plot-ratio with low-site-coverage (LPR-LSC) characterized by the earliest models of urbanization characterized by the plan-less building of settlements, and an almost unrestricted land consumption; The forthcoming land scarcity has then transformed the LPR-LSC settlements to a (2) low-plot-ratio with high-site-coverage (LPR-HSC) model, whereby population growth that is a key characteristic of urbanization, effects to encroachment of previously open and green spaces in order to comply with the housing requirements of a larger population (Fig. 2-4); (3) A high-plot-ratio with high-site-coverage model (HPR-HSC) is characterized by an extremely poor urban environment, and can be commonly typified by urban slum settlements, where no land use plan or any other legislative actions have regulated or controlled this highly-intensified growth in urban areas; 4) High-plot-ratio with low-site-coverage settlement (HPR-LSC) is the recommended urban housing model, exemplified by residential developments in Singapore, usually having minimum plot ratios of 2 to 3, and maximum site

Figure 2-4. Plan view of a low-plot-ratio with high-site-coverage street blocks in HCMC, Vietnam (Zhu, 2012)

Figure 2-5. Plan view of a private housing estate in Guangzhou, China, exhibiting high-plot-ratio with low-site-coverage type of development (Zhu, 2012)
coverages of 40% (Fig. 2-5). This conclusion is driven by the practicality of housing costs, scarcity of land and available areas of usable open spaces for residents.

Residential Land Use Efficiency. In a similar study on urban density, Diamond (1976) identified the missing gap between single family dwelling types and high-density, high rise apartments in Canada. These were the more popular housing options in the country during the study period. The author established a simple methodology of determining the relationship between density and land use efficiency, and taking neighborhood amenities into consideration.

The study resulted to a presumably more desirable medium density housing form, which was considered to be a highly-efficient

Figure 2-6. Relationship of floor area ratio, against land area required, resulting to an asymptotic curve of land-use efficiency (Diamond, 1976)
solution and alternative to the extreme densities of single family dwelling types and high-rise apartments. The author established the relationship between floor-area ratio (FAR - ratio of total development floor area to the site area), and area of land (expressed in acres) required to be occupied by the corresponding FAR. This resulted to an asymptotic curve (Fig. 2-6) that translates to a decline in site efficiency after an FAR of 1.5; as it can be observed from the graph, that land savings continue to increase, but in diminishing intervals beyond the mark. From here, the study concluded that FARs from 0.75 to 1.5, characterized by medium density and low to mid-rise (2 to 4 stories) stacked row houses, walk-up or garden apartment housing typologies are most efficient in terms of land use.

While the above study was successful in introducing effective methods and generally reasonable results, the target user group was, however, not defined, Acceptable residential densities (dwelling units / hectare), for instance, differ from one income group to another. This opened up an opportunity to further study and refine land use efficiency standards for various income groups.
Leadership in Energy and Environmental Design (LEED) Location and Transportation Category (LT) Version 4 (V4)

The adverse environmental impact of the building and construction industry has been recognized and addressed through the formation of the concepts of green buildings and green building assessment tools. The birth of the United States Green Building Council (USGBC) in 1993, and consequently, efforts in developing the LEED standards in 1994, happened almost concurrently with the forming of United Kingdom’s BREEAM (Building Research Establishment Environmental Assessment Method), which took place in 1992. LEED has since been driving the demand for high performance buildings and communities, and leading the industry to a more sustainable design approach that is applied throughout a building’s life cycle (from design inception, development, construction, and operations, and up to renovation and demolition).

LEED Location and Transportation (LT), is a new credit under the latest LEED version 4 (v4). This category emphasizes on and promotes the following:

1. Protection of sensitive land including prime farmlands, flood plains, endangered species habitats, water bodies and wetlands;
2. Building on high priority sites such as historic districts, infill sites, brownfield lands for remediation, and other designated areas for priority development as designated by local authorities;

3. High density, mix of land use and diversity of form and function;

4. Accessibility to quality transit, resulting to a reduction of vehicle miles travelled (VMT) through frequency of transit trips and quality and distance of walking routes;

5. Inclusion of bicycle facilities, including parking areas and provision of shower for cyclists;

6. Reduction of parking footprint through the provision of shuttle services, shared parking between surrounding buildings and introduction of transit subsidy among building users, and;

7. Introduction of green vehicles such as electric cars (USGBC, 2014).

Points are achieved through fulfillment of specific requirements under the LT sub-categories as summarized above.
It is noticeable how the LEED LT mirrors the principles of sustainable urban form as described earlier, and that it is able to quantify, by means of specific rules and guidelines, how any given development can be assessed in terms of sustainability, under the larger context of urban design.

**Low-Cost and Sustainable Housing**

*Ho Chi Minh City and Low-Cost Sustainable Housing.* Literature on low income housing models and precedent studies are reviewed. The urbanization of Ho Chi Minh City (HCMC) in Vietnam came with it, a necessity to address the housing needs of its growing population, most particularly its low-income sector, whose informal residences within the inner city of Ho Chi Minh are in great danger of being replaced by high-end, up-market housing developments and other profitable uses. The dismal daily road traffic situation in HCMC requires an urban design strategy that is based on the principle of “City of Short Distances”. A sustainable neighborhood in HCMC then entails a mixed integration of use that includes places of employment, social facilities, schools and commercial areas (Waibel, Ecekrt, Rose & Martin, 2007) to facilitate more walking and public transport use. The authors recognize the financial savings incurred when designing high density and medium-rise, five-to-six story apartments, as opposed
to low density housing types. The compact and densified model minimizes the provision for technical infrastructure, such as road networks, water and storm water management systems, electricity and telecommunications, that are essential components of a sustainable development. Waibel, et al. (2007) indicated savings of 50% to 75% on the cost of technical infrastructure when compared to the conventional single family detached housing development type. The authors likewise investigated the feasibility of developing high-rise residential buildings of more than 10 stories high, but are faced with an additional significant cost of one-third to one-half of comparable costs for low rise buildings, thus demonstrating the need to seek additional savings through modular construction components and locally-available materials. The study also explored the adaptive use of traditional Vietnamese “shop house” design that incorporates the highly effective home planning model of combined and flexible living and working spaces, allowing residents to perform informal economic activities, such as sales of products.

Malaysia and Low-Cost Sustainable Housing. One study on affordable housing in Malaysia (Rahman et al., 2013) offered a more micro-scale approach to addressing housing sustainability and affordability, by introducing passive design strategies, while compensating for minor additional improvement costs through
savings on energy in the household operations. Building orientation, improvement of fenestration location and configuration within the house, raised story height, inclusion of rainwater harvesting mechanism, addition of vegetable gardens, and other passive design, naturally cooling and ventilation strategies were presented as design solutions. The study focused on improvements on the overall thermal comfort levels and energy within the living units, in the context of affordable homes. The authors demonstrated how sustainability and affordability are achieved in the most basic unit of housing.

Chapter Conclusion

Outside the sphere of architectural planning and design, the mechanics of housing provision remains equally complex and multi-dimensional, addressing issues that include subsidy and government implementation policies; security of tenure; construction standards and material pricing, financial provision and budgetary constraints, and other associated social, political and economic matters. And while all these are critical variables, the research work will remain focused on the physical form of sustainable housing within the framework of low-cost housing provision.
It is interesting to observe that the above reviewed literatures have been consistent in promoting the compact, medium to high-density housing type as the prescribed urban form, in order to achieve a sustainable housing design. It can also be inferred from these that housing aesthetics and human perception are important components of housing, regardless of cost classifications and income groups.
CHAPTER 3
METHODOLOGY

A Background - The Study Design

The research study, with its primary aim to establish environmental sustainability within the framework of affordable housing, is subdivided into five major parts: Part 1 sets the urban form criteria as primary bases of evaluation for the schemes presented in the study; Part 2 establishes existing site conditions and identifies the site’s key characteristics; Part 3 examines the selected precedence study; Part 4 discusses the design proposal for the selected site; and Part 5 reviews the associated costs and their corresponding comparisons.

The research is designed foremost, as a comparative case study between an existing row house, low-income and sprawled housing development (base scheme); and a new proposed urban housing form, based on tested, and widely accepted criteria and standards of a sustainable urban housing design (design scheme). These identified criteria will be applied on a selected housing site in the Philippines. A cross-sectional study design has been adopted in the research, using a single point of contact with the study population through an interview process. As the research seeks to advance housing performance and residents’ living conditions in terms of environmental sustainability, a scoring method, using a
points system approach will rate each design scenario for both base and design schemes, using the pre-determined set of criteria to be elaborated in the succeeding chapters.

Part of the research seeks to identify an existing and successfully-implemented sustainable housing development (model scheme) that is relevant to the specific region, context and scope of the base case study. The model scheme will be rated and evaluated using the same set of criteria used in the base and improved designs. This comparative study approach will provide guidance to the research work, and support the design proposal, by setting a successful precedence.

This research of already well-established sustainable urban forms as implemented in the base site conditions, and resulting to the design scheme, generally fits the study into a retrospective-prospective design in terms of the research’s reference period of study.

**Statement of Hypotheses**

Hypotheses based on the three major research can be found in Table 3.1.
Table 3-1. Research objectives and hypotheses

<table>
<thead>
<tr>
<th>Research Objectives</th>
<th>Hypotheses to be tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify the most suitable housing form in the context of the case study locale, that exudes the most environmentally-sustainable plan and design, based on the key principles of sustainable urban form</td>
<td>1.1 Higher housing density and more compact design strategies as exemplified, for instance, by cluster housing developments are more environmentally-sustainable than the established sprawling “subdivision” housing type, extensively implemented in the country. Such designs use land more effectively and thoughtfully, and promotes walkability that reduces the use of fuel-driven transport.</td>
</tr>
<tr>
<td></td>
<td>1.2 There is a specific urban layout and pattern, unique to the case study site that is efficient in terms of naturally shading activity spaces (whether outdoor or indoor) or passively allowing the flow of air through the site and within housing units.</td>
</tr>
<tr>
<td>2. Ensure cost-efficiency of the proposed housing design, by keeping to minimum initial building costs as possible, in accordance to the budgetary standards of low-cost housing in the Philippines; but not, in any way, compromising on any valuable sustainable design feature that will support buildings and the neighborhood, throughout its life cycle; and in that, such additional costs are justified.</td>
<td>2.1 Low-income housing can also be an environmentally-sustainable and quality housing.</td>
</tr>
</tbody>
</table>
2.2 Environmentally-sustainable housing and urban form features will entail a comparatively higher investment cost during the development’s construction phase, that will not only effect significant energy savings during occupancy and operational stages of the development, but will also positively impact the community, by creating vibrant spaces that residents can use, and an aesthetically pleasing environment, with an ecologically significant value through extensive greenery provision.

3. Design towards a more people-oriented, humanistic approach, by ensuring a positive impact to end-users: enriching people’s lives, instilling a sense of pride in their homes and neighborhoods, and fostering a better sense of community through a sustainable housing design.

| 2.2 | Environmentally-sustainable housing and urban form features will entail a comparatively higher investment cost during the development’s construction phase, that will not only effect significant energy savings during occupancy and operational stages of the development, but will also positively impact the community, by creating vibrant spaces that residents can use, and an aesthetically pleasing environment, with an ecologically significant value through extensive greenery provision. |
| 3. Design towards a more people-oriented, humanistic approach, by ensuring a positive impact to end-users: enriching people’s lives, instilling a sense of pride in their homes and neighborhoods, and fostering a better sense of community through a sustainable housing design. | 3.1 | Sustainable housing can improve user satisfaction levels as well as residents’ lives in general. |
| | 3.2 | Residents may strongly object and may not instantly yield to the alien features of the proposed urban form at the onset, but that these impressions could change, if the potential benefits and overall positive impacts of the suggested design to the community and to individuals, are communicated properly and effectively |

Identification of Sustainable Urban Forms: Setting the Criteria

From a collection of relevant literature that expounded on sustainable urban forms for housing, an article by Jabareen (2006), identified seven design concepts that have been recurring and most popular themes of sustainable urban
forms: (1) compactness; (2) sustainable transport; (3) density; (4) mixed land use; (5) diversity; (6) passive solar design; and (7) greenery provision. Each of the seven principles is further defined and discussed in the succeeding chapters. These principles are operationalized, measured and expounded as per Table 3.2, to be found at the final end of this chapter:

The three major components of the research study: the housing “base scheme”, “design scheme” and “model scheme”, are evaluated based on the above seven principles of sustainable urban form. A similar scoring method by Jabareen (2006) is adopted in this research; whereby, each of the seven criteria are given equal bearing in the scoring process, using a scoring range from 0 to 9: 0 being if the criteria are not exhibited in any way throughout the design of the scheme, and a full score of 9, if the given criteria have been perfectly exemplified. Scores of the seven criteria on each of the design category are tallied; the results are analyzed quantitatively and qualitatively in the succeeding sections.

Leadership in Energy and Environmental Design Category (LEED) Version 4 (V4) is a well-received, third-party green certification program for green buildings. The LEED Location and Transportation (LT) category specifically, is
used in this study as a reference guide for the assessment of the three study
schemes identified earlier. Requirements under the LEED LT credits: surrounding
density and diverse uses; access to quality transit; and bicycle facilities are used
as evaluation and design criteria.

Setting the *Base Scheme* – Site Selection and Existing Conditions

*Site Selection.* From a roster of recently occupied low-income housing
projects by the National Housing Authority of the Philippines (NHA), a site that
fulfills the following criteria has been selected:

1. A recently built housing site, representative of its contemporaries
   and includes the latest implemented housing design improvement
   and innovation in the country.
2. A site within the urban center or along the fringes of the city; and,
3. A housing site built, to a certain degree, along the principles of
   sustainable design (if such a case exists).

*Site Information.* Through actual site visits, surveys and close coordination
with NHA, the following site data and information are collected:
1. Existing physical site profile and conditions including: site boundaries, general topography and natural environmental features;

2. Surrounding occupancy and usage, such as:
   
   2.1 Existing community facilities, such as: schools, day care center, clinics or hospital, church, multi-purpose and sports areas, public libraries, etc.;
   
   2.2 Commercial or profit-generating areas, such as: eateries, repair shops, mini-salon, etc.;
   
   2.3 Transportation facilities and infrastructure, such as: network of roads, parking areas, sidewalks, cycling paths, terminals; and to identify the different modes of transportation within the site;

3. Existing greenery and recreational open spaces;

4. Climatic conditions, such as: prevailing winds, amount of rainfall, temperature and relative humidity.
The following existing data survey, demographics and project information were retrieved from NHA and the Philippine Statistics Office (PSO):

1. Site area;
2. No. of dwelling units (DUs) / household;
3. Average household size;
4. Population;
5. Lot area of DU;
6. Floor area of DU;
7. Overall project construction cost.

Data Collection from Existing Site. A first part of a round of interviews (Part A) aim to identify existing household energy usage and consumption patterns, as well as unique routines as a result of possible absence or limitations in electricity provision. Mobility and current transport modes used, as well as travel patterns will also be covered in this first part. The second part (Part B) covers the more qualitative and preferential aspect of the research, which will be further discussed in detail. The complete set of interview questions and responses, and other relevant interview materials may be viewed via Appendix 1. A judgmental or purposive sampling was used in the interview, whereby samples were selected
based on the combined experts' knowledge and the researcher's judgement on what or who is most suitable to participate in the activity. An advanced research on the site’s existing statistics and demographics, quality and unique characteristics of its population via the NHA, helped to determine the process of sample selection.

**Scoring the Scheme.** As mentioned above, the *base scheme* will be subjected to a scoring procedure based on the seven principles of sustainable urban form, as well as the LEED LT assessment criteria

**The Model Scheme – A Precedence**

The comparative case study design of the research includes an analysis of a precedent design that is found to have a significant relevance to the existing site in terms of climatic conditions, size, density and nature of housing (public or private). This is referred to as the *model scheme* in the study. The successes of the precedent study site are identified and examined within the context of sustainability, and are likewise evaluated and subjected to the abovementioned scoring exercise.
The Proposed Design Scheme

Prior to developing the design scheme, results from the interviews are analyzed. The interview seeks to gather from residents- comments, and insights that reflect their preferences and point of views, pertaining to the seven principles of urban form through a pictographic presentation and comparison of base design versus vignettes of improved design concepts. It is worthwhile to know how people feel and what people think about new concepts, after having been accustomed to the traditional design; i.e., it has always been said that people were skeptical about multi-level living due to absence of private open spaces, but what if private open spaces are available on the upper levels as well; would that convince residents to try out new ways of living? The interview is carried out inside the model house unit within the existing housing compound, where the interview questions and images are projected via an LED TV screen, to closely simulate a sense of 3-d reality among the images, and capture an equally realistic response among residents.

The new proposed design takes into account and incorporates the seven established principles of sustainable housing urban forms, as well as new findings from the interviews. Lessons from the existing scheme and inspirations from the model scheme are also synthesized and integrated in the proposed scheme. Based on these, an ideal and sustainable housing design is developed.
Sustainability and Affordability – The Cost Component

Housing costs for the base and design schemes will be presented and compared against each other; taking into account costs of dwelling units, landscaping, neighborhood facilities such as fitness and play equipment, covered walkways, waiting sheds and street fixtures. The costs shall exclude all other uses within the residential complex, such as school, hospital, commercial and civic areas. The net dwelling costs will be derived from independent costs of an individual row house unit or costs of each typical block; while non-dwelling, community amenity and landscape costs are deduced from a dollars-per-square-meter (dollars per square foot) basis. A summary of cost analysis and justification are included in the chapter.

Data Analysis

The collected information, statistical data and results are put together and synthesized. Comparisons are organized; and results are summarized. An analysis is made based on the previous guidelines discussed, from where discussions are to be made, and conclusions and future steps to be drawn.
Research Limitations

Research limitations are identified as follows:

1. Sustainable urban form criteria, as the core basis for this study, focused on the seven principles presented by Jabareen (2006). While these principles have been the most frequent subjects of other related studies (as expounded in Chapter 2 – Literature Review), and in the same sustainability context, there are other sustainable urban form principles that may be of equal importance, but are not yet included within the scope of this research.

2. The LEED LT criteria and the indicated credits are used as evaluation and design measures. The rest of the LT Criteria and other LEED categories, although relevant, will not be used in the study.

3. The extent of the site used as case study is not only limited by the actual project boundary as established by the National Housing Authority (NHA), but also by the permissible limits allowed by the study time frame.
4. A second round of interview with the same set of participants – gathering their feedback on the proposed design, in comparison with the base design conditions, may have contributed to a more complete preferential aspect of the study.

5. To keep within the research work’s limited time frame, a focus group discussion was conducted, in place of individual interviews, which used the same set and structure of questioning. As in the case of most group interviews, this posed a problem of expressing individual responses, without being influenced by opinions of other members of the group.

6. The limited time-frame resulted to limited population of participants, as opposed to a potentially more successful study result, brought about by adequate representation of subjects effecting a diverse set of responses.
<table>
<thead>
<tr>
<th>Design Principles</th>
<th>Required Information</th>
<th>Questions</th>
<th>Data Collection Method</th>
</tr>
</thead>
</table>
| Compactness       | Qualify housing compactness by understanding the site context, history of site selection, adjacent urban uses and connectivity to its surroundings. | • Can the development be considered dense in terms of the number of dwelling units per land area?  
• How does the existing site connect to adjacent urban uses?  
• Are other uses apart from residential accessible to all dwelling units within the study site?  
• Was the housing development built over a previous greenfield, brownfield or infill site? | Research on site history and actual site visit and inspection; primary data collection through interviews, and; secondary data collection through research on already existing and relevant studies, assessing well-established theories and principles of urban compactness. |
|                   |                                                                                       |                                                                           |                                                                                                                                                      |
| Mixed-use         | Identify needs and requirements of the residents in terms of consumption patterns that are accessible through walking, cycling or motorized and fuel-powered vehicles. Identify any other community features such as schools, clinics, fitness centers that can potentially and immediately benefit the community. | • Is a mixed-development suitable for the site and its population? Can this potentially create a more sustainable way of living?  
• What types of mix uses are suitable and could widely benefit the users? | Primary data collection through interviews.                                                                                                           |
| Sustainable transportation | Acceptable travel (walking or cycling) distance to the nearest transport hub / terminal, transport preferences, and support of residents to the possibility of an active cycling community, are to be determined | • Would residents prefer walking or cycling to the nearest transport point or to a short-distance destination, if a complete, well-designed and convenient cycling paths and dedicated pedestrian walkways are provided for?  
• What is the maximum distance limit for walking and cycling that residents can take?  
• Are there any other means of transportation or transport facilities that are envisioned by residents to be useful and relevant to their daily activities? | Primary data collection through interviews and secondary data collection of existing studies and research. |
| --- | --- | --- | --- |
| Density | A range of acceptable density specific to residents' profile and site conditions needs to be established using different scenarios that combine building height, building configurations, built-up areas, open spaces and green areas, and floor area ratios. | • What are established and acceptable housing types, configurations, setbacks and their corresponding densities?  
• How do residents perceive the new urban form resulting from the established density standards? | Secondary data that define standards of housing densities and acceptable building configurations; and primary data collection through interview to check on residents' preferences or acceptance of the proposed density and its urban form implications. |
| Greenery Provision | Sustainable landscape design, species selection that are native to the site and are drought tolerant, need to be identified. Extent, quality, uses and benefits of greenspaces are to be identified and justified. | • Can landscaping be sustainable, in that it can survive with minimum maintenance?  
• Can landscaping be cost-effective in the context of low-cost housing?  
• Will residents appreciate and utilize greenspaces?  
• Will residents be more encouraged to walk or cycle along well-landscaped paths and naturally-canopied walkways? | Secondary data collection and research on established literature on the benefits of landscaping and greenspaces, especially in a highly dense housing context will be undertaken; drought tolerant and low maintenance species of flora will also be researched; primary data collection on residents’ opinions and preferences will be collected. |
| --- | --- | --- | --- |
| Passive design | Evidences of improvement in indoor thermal comfort conditions, as well as reduced energy consumption are to be established, with the integration of passive design strategies that can help to bring down high levels of temperature ranges and humidity in the tropical climate. | • Which passive design strategies are most suitable to the site and its residents?  
• Can passive design strategies be cost-effective? | Secondary data collection on existing literature will be used as initial basis for passive design; a simulation study of passive design strategies, such as optimum solar orientation and solar shading in residential buildings will be conducted. |
CHAPTER 4  
STUDY RESULTS, DESIGN PROPOSAL ANALYSIS AND DISCUSSION  

4.1 Identification of Sustainable Urban Forms and Setting of Sustainable Design Criteria  

Principles of Sustainable Urban Form  

The seven principles of sustainable urban form: compactness, density, sustainable transport, mixed-use development, greenery, and passive design are discussed in detail through the succeeding paragraphs, so that a set of sustainability criteria is established to assess the case study scenarios of the base, precedence and model schemes of the research study.  

1.0 Compactness. Attributes of a walkable community that is able to reduce or eliminate the use of privately-owned automobiles include a compact environment. This concept of compactness in urban form has been the core principle of infill cities, urban containment, and the “compact city” concepts, all aiming for, in one way or another, a sustainable approach to urban planning. Urban compactness has been largely associated with sustainable transportation modes and mobility patterns that help to significantly reduce greenhouse gas (GHG) emissions. It also promotes use of the smallest possible land area, and keeping within an already existing urban setting; thus resulting to a more
meaningful and efficient use of land. Consequently, rural areas are preserved and protected from urban sprawl. Compactness, in most cases, is likewise associated with building and infrastructure works cost efficiencies due to mobilization savings and shared amenities. Potential energy savings from reduced consumption can be achieved in compact and highly-dense communities through a greater feasibility of combined power systems. In addition to these, the higher densities of compact neighborhoods support a mixed-use development that is able to thrive, and in turn reinforces the community, by allowing it to grow from within and become self-sustaining.

Jenks & Burgess (2000) highlighted how the concept of compactness in cities has stemmed from the very sustainable roots of resource conservation and waste reduction. But while its origins are certain, there has been much debate on the physical form and scale that compact cities were to assume, and the appropriate context for compaction to take place. Amidst arguments and uncertainties, Jenks & Burgess (2000) provided a “tentative and composite” definition of the contemporary compact city that is characterized by this set of objectives: “to increase the built area and residential population densities; to intensify urban economic, social and cultural activities and to manipulate urban
size, form and structure and settlement systems, in pursuit of the environmental, social and global community benefits derived from the concentration of urban functions” (pp 9-10).

Applications and attributes of compactness in the case studies of this research will be analyzed qualitatively, based on the above concepts. Density, mixed use and sustainable transport are major functions of compactness that will be discussed as separate points within this chapter. Site coverage, the ratio of built-up area over the site area, will be studied in relation to the extent and effects of compactness in the allocation of open spaces for greenery and community activity areas. Compactness will also be evaluated based on connectivity of community facilities, open spaces and greenery within the case study neighborhoods, as well as the sites’ contiguity to the bigger urban scale. Prior functions and former usage of the study sites for the base, precedence and design scenarios will be investigated and assessed.

2.0 Density. Density is the ratio of people, or dwelling units (in the case of this study), to a given identified area. Architects and planners typically express density in dwelling units per hectare (DUs/Ha). Much has been written about density as a critical component of sustainable urban form, due to its direct
relevance to the implementation of compact cities; its allowance for a potentially successful mixed-use development; and the resulting achievement of sustainable transportation. Density, being a function of compactness share similar benefits on both cost and energy savings, as discussed in the previous section.

Density, however, is not as straightforward as researchers in the discipline hoped it would be. As Alexander, Reed and Murphy (1988) identified in their study, density is represented contextually as 1) perceived; 2) physical; and 3) measured density. Perceived density has been defined as a combination among three factors of individual cognition, physical density, and socio-cultural factors. Physical density consists of attributes and characteristics in the built environment that are more qualitative in nature and are excluded in measured density such as building heights, relative spacing, massing, building façade treatment and materials, juxtaposition, lighting and even landscaping. Measured density, on the other hand, encompasses quantifiable expressions of physical density, such as plot ratio or floor area ratio (FAR), site coverage, building angles and its relationship with heights and setbacks (Alexander, 1988).

Measured density will be the greater focus of this research study, which uses dwelling units per area, ratio of housing area over the site area (plot ratio),
and percentage of site area covered by buildings (site coverage), as the factors for determining the optimum and appropriate density for the specific requirements of the case studies. A section on the previous Chapter 2 (Literature Review) discussed studies by Alexander, et al. (1988) and Diamond (1976) on density categories (Fig. 4-1) and optimum density. The range of densities for low-income to high-income areas is extensive. Similarly, city-to-city density variations are also apparent. While a universal density is non-existent, this research aims to establish a sustainable density that is appropriate for the distinct requirements and characteristics of the case study site. The unique desires and preferences of residents are also taken into

Figure 4-1. Various housing typologies and their corresponding densities (Diamond, 1976)
consideration, with every intention of incorporating as much of the reasonable inputs as possible.

In summary, a sustainable density for this study’s purposes is defined using the following criteria: 1) Optimum population per area of land (expressed in DUs / Ha); 2) Ratio of total housing floor area to site area (floor-area ratio – FAR) occupied by housing (a fraction expressed in decimal); 3) An evaluation and analysis of residents’ perception through a survey of human preferences (as detailed in Section 4.2); and 4) A cost comparison of density types present in this research work.

3.0 Sustainable Transport. Private car ownership has been a much discussed subject among environmentalists and environmental planners, due to the significant and massive contribution of fuel-enabled automobiles and other transport modes to the overall greenhouse gas emissions of the planet. Transport accounts for 23% of energy-related CO2 emissions and 19% of global energy use (International Energy Agency, 2009). Thoughtful planning of cities from an urban scale to community scale, allowing for walkable neighborhoods, efficient public transport systems and a mix of use significantly decrease dependence on private transportation without hampering people’s freedom of movement.
Sustainable transportation has been defined by Jordan & Horan (1997) as “transportation services that reflect the full social and environmental costs of their provision; that respect carrying capacity; and that balance the needs for mobility and safety with the needs for access, environmental quality, and neighborhood livability” (p.72). A sustainable transport system in place is characterized by its ability to support green transport modes, such as walking and cycling within and across neighborhoods, by providing pedestrian and cycling-friendly road networks and facilities, such as designated sidewalks or cycling paths, covered walkways and secured bicycle parking. The reduction of motorized vehicles in our streets not only impacts the environment positively, but uplifts the social and aesthetic qualities of communities; with significantly diminished air and noise pollution, and reduced vehicle-induced street hazards. Such an environment also fosters a sense of community, is conducive to human interactions, and is civic-centered.

Much of the urban form principles discussed in this chapter: a compact, dense, mixed use and diverse urban form have been established as means to achieve transportation sustainability, which in turn, addresses the global phenomenon of climate change, as a result of the reductions in fuel-dependence and greenhouse gas emissions. This study aims to determine travel patterns of
residents within the community, to assess existing conditions, and to study ways by which such conditions may be improved towards greater sustainability. This project’s design proposal (Chapter 4.4) will explore and study methods of achieving shorter, more efficient and “greener” trips within and outside of the specific neighborhood of the case study.

4.0 Mixed-Use Development. When basic commodities and services are at a very close proximity to one’s home, the use of cars, buses and other vehicles for longer trips are reduced, or at times, eliminated. A walkable neighborhood comprises not only of pedestrian friendly road networks and facilities, but of nearby establishments, amenities, services and destinations that are easily accessible to residents. The values of monetary and time savings, and of reduced emissions by fuel-powered vehicles are the predominant gains of incorporating a mixed-use development concept within residential neighborhoods. Furthermore, additional sources of livelihood and employment are opened up to the locality, potentially improving or elevating the economic state of communities.

In an attempt to determine how the concept of mixed-use development can be incorporated into the unique premise of the case study, observations of the existing site and of the community dynamics and culture; as well as interviews of
residents, may help to determine the applicability of the concept, and identify the physical form it must take in the unique setting of the case study environment.

5.0 Diversity. Diversity is an attribute of a lively community that is desirable for walking. Especially in denser areas, where it is easier and more practical, in terms of time and cost, to develop buildings according to a more homogeneous form, it is worthwhile to understand and define the physical form of diversity that residents can relate and respond to.

The concept of diversity is easily confused with mixed-use, but that the latter rightfully fits within the broader umbrella of diversity. Housing types, styles and densities; mixture of architectural forms; household sizes, ages and income groups are all potential forms of diversity. However, for this research, the more physical aspects of diversity such as form, style, density and mix of uses will be reviewed. Applications of this concept will be explored in this study, gauging and attempting to understand how residents perceive diversity, and how they respond to its many forms and face.

6.0 Greenery. Green spaces are known to positively impact built environments, not only via the natural functions of vegetation, but through their softening attributes and pleasant appeal. Adding greenery makes spaces more
desirable. Quality landscape in housing environments attract residents with its “total visual milieu” (Marcus, 1982, p. 9). And while the more common known motivation for visiting urban green spaces (UGS) include nature appreciation and some rather spiritual purposes; residents of very compact cities such as Hong Kong tend to value greenery for more pragmatic intentions, such as air cleansing for a healthier environment (Lo & Lim, 2010).

An existing conflict between highly dense and compact urban environment, and “greenspaces” was underscored in a study conducted by Beer, Delshammar and Schildwacht (2003). The authors highlighted potential planning failures if greenspaces remain inadequately funded and left excluded.

<table>
<thead>
<tr>
<th>Communal greenspaces</th>
<th>Communal greenspace should ‘belong’ visibly to specific groups Make ‘greener’ Make more diverse Enable social control by residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parks</td>
<td>Make more interesting places Enable more diverse activities More places to sit and watch the world go by More spaces to go to – make into ‘places’ More round walks within parks and walks linking parks More variety of plants More features and landmarks More sense of arrival</td>
</tr>
<tr>
<td>Sports grounds</td>
<td>More diversity Sports open to all Enhanced facilities Places to sit and linger</td>
</tr>
<tr>
<td>‘Doorstep’ greenspaces</td>
<td>Make the space just outside the door more interesting Remove ‘municipal’ landscape Sitting opportunities Meeting opportunities – places to wait Enable informal supervision of space by residents A place for children to play safely</td>
</tr>
<tr>
<td>Greenspace in general</td>
<td>Improve the landscape of the shopping centres Improve access to canals and other water Make historic sites special Ease access to countryside Grow vegetables on site Gardens in school yards</td>
</tr>
<tr>
<td>Greenspace with routeways</td>
<td>More round walks passing diverse greenspace More leisure cycle routes History and art routes Safer crossings to countryside More places to sit along routeways Less brutal looking parking areas – break up and make more visually interesting Enhance the strong visual structure of the roads and vary roadside landscape to give sense of location Use verges as wildlife habitats</td>
</tr>
<tr>
<td>Private gardens</td>
<td>Redesign garden fences Expand gardens to take in useless grass strips Make more private gardens</td>
</tr>
</tbody>
</table>

Figure 4-2. Residents’ response on qualities that would improve greenspaces, from the Overtrecht Project in 2000 (Beer, Delshammar & Schildwacht, 2003)
from urban design and planning processes. The Overvecht case study, which was illustrated in the same literature, highlighted the financial and management burden of maintaining greenspaces on one end, and the high premium that residents place on these valued components of the community, on the other. Significant data from a focus group discussion at Overvecht (in the year 2000), summarized good qualities of greenspaces as contributed by residents (Fig. 4-2).

Furthermore, studying plant species more closely and identifying those that are more appropriate to the specific climatic conditions, spatial qualities and functions of the place can result to a practical, almost maintenance-free landscaping. Shading qualities of several plant species also allow for more pleasant walks.

The study acknowledges the meaningful contributions of landscape in the desirability of a place and the ecosystem services that plants deliver to humans and the environment; however, there is a need to balance these, and the added costs of planting, as well as their maintenance. Selection of appropriate plant species and knowing their costs, as well as values, are key strategies in the study under this category. Learning how the community perceive and respond to a
greener environment, and the specific ways by which green spaces positively impact residents, will also help to improve the process of planning and designing of these spaces.

7.0 Passive Design. When households are able to reduce their energy consumption through a thoughtfully-designed urban environment, a certain degree of sustainability is being achieved. Passive design strategies, such as passive cooling and daylight maximization can be studied in relation to the site and its components and their attributes, including: materials, heights and density; orientation, layout and landscaping.

In the tropics, for instance, such as in the case study site, there is a greater interest in eliminating heat and controlling heat gain in buildings, through studies of façade treatment and external thermal transfer values of façade materials. Intense heat and daylight in the tropics also effect solar irradiation that can cause visual and thermal discomfort when the sun hits surfaces of varying thermal transmittance values in its surroundings. These are only a few of the several environmental factors that may be addressed through passive design strategies such as proper solar orientation of buildings, selection of appropriate materials to
slow down heat transfer, landscaping, siting of buildings and green or open spaces
and providing shade or shelter, wherever necessary.

**Leadership in Energy and Environmental Design (LEED) Location and Transportation (LT) Criteria V4.**

The LEED LT Credits included in this study: (1) Surrounding density and
diverse uses; (2) Access to quality transit, and: (3) Bicycle facilities, aim to achieve
the following respectively:

1. To conserve land and protect farmland and wildlife habitat by
   encouraging development in areas with existing infrastructure. To
   promote walkability, and transportation efficiency and reduce vehicle
distance traveled. To improve public health by encouraging daily
   physical activity;

2. To encourage development in locations shown to have multimodal
   transportation choices or otherwise reduced motor vehicle use, thereby
   reducing greenhouse gas emissions, air pollution, and other
   environmental and public health harms associated with motor vehicle
   use, and;
3. To promote bicycling and transportation efficiency and reduce vehicle distance traveled. To improve public health by encouraging utilitarian and recreational physical activity (USGBC, 2016).

These objectives are in line with the aims of the earlier discussed seven principles of sustainable urban form. Some of the credit requirements considered include the *Diverse Uses* option that rewards a development within a ½ mile (800-meter) walking distance from entrances of a minimum four types of existing and public mix of uses, including: food retail (e.g. supermarket); community-serving retail (e.g. convenience store, farmers market, pharmacy, etc.); services (e.g. bank, fitness center, laundromat, hair salon, restaurant and café); civic and community facilities (e.g. child care center, recreation area, education facility, government office, medical center, place of worship, police and fire stations, public library, public park, etc.), and; community anchor uses (e.g. commercial office and housing of 100 or more dwelling units).

Location of the development entry point within ¼ mile (400-meter) walking distance of transport stops; or within ½ mile (800-meter) walking distance of bus or mass rapid stations, light rail stations or commuter ferry terminals is also considered as an evaluative measure and design guide in this study. Inclusion of
bicycle networks with a 3-mile (4800-meter) cycling distance of at least ten diverse uses, as indicated in the previous paragraph, as well as bicycle parking facilities are also considered.

**Summary.** It is the study’s primary aim to bring all the above principles and guidelines together to achieve a housing design that does not only meet environmental sustainability standards but addresses residents’ aspirations in terms of housing and community satisfaction. Each one of the seven urban form principles are studied in detail within the context of the study sites. These concepts also set a fundamental guidance to the interview framework. Residents of the case study site are to participate in a focus group interview that primarily investigates on users’ energy consumption and travel patterns, as well as residents’ specific functional and aesthetic preferences for housing, open spaces and community facilities within the neighborhood development.

4.2 Focus Group Interview

**Process.** A focus group interview was realized to be the most suitable data collection strategy for the limited time frame available, as well as the potentially vibrant tone of the research topic towards user preference. The energy of a group participation was envisioned to be a more fruitful strategy for the research work
Two site visits prior to the focus group discussion were conducted to investigate physical site conditions and to facilitate coordination with the National Housing Authority (NHA). The SJDM Heights on-site model house unit was used as venue for the event. Due to time constraint, a group of recommended respondents by NHA were invited to participate in the discussion. The group comprised of 13 volunteers, consisting of phase and block leaders, among the development’s elected homeowners’ association.

Questions were presented to the 13 participants using an LED TV screen. Responses were transcribed for every question asked. A first part of a round of interviews (Part A) aim to identify existing household energy usage and consumption patterns, as well as unique routines as a result of possible absence or limitations in electricity provision. Mobility and current transport modes utilized, as well as travel patterns are covered in this first part. The second part (Part B) covers the more qualitative and preferential aspect of the research, and comprises of visually stimulating materials that aim to appeal to the participants’ visual senses and effect a more vibrant discussion and exchange of views.

Some questions required participants to offer individual responses, while some meant to facilitate deeper and more spontaneous discussions among the
group. This informal and unstructured process is carried through towards the end of the interview session.

**Summary of Results.** The interview, although with a limited number of participants, yielded a set of useful data for this research study. Several of these interview inputs will be discussed in detail or mentioned in part, in the preceding sub-chapters. The following summarizes and discusses these critical responses and inputs from residents. Appendix 1-a can be referenced to view the full set of questions and responses for the entire interview.

**Transportation Modes, Patterns and Preferences.** Daily commutes to employment, especially travels to the city center – a place of work for several of the respondents’ “housemates”, are not straightforward or direct. The large extent of the existing site renders some housing units, at very remote points from the development’s main entry point, to walk a very far distance to the site’s entrance, and another set of long distance walk to the transport terminals (See Chapter 4.3). According to residents, daily, one-way walks to the nearest terminal take 20 to 30 minutes, depending on their walking pace. Total average daily travel, using all required modes of transport, including walking, and taking the public jeep and bus, range from two to four hours, depending on traffic conditions.
As would be discussed further in the proceeding sub-chapters (Chapters 4.3 and 4.5), although residents often prefer to walk, tricycle rides are popular among residents, especially during periods of rain and high temperature. One out of the thirteen participants use her bicycle 25% of the time to reach the site entry point from her home. The bicycle is left to the care of the development’s security personnel near the site’s entrance. When asked, all 13 interviews are willing to cycle up to a certain point towards their destinations, with proper bicycle facilities such as parking places and designated cycling lanes; and given the scenario that everybody owns a bicycle and knows how to ride one. Destination maps presented in Chapter 4.2 show areas that residents visit on a regular basis.

On a side but relevant note, residents prefer to take trains to their respective workplaces, rather than use public buses, with trains being more travel time-efficient.

**Mix of Other Uses Apart from Housing.** Among possible neighborhood amenities, residents indicated the following uses to be most significant, based on individual assessments made: (1) grocery stores and supermarkets; (2) convenience stores; (3) public library; (4) school; (5) health centers and complete hospital amenities. Secondary to these are the following: (1) fitness center; (2)
child care center, and; (3) eating places. The proposed design in the proceeding sub-section (Chapter 4.5), incorporates these requirements by the residents.

Residents' Energy Consumption Patterns. Residents indicated that window openings, electrically-powered ventilating fans (using 1 to 3 units per household), shades from trees nearby units, and ceiling installations help to alleviate excessive discomfort, especially during the summer period (from end of March to early June). On a side note, during the rainy season, temporary flooding causes slight and momentary inconveniences to residents, and usual mudding of streets after a rain shower cause nuisance and reduces neighborhood walkability.

Some technical difficulties encountered by the existing development include delays in electrical service provision, causing several housing units to remain disconnected from the grid, even half a year after the turnover period. One positive indication, however, in the aspect of clean energy source as a component of environmental sustainability is that, one out of the 13 interviewee’s uses photovoltaics in her home.

Style and Aesthetic Diversity through a Preferential Survey. Visually-rendered images (selected from several sources) of various architectural forms, from traditional row house styles, villa types, and modern geometric designs; and a
Architectural Style of Low-Rise Housing

1 – Traditional low-cost housing style in the Philippines

2 – Simple villa type, log cabin, vacation homes style

3 – Modern and boxy style

4 – Basic geometric forms and solid colors

5 – Simple geometry, neutral tone with color accents

10x10 Housing Initiative at Cape Town, South Africa

Architectural Style of Mid-Rise Housing

1 – Repetitive housing blocks of varied colors

2 – Low-Rise blocks of traditional form

3 – Traditional mid-rise housing w/ open spaces & lush greenery

4 – Modern low-rise form w/ varied textures & colors

5 – Modern form w/ simple geometry and colors

6 – A very diverse & geometric forms and colors

Proposal for Low-Cost Housing in Liberia

Roundtree Residences

Monterey Housing

Tetris Apartments

Retrieved from:
http://www.architectmagazine.com/project-gallery/monterey-housing_o

Retrieved from:
http://www.shareable.net/blog/11-projects-that-prove-affordable-housing-can-be-beautiful
Level of Diversity of Mid-Rise Housing

Figure 4-3. Images shown during the focus group interview session, representing types of architectural styles and levels of diversity in low and mid-rise housing.
range of diversity from homogenous to extremely diverse forms, were presented to
the interview participants (Fig. 4-3). Each one voted for an image under a
designated category, which included architectural styles and levels of diversity, for
both low-rise and mid-rise apartment housing types. Votes were tallied as
indicated on the illustration (Fig. 4-3).

Inquiry on Residents’ Perception of Mid-Rise Living and Related Attributes.
Interviewees were again presented with several images that mostly depict mid-rise
homes, green and open spaces, and residential / mixed-use development forms
(See Appendix 1-b). Each of the image was shown and described in detail, sharing
concepts, principles and rationale, which the figure represents; after which,
interviewees’ comments, opinions, and thoughts, in general, were solicited and
recorded. Solid and unwavering responses of apprehensions against mid-rise
living were clearly received from the interviewees. The (relatively) complex
homeownership concept of mid-rise living; safety from earthquakes and spread of
fire; safety from falling (especially for children), and; accessibility requirements by
elderly residents are among typical concerns of respondents. Only one of the
thirteen interviewees expressed a willingness to consider living up to the 5th story
(only), whereas the remaining respondents can only consider the 2nd floor.
Residents were asked to vote and comment on their preferred location for commercial spaces within the housing development (Fig. 4-4). Images of mixed-use buildings with ground level shops and eateries, were set against a centrally located commercial complex, amidst blocks of purely residential use. A unanimous set of votes, 10 out of 13, was one by the latter.
San Jose del Monte Heights, Philippines – The Base Scheme

Project Location and Site Profile & Data. The selected case study site is located at the northern portion of the Philippines, within the Central Luzon province, sitting just at the northern tip of Metro Manila – the archipelago’s city center (Fig. 4-5). The development is named San Jose del Monte Heights, within the municipality of San Jose del Monte, province of Bulacan.

The site is continuously being developed, in phases, by the government of the Philippines, under its resettlement housing program, through the National Housing Authority (NHA) and the Housing and Urban Development Coordinating Council (HUDCC). The project recipient are vulnerable and informal settlers across the country, lined along floodplains and situated within identified danger zones. The case study covers only Phases 1 and 2, which are the completed and occupied sections of the development. The case study site boundary is defined by NHA.
Figure 4-6. Site Map of existing site (Google Maps, 2016)

Legend

01 Row House Dwelling Units
02 Elementary School
03 Future Community Facility
The site is a rectilinear grid of row houses, with small patches of open and undeveloped areas that are dedicated for future community amenities, such as a health center with birthing facilities, a wet and dry market, and additional classrooms for the existing elementary school (Fig. 4-6). The study boundary encloses a 30.51 hectares (75.39 acres) of previously undeveloped land, which currently houses 4202 row house units. The existing gross residential density is 137.72 DUs per hectare (56.74 DUs per acre). Roads, walkways and other paved surfaces occupy an extensive area, covering 28.51% of the site. 2.08 Ha (5.14 Ha) of land is dedicated to open spaces and community facilities, giving residents 0.99 sq. m (10.66 sq. ft) of open space per person. Other important site information can be found on Table 4-1 below:

**Existing Site Conditions.** Photos taken from the site visit are presented below. Generally, the development is a blanket of highly repetitive architectural form, constituting of a single typical dwelling unit type, all finished with the same color throughout (Fig. 4-7). There are both major and minor roads within the development; with the former, being more than six-meters (20-feet) wide, and the latter, being four meters (13 feet). Due to the country’s general love for the sport, two numbers of covered basketball courts are present on site. These spaces are

![Figure 4-7. Site photo taken at SJDM Heights site, showing typical row houses (Salvatus, 2016)](image)
also often used s multi-function areas that house bigger community gatherings. Intermittent patches and forms of informal greenery can be found on site.

A typical dwelling unit has a lot area of 40 sq. m (473 sq. ft), and a compact building footprint of 22 sq. m, resulting to a plot coverage of 55%. Together with the sleeping area – a loft space at mezzanine level, the total gross floor area (GFA) of one unit is 33 sq. m (355 sq. ft), and thus resulting to a floor area ratio (FAR) of 0.83 for an individual dwelling unit (Fig. 4-8). Typical cross and longitudinal sections illustrate the added loft space within the very compact and tight living space of the unit (Fig. 4-9).

**Site Context.** A location map of the existing site (Fig. 4-10), summarizes the
Figure 4-8. Typical floor plan of existing individual dwelling unit (NHA, 2016)
various mix of uses within a 2-kilometer (1.2 miles) radius from the site. A series of destination maps have been tabulated (Table 4-2) to show important areas around the housing site, and the corresponding travel distance from the site’s farthest point to these destinations. The shortest walking distance of 0.55 km (0.34 miles) from the public elementary school within the site, and the longest distance of 2.3 km (1.43 miles) from the commercial center have been recorded.

**Mode of Transport.** One of the key findings during the focus group interview session with the residents included walking, as a preferred mode of travel, to as far as the above mentioned commercial center at 2.3-kilometers’ walking distance from the site. Other travel options include walking to the
Figure 4-10. Site map of existing site, showing surrounding mix of uses within a 2-km radius.
Table 4-2. Destination maps of surrounding mix of uses from farthest point on site (Google Maps, 2016)
terminal and taking the public jeep to farther points around the site's vicinity (See Table 4-
2). A more convenient, yet costlier short-term commute option is available to residents via a
motorized tricycle ride (Fig. 4-11), which is an often preferred transport mode during
unpleasant weather conditions such as extreme heat and heavy downpour of rain. At
an average rate of US$ 0.50 per trip
(compared to US$ 0.18 per trip using public jeep), absence of proper pedestrian
amenities such as covered walkways, force commuters to resort to these costlier tricycle
rides. However, although convenient in most occasions, and with over 3.5 million units
operational nationwide, tricycles contribute to a high of 10 million tons of CO2 generated,
and is responsible for an average of 4,000

Figure 4-11. Tricycle ride in the Philippines (Wright, nd)
yearly air pollution deaths in Manila alone (Cooper, 2013).

Two major transport terminals and a transport waiting point are present around the site: (1) Tungko Jeep Terminal; (2) San Jose Del Monte (SJDM) transport waiting point, and; (3) Muzon (bus) Terminal, within 1.5 km (0.93 miles); 1.7 km (1.06 miles), and; 2.2 km (1.37 miles) of walking distance, respectively. While Tungko and SJDM terminals bring residents to further destinations, such as neighboring towns, and other provinces, Muzon Terminal is highly utilized for trips to major transport point in Metro Manila (city center), which bring residents to their workplaces within the city.

An Evaluation: Sustainable Urban Form & LEED LT. The SJDM Heights site is studied based on the principles of sustainable urban form as discussed in the previous sub-chapter. Using the available site information gathered from existing plans and data through the National Housing Authority; observations made during site visits, and; collected responses from the focus group interview respondents, the following evaluation are made:

1. **Density.** The base scheme, mainly characterized by its grid of row houses, has a gross residential density of 137 DUs per hectare (55 DUs per acre), exemplifying a considerably dense housing development based on previous studies, some of which were discussed in the Literature Review chapter (Chapter 2). However, it is also important to note the site’s relatively low floor area ratio (FAR)
2. at 0.65 and its relatively high building site coverage, occupying nearly 65% of the site.

While FARs can be very good indicators of density, as to be illustrated through the next chapter’s Model Scheme, it may not be so, especially when dwelling unit sizes are small, so that each person in a household is entitled, only to a limited amount of net floor residential area per person. Each of the 5 persons in one household of the base scheme is allocated an area of 6.6 sq. m per person (71 sq. ft per person), versus a standard allocation of approximately 20 sq. m per person (215 sq. ft per person) in public housing flats in Singapore (Housing and Development Board, 2016). In this case, dwelling units per area is a better indicator of density in the development.

Site coverage, however, cannot be used independently as an indicator for density. As a point of comparison, built areas of the precedent study site (details to be found in the succeeding chapter 4.4) covers only 40% of the total land area, but achieves a density of 245.52 DUs per ha (99.30 DUs per acre). However, when the site coverage is read together with the precedent’s high FAR of 3.2, the resulting density generally makes sense. On the other hand, the base scheme, with its low FAR and high site coverage, resulted to a similarly high density.

The base scheme’s score in the category is marked at 9 over 9.

3. Sustainable Transport. It has been clearly emphasized in the earlier paragraphs of this sub-chapter, how transportation is a critical area of improvement, among the site’s many sustainable issues. Clearly, there is willingness among SJDM residents to walk their way through, to destinations and transport points discussed above. Unfortunately, proper infrastructure and sustainable transport facilities are not in place.
While all interview participants expressed willingness to cycle to transport points outside of the site, absence of bicycle parking facilities and designated, suitably-finished cycling lanes make bicycling an undesirable option for travel. Budget limitations may have restricted provisions for proper covered walkways throughout the site; however, these are essential site facilities that need to be present in the hot and rainy-seasoned tropical climate of the country.

An unsustainable and costly, yet mobility-effective solution has been presented to SJDM residents’ travel problems, by introducing the tricycle commute. With this, and with the justifications presented above, a score of 1 out of 9 is given to the base scheme, under the sustainable transport category.

4. **Mixed-Use Development.** A public elementary school is present and located at the heart of the extensive residential development. The school’s three blocks consist of three stories each and housing a total number of 15 classrooms. A temporary market place has been set up for accessible fresh food supply to residents. Informal convenience stores and roadside vendors are also present to supply various immediate commodities (Fig. 4-12 a to c).

With a school in place, though with a limited number of classrooms, and with the existence of informal commercial and food providers, the base scheme is given a score of 3 out of 9.

5. **Compactness.** One of the key principles of urban compactness is that it promotes the use of the smallest possible land area, and keeping within an already existing urban setting; thus resulting to a more meaningful and efficient use of land. A compact form is well connected to its neighbors, very much walkable and highly dense.

The case study site is characterized by its extensive sprawl of row house units, rendering the development inefficient in terms of land use.
use. In fact, the demarcated site area for this research work constitutes only a portion of the total site, whereby phase extensions are already almost fully occupied, and further expansions on the northwestern edge of the boundary is underway. Row houses, although compact in terms of elimination of side building setbacks require individual access points from the road, resulting to larger land area requirements. Analysis from the project data tabulation of the base scheme, implies that the low FAR and high site coverage (of housing and paved areas), nor the low provision of green and open spaces per person, exemplified by the scheme, do not at all equate to a compact design. Indications of the existing scheme’s failure to achieve compactness, is exhibited by its inability to limit its extremely fast urban sprawl rate, and long-distance walks from one point within the site to another. The huge percentage of site area allocated for roads, walkways and easements at 28.51% of the site also clearly suggests a lack of compactness in the development.

The scheme scores 2 out of 9 under this category.

6. Diversity. Diversity is an attribute of a community that is desirable for walking. Especially in denser and budgeted developments, it is very easy to accede to the practicality of repetition and monotony. There are several aspects of diversity such as housing types, styles and densities; mixture of architectural forms; household sizes, ages and income groups. However, this research will focus more on the physical aspects of diversity.

The monotony of architectural form and style is very much evident in the SJDM Heights site (Fig. 4-13). While budgetary constraints could have been the greater driver for this highly repetitive form, there are potentially various ways to achieve a level of aesthetic diversity, while keeping to a limited cost.

A score of 0 out of 9 is thus granted under this category.
7. **Greenery Provision.** Much has been said about greenery and how positively it impacts the built environment. Its softening effect on rigid urban lines, and its air filtering service in highly urbanized areas are just a few of the many meaningful contributions of greenery. At San Jose del Monte Heights, patches of intermittently occurring greenery can be found throughout the development. It is also noticeable how roads are deprived of the usual avenue of trees that are visible in many different places and cities around the world. Planting and landscaping are an inexpensive and yet worthwhile investment. Unfortunately, these were not explored and implemented in the development.

A low indication of space occupied by greenery, including open spaces and community facilities per person, at 6.82% of the total site area, is a very clear evidence that these spaces are not prioritized in the total design and planning of the housing development.  

The scheme scores 2 out of 9 under the greenery category.

8. **Passive Design Strategies.** Plots are subdivided on site, and units configured in order to maximize the number of saleable houses and lots, without due consideration for the passive design potentials of the site, such as good solar orientation to maximize daylight and minimize heat gain.

Operable louvered windows (jalousie windows) provided in the typical units are excellent for maximizing control over wind passage. Windows on opposite side of walls allow for well-ventilated interior spaces. However, the small openings provided may not effectively allow a reasonable movement of air within the units’ interior spaces. Furthermore, standard-sized window openings throughout disregards unique fenestration configuration and sizing, for the varied orientation of the dwelling units on site.
For providing operable fenestrations that are significant building passive ventilation features in a hot humid setting, such as the case study site; but with a great disregard for proper building orientation, and potential daylight harvesting and heat gain evasion strategies, a score of 4 out of 9 is given to the scheme.

Using the LEED LT credit as an evaluation tool, it can be observed from earlier illustrations that most of the criteria specified (under LEED LT) were not met. The nearest community amenity is the public elementary school at 0.55km (0.34 miles) from the site. The rest of the mix of uses, including transport terminals and waiting points can only be found outside the ½ mile radius required by LEED LT. Although streets are mostly walkable within the site due to absence of privately-owned automobile, the lack of dedicated and covered walkways exclusively for pedestrians and bicyclists, are currently not present on site.

To summarize, an overall score of 21 out of 63 is earned by the base scheme site at SJDM. The scoring system has been devised as a simple strategy to help readers better relate to the scheme’s status in terms of environmental sustainability. A score of 21 over 63 simply represents an apparent failure to comply with the set of sustainable criteria, and a great potential for improvement.
4.3 Singapore Public Housing as a Precedent Study – The Model Scheme

Overview of Public Housing in Singapore. Singapore is one of the densest countries in the world at 7,697 persons per square kilometer of population density in 2015 (Statistics Singapore, 2016). With a significantly small land footprint of 719.1 sq. km for the entire country, land scarcity has been one of its most challenging and prevalent issue throughout the years. To support the country’s growth, to satisfy the housing requirements of its 5,535 population (Statistics Singapore, 2016), Singapore had to carefully and strategically plan denser and yet livable neighborhoods.

At the core of Singapore’s public housing is the basic, yet often overlooked principle of homeownership: “The fundamental aim of the present government from the inception of its public housing program has been the creation of a nation whose people have homes they are proud to call their own. The underlying philosophy is that if one owns an asset in the country, one would stand to defend it” (Field, 1987, p.154). The country has since been known for the outstanding and successful implementation of its public housing program via the Housing and Development Board (HDB). Using current data, 80.1% (Table 4-3) of Singapore’s total population reside in public housing estates, more widely referred to as HDB estates or flats (Statistics Singapore, 2016). The nation’s success in the
Table 4-3. Singapore’s household and Housing Data (Dept. of Statistics Singapore, 2016)

<table>
<thead>
<tr>
<th>Items</th>
<th>Latest Period</th>
<th>Latest Data</th>
<th>% Change (Y-o-Y) 1/</th>
<th>Previous Period</th>
<th>% Change (Y-o-Y) 2/</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Households &amp; Housing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Resident Households</td>
<td>'000</td>
<td>2015</td>
<td>1,225.3</td>
<td>2.1</td>
<td>1,200.0</td>
</tr>
<tr>
<td>Average Household Size 34/</td>
<td>Persons</td>
<td>2015</td>
<td>3.39</td>
<td>na</td>
<td>3.43</td>
</tr>
<tr>
<td>Home Ownership Rate 34/</td>
<td>%</td>
<td>2015</td>
<td>90.8</td>
<td>na</td>
<td>90.3</td>
</tr>
<tr>
<td>Resident Households by Type of Dwelling</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total 35/</td>
<td></td>
<td>2015</td>
<td>100.0</td>
<td>na</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total HDB Dwellings 36/</strong></td>
<td></td>
<td>2015</td>
<td>80.1</td>
<td>na</td>
<td>80.4</td>
</tr>
<tr>
<td>HDB 1- &amp; 2-Room Flats 37/</td>
<td></td>
<td>2015</td>
<td>5.6</td>
<td>na</td>
<td>5.3</td>
</tr>
<tr>
<td>HDB 3-Room Flats</td>
<td></td>
<td>2015</td>
<td>18.2</td>
<td>na</td>
<td>18.3</td>
</tr>
<tr>
<td>HDB 4-Room Flats</td>
<td></td>
<td>2015</td>
<td>32.0</td>
<td>na</td>
<td>32.2</td>
</tr>
<tr>
<td>HDB 5-Room &amp; Executive Flats</td>
<td></td>
<td>2015</td>
<td>24.1</td>
<td>na</td>
<td>24.4</td>
</tr>
<tr>
<td>Condominiums &amp; Other Apartments</td>
<td></td>
<td>2015</td>
<td>13.9</td>
<td>na</td>
<td>13.5</td>
</tr>
<tr>
<td>Landed Properties</td>
<td></td>
<td>2015</td>
<td>5.6</td>
<td>na</td>
<td>5.8</td>
</tr>
</tbody>
</table>

80.1% of Households live in HDB flats (2015)
timely delivery not just of quality homes, but of thoughtfully-planned neighborhoods for public housing is not only acknowledged locally, but worldwide as well (HDB, 2016).

Public Housing Satisfaction in Singapore. Housing satisfaction among residents can be measured and studied through surveys – an exercise carried out by the HDB on a 5-year interval basis (since 1968), in an attempt to define preferences and areas of improvement in its public housing provision (HDB, 2014). The word “flat” for the purpose of the study is defined as the physical aspects of a home, such as: size, design and layout, condition and view from flat; while “neighborhood” likewise pertains to physical attributes, such as: cleanliness, maintenance, safety, security, provision of estate facilities and estate location; as well as social attributes: relationships with community members and neighbors (HDB, 2014). HDB’s Sample Housing Survey (SHS) report recorded a drop in flat satisfaction from 96.4% in 2008 to 91.6% in 2013. According to the SHS, dissatisfied households were mainly unhappy with flat conditions that are associated with its ageing (Fig. 4-14). Neighborhood satisfaction remained at a high of 92.0% (Fig. 4-15). While satisfaction was attributed to friendly neighbors and peaceful environments, dissatisfied residents are mostly unhappy with noise,
Table 4-4. Residents’ satisfaction with estate facilities from Sample Household Survey of 2013 (HDB, 2016)

<table>
<thead>
<tr>
<th>Types of Estate Facilities</th>
<th>2003</th>
<th>2008</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) General Retail Shops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- HDB shop/neighbourhood centre</td>
<td>-</td>
<td>89.1</td>
<td>89.9</td>
</tr>
<tr>
<td>- Shopping centre/shopping mall</td>
<td>-</td>
<td>89.9</td>
<td>90.8</td>
</tr>
<tr>
<td>- Overall</td>
<td>85.6</td>
<td>93.3</td>
<td>93.4</td>
</tr>
<tr>
<td>(ii) Markets or Market-Produce Shops/Stalls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Dry/wet market</td>
<td>-</td>
<td>-</td>
<td>85.4</td>
</tr>
<tr>
<td>- Supermarket</td>
<td>-</td>
<td>-</td>
<td>94.1</td>
</tr>
<tr>
<td>- Overall</td>
<td>83.6</td>
<td>87.5</td>
<td>94.7</td>
</tr>
<tr>
<td>(iii) Eating Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Hawker centre</td>
<td>-</td>
<td>-</td>
<td>86.3</td>
</tr>
<tr>
<td>- Eating house <em>(e.g. coffee shop)</em></td>
<td>-</td>
<td>-</td>
<td>88.3</td>
</tr>
<tr>
<td>- Food court</td>
<td>-</td>
<td>-</td>
<td>89.1</td>
</tr>
<tr>
<td>- Fast food outlet</td>
<td>-</td>
<td>-</td>
<td>94.2</td>
</tr>
<tr>
<td>- Overall</td>
<td>85.5</td>
<td>89.0</td>
<td>92.4</td>
</tr>
<tr>
<td>Transportation Facilities</td>
<td>84.1</td>
<td>84.1</td>
<td>80.4</td>
</tr>
<tr>
<td>Sports Facilities</td>
<td>81.8</td>
<td>85.2</td>
<td>88.9</td>
</tr>
<tr>
<td>Recreational &amp; Leisure Facilities</td>
<td>86.3</td>
<td>89.1</td>
<td>91.7</td>
</tr>
<tr>
<td>Precinct Facilities</td>
<td>88.5</td>
<td>88.7</td>
<td>86.7</td>
</tr>
<tr>
<td>Community Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education Facilities</td>
<td>96.0</td>
<td>96.5</td>
<td>95.0</td>
</tr>
<tr>
<td>Health/Medical Facilities</td>
<td>87.8</td>
<td>90.1</td>
<td>85.7</td>
</tr>
<tr>
<td>Financial Facilities</td>
<td>80.7</td>
<td>85.5</td>
<td>86.7</td>
</tr>
<tr>
<td>Overall Satisfaction</td>
<td>93.4</td>
<td>94.4</td>
<td>96.1</td>
</tr>
</tbody>
</table>
as well as unfriendly and inconsiderate neighbors. This underscores the social aspect of housing, which most often affects satisfaction levels among residents. The SHS also reported Location and Transportation Network as the two most “liked” attributes of the neighborhood, followed by flat size, provision of estate facilities, safety and security, and estate upgrading projects. However, noise, and cleanliness and maintenance ranked high in the most “disliked” aspects of the HDB environment. Residents’ perception on their owned and rented flats as value for money, is also an important aspect of housing satisfaction. SHS recorded a rating of 90.3% in the category.

Estate facilities and amenities are a key feature of HDB sites. Each neighborhood is provided with a complete set of community facilities that allow residents to “work, live, play and learn” (HDB, 2014, p. 105) within their respective communities (Fig. 4-16 to 17). An overall satisfaction of 96.1% has been recorded by the HDB, with education, community, retail and market-produce facilities, having the highest satisfaction ratings among the other specified categories.

Usage levels were also recorded, with supermarkets, wet and dry markets, hawker centers (neighborhood food centers), shops, covered walkways and drop-off porch
as being the most highly-utilized among other facilities. Secondary to these are fitness stations and jogging tracks, as well as the void deck – a key feature among HDB blocks, characterized by a completely open, multi-functional ground level space that residents can use for a variety of activities (Table 4-4).

Precedence Study Selection. From the above statistical data, it could be inferred that the HDB has been successful in providing livable homes and neighborhoods to its public housing residents. Having established this, a model of implemented and fully-operational public housing project in Singapore is to be selected for the research project as a precedence study. The selected housing precinct 1 will be investigated, and analyzed based on the earlier determined sustainable housing and urban form principles of compactness, density, sustainable transport, mixed use development, diversity, greenery and passive design.

The above illustrative map (Fig. 4-18) shows locations of HDB developments throughout the island. The most common of the HDB types, according to systems of allocation is the build-to-order (BTO) HDB flats. BTO flats

1 Precinct is a term used specifically in Singapore to refer to a single unit, development or estate of public housing blocks that is managed by an estate manager.
are a standard system of flat allocation that offers eligible buyers to apply for and select from apartments in planned HDB projects at their preferred and available locations (HDB, 2016). The standard waiting period for flat occupancy averages from three to four years. Since the launch of BTO flats in 2001, there has been a total of 251 BTO projects to date (Teoalida, 2016). BTO projects follow a standard set of design and construction guidelines that are strictly regulated and implemented by the HDB. Standardization and minimization of precast structural prototypes has been a key strategy by the HDB that has kept construction costs to an affordable range. Residential projects, in general (including HDB developments), adhere as well to a stringent set of residential

Figure 4-18. HDB BTO sites locations throughout Singapore (HDB, 2015)
planning guidelines by the Urban and Redevelopment Authority of Singapore (URA), and are required to achieve a minimum green building rating of Green Mark “Certified” for developments with more than 20,000 sq.m (215,168 sq.ft) of gross floor area (GFA), under the code requirements of the Building and Construction Authority of Singapore (BCA, 2015). The required rating has been set as a mandatory requirement by the BCA since the year 2008.

The Treelodge@Punggol, a standard BTO precinct, prides itself of having achieved BCA’s highest green rating of Green Mark Platinum in 2007 - a first of its kind under the public housing category, to incorporate and implement a thorough and intensive set of sustainable and green building features and practices. This unique and remarkable achievement has made the precinct a suitable precedent case study for the research.

**Treelodge@Punggol**

*Project Background and Profile.* Treelodge@Punggol (Fig. 4-19) represents the sum of HDB’s efforts to initiate the planning, building and delivery of a sustainable public housing. The project was launched for sales by the board in March, 2007 and was completed for occupancy in December, 2010. It is situated in
Figure 4-20. Treelodge@Punggol’s site plan from the HDB sales brochure (HDB, 2012)
Table 4-5. Site data and information for the Model Scheme

<table>
<thead>
<tr>
<th>Model Scheme</th>
<th>General Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site Area</td>
</tr>
<tr>
<td></td>
<td>Gross Floor Area (GFA)</td>
</tr>
<tr>
<td></td>
<td>Floor Area Ratio (FAR)</td>
</tr>
<tr>
<td></td>
<td>Dwelling Units (DU)</td>
</tr>
<tr>
<td></td>
<td>Gross Residential Density</td>
</tr>
<tr>
<td></td>
<td>99.30 DUs / Acre</td>
</tr>
<tr>
<td></td>
<td>No. of Blocks / Story</td>
</tr>
<tr>
<td></td>
<td>Site Coverage</td>
</tr>
<tr>
<td></td>
<td>Open Space per Person</td>
</tr>
</tbody>
</table>

one of Singapore’s newer towns, Punggol, along the island’s north-eastern edge. The precinct’s seven blocks of 16-storeys high and 712 dwelling units sit atop a single-story ground level carpark, with the carpark roofing that acts as an eco-deck – an extensive stretch of landscaped community space for the residents that houses playground facilities, fitness stations and community gardening areas (Fig. 4-22). The 2.9 hectares (7.17 acres) site has a total gross floor area of 93,200 sq. m (1,003,196.5 sq. ft), resulting in a gross plot ratio or floor area ratio (GPR = gross floor area / site area) of 3.2 – a standard ratio among residential developments in Singapore. The precinct’s gross dwelling density, with its 712 residential units is equivalent to 245.52 dwelling units.
(DU) per hectare, but with an approximate built-up area of 1.16 hectares and open spaces at 1.74 hectares. This results in a site coverage (SC) of only about 40% of the entire site (Table 4-5).

Treelodge@Punggol is the first Green Mark Platinum rated public housing project in the country. HDB’s efforts in committing a green housing project paved the way for new technologies and innovative ideas in building greener houses and neighborhoods. Major axes of blocks within the development face north-east and south-west in order to maximize the flow of prevailing winds along these general directions, thereby facilitating cross-ventilation across blocks and through units. This is a passive design strategy that addresses thermal comfort challenges in the tropics, through efforts in reducing heat and humidity by allowing the movement of air. A community garden (Fig. 4-21) has been introduced in the ground level “eco-deck”, to encourage residents to grow and harvest their own produce, and to advance social ties among community members. The lush landscaping and intense greenery is an important feature of the precinct that aims not only to mitigate the occurrence of urban heat island effect but to promote and improve the environmental and aesthetic appeal of the place. Other green features

Figure 4-21. Community garden area at the eco-deck and PV panels installed on the roofs of Treelodge@Punggat (HDB, 2012)
Figure 4-22. Schematic section and blow-up section of eco-deck with carpark below and landscaping above (HDB, 2012)

Figure 4-23. Punggol Waterway Park at Punggol Town (MND Link, 2013)
implemented on site include installation of photovoltaics on the blocks’ roof deck and covered walkways (Fig.4-21); energy efficient light fittings in common areas, as well as motion sensors; water efficient fittings and plumbing fixtures; rainwater harvesting system; dedicated and centralized refuse chutes for recyclable materials; application of “cool wall” detail for east and west-facing walls, to reduce heat transmission within interior spaces; and, a resource-efficient construction method, using pre-fabricated precast structural components for the entire development.

Treelodge@Punggol is sited in one of the island’s newer towns of Punggol, formerly a fishing town. The government’s launch of development projects, “Punggol 21” in 1996 and subsequently, “Punggol 21-plus” in 2007, placed Punggol as a themed, integrated and sustainable town – a first in the island. Labels, such as “new town”, “waterfront town”, “cycling town”, and more generally, an “eco-town”, has been coined (Fig. 4-23). Treelodge@Punggol is at the town’s heart, alongside other public housing developments. A map of other uses surrounding the site, and with a ¼ - mile radius around the site has been mapped to easily show existing amenities that are accessible to the site (Fig. 4-24). To its north is the town park, currently referred to as “My Waterway@Punggol” and a
Figure 4-24. Mix of uses within a quarter-mile radius from the Treelodge@Punggol site.

Mixed Uses within 600 m (0.37 miles) of walking on proper and designated walkways

- Fo Guang Buddhist Temple
- Punggol View Primary School
- Transport Service / Gasoline Station
- Residential Developments
- Bus Stop / Waiting Area
- Damai LRT Station
- Waterway Pt. Mixed Use Dev’t
- Future Mixed Use Dev’t
- Punggol MRT Station
- Punggol Bus Interchange
- Future Sports Complex
planned sports complex; to its west is the future Town Centre; public housing developments are at the site’s east, and; Punggol View Primary School is at the south. The Punggol MRT and LRT stations, as well as bus interchange (terminal) is approximately 500 m (1640 ft) away from the precinct. Cycling paths and park connector networks (PCN) are in place, joining the town park to other more parks and recreation spaces around the island.

An Evaluation: Sustainable Urban Form Principles and LEED LT. The residential development, Treelodge@Punggol is further studied and evaluated based on the criteria of sustainable urban form as set earlier. How, and how well the model scheme fares in terms of overall environmental sustainability, as compared with the rest of the two schemes (base and design schemes), and how it sets itself as a dependable precedence and model, will be tackled more profoundly in the succeeding Discussions section of this book. The development will be “graded” based on the seven principles, using the previously mentioned method and criteria.

1. **Density.** Based on a measured gross residential density of 245.52 DUs per ha (99.30 DUs per acre), and a floor area ratio (FAR) of 3.2, Treelodge@Punggol is a highly-dense residential development. Exemplifying such high ratio, land use efficiency is optimized in the scheme. Singapore’s high-density living is its response to the problem of land scarcity in the country. Similar to Hong Kong, it has
started to build high density, high rise developments, in order to fulfill its growing space requirements. The country, however, has been very conscious in providing enough open and community spaces and complete estate facilities and amenities to its residents. The government has been constantly improving its policies and guidelines to create quality spaces, in order to advance the quality of life of its people, despite the island’s space constraints.

The development is given full marks, 9 of 9, for the “Density” category.

2. **Sustainable Transport.** The average walking distance to a Mass Rapid Transit (MRT) station that a commuter is willing to walk, averages at 608 m, although decision to walk to transit is mainly influenced by “provision of rain shelters, walking distance, walking comfort, and security” (Olszewski, & Wibowo, 2005, p. 45). The Punggol MRT station and bus interchange are approximately half a kilometer distance away from the residential development. A barrier-free and dedicated pedestrian walkway leads to the transit hub; however lacking in shelter provision, which is critical during rainy periods. The future integrated development site, earmarked by the Urban and Redevelopment Authority of Singapore (URA, 2013) to the west of the site, poses however, a good potential for a more walkable route to the MRT station.

Generally, Singapore’s public transport system is one of the most efficient in the world (The Straits Times, 2014). The Land Transport Authority of Singapore (LTA) has been working towards its 2030 target of additional and improved transport facilities and infrastructure, in order to increase transport efficiency and achieve a closer proximity to train stations at a target of 8 in 10 households within a maximum of 10 minutes’ walk (LTA, 2016).
However, although dedicated bicycling paths are present around the site’s vicinity, its broken profile and intermittent occurrence, is a greater area for improvement. Since the new town is being groomed as a cycling town, and while still in the early stages of its development, there is much potential to incorporate a complete cycling network and facilities, in order to further promote green and sustainable transport.

At this, with the combined successes of a successful public system countrywide and the site’s walking proximity to Punggol’s transport hub; and considering areas of improvement in terms of providing sheltered linkages and a continuous cycling network, a score of 8 out of 9 is given to the development under the category.

3. **Mixed Use Development.** The development’s close proximity to mix of uses, such as a primary school, an integrated mixed-use development with commercial facilities (Waterway Point to the site’s west), and a community center on the neighboring block, compensates for the lack of it within the precinct itself. In general, commercial and other mixed-use facilities within HDB developments are limited to eating houses and coffee shops, child care and elderly centers, activity hubs, residents’ corner, clinics, convenience stores and mini-groceries. These are often to be found on the ground level of residential blocks. In the case of Treelodge@Punggol, however, these amenities were not viable due to the absence of a true ground level space that is being utilized as the precinct’s parking area. Moreover, public housing developments in the country tend to build around certain financial limits and maintenance costs that disallow it to develop using a mixed-use model. Possible noise and other potential nuisance, generated from non-residential occupancies, which is an important concern among residents as highlighted above, are difficult to mitigate without sufficient resources and limited management controls.
The special case of the site, and the general constraints in adopting a mixed-use model for public housing; but however compensated by a robust and overall well-planned town, complete with a mix of uses that are accessible to the development, gives the site a score of 7 of 9 for the category.

4. **Compactness.** Punggol is a former fishing town at the north-eastern fringe of the island. Unlike the more mature estates of Toa Payoh, Ang Mo Kio and Tanjong Pagar at the city’s center, the Punggol today, is a fairly new town that started to develop only partly, upon the launch of “Punggol 21” plan in 1996, due to the ongoing economic crisis at that time. Development only picked up fully in 2008 and onwards, with the launch of “Punggol 21-plus”, revamping the original Punggol 21 blueprint and aiming towards Punggol’s transformation as “A Waterway Town of the 21st Century” (HistorySG. 2016). Reclamation works were inevitable in order to fulfill further demands for space, as the population grew from year to year.

Compactness is a combined output of density, mixed-use, sustainable transport, urban connectivity and site usage and history. The site’s particularly high density of 246 dwelling units per hectare, which has been expounded under the heading, “Density”, of this chapter, implies a compact development that is able to sustain a high number of residents on a relatively small site. The building site coverage of 40% is a controlled value, stipulated by Singapore’s Urban Redevelopment Authority (URA, 2016), as a result of the nationwide effort to create larger areas of open and green spaces despite the country’s high density. Treelodge@Punggol is neither a redeveloped nor an intensified site from existing use; it is a completely new development on a new site. Public housing estates are generally open to public and are completely accessible from road-facing boundaries. The precinct is connected to neighboring
sites via road networks and designated pedestrian walkways (non-sheltered).

At this, we can conclude that the development has exuded the principle of compactness quite moderately, and therefore receives a rating of 6 out of 9 points, under the category.

5. **Diversity.** Public housing developments by the HDB are mainly characterized by highly-efficient precast structural system that results to a reduced construction cost, mostly due to the required module repetitions. Consequently, these are design limitations that give HDB developments a repetitive and monotonous look that only differs from one precinct to another using varied paint applications. Such is the case of Treelodge@Punggol, whereby the seven residential blocks are treated similarly, so that the entire development is perceived as a singular precinct that is unique to the adjacent precinct. Also dictated by a maximization of land usage, optimum number of dwelling units are to be achieved, in order to deliver sufficient number of units required. As such, block heights are maximized to the allowed level (at 16th story for this specific development), thereby effecting a monotonous HDB skyline throughout.

HDB precincts, however, house a great diversity of people from various walks and trades, age, ethnicity and economic status. This is quite inevitable for public housing developments, with their current residents at 80.1% of Singapore’s population. It is for the above reasons that a score of 3 out of 9 points is designated to the development for the above category.

6. **Greenery Provision & Passive Design.** It has been thoroughly discussed above, how the Treelodge@Punggol has been extensively landscaped, incorporating as much greenery into the development; and how passive design strategies, such as wind and solar
Figure 4-31. Block configuration and layout allow air movement and cross-ventilation (HDB, 2012)

Figure 4-30. Play and fitness equipment among the development's functional and vibrant open spaces (HDB, 2012)
orientations were the rationale for the blocks' layout. Successful implementation of the two principles earned the development full marks of 9 for both categories.

To summarize, the total number of points earned by Treelodge@Punggol is 51 out of 63. The score will be compared to scores of the existing case study site and the proposed improvements.

Although the LEED LT criteria requires a ½ mile (800 m) radius that encompasses a diversity of uses, a ¼ mile (400 m) radius was sufficient to illustrate how several amenities are easily accessible to Treelodge&Punggol residents (Fig. 4-24). These neighborhood amenities include the following: a Buddhist Temple; primary school; gasoline station; existing and future commercial / mixed-use development; future sports complex, and; a community center in the neighboring precinct, which houses a small coffee shop, a mini grocery store, and other convenience and service outlets for residents.
4.4 A Sustainable Design of the Case Study Site – The Design Scheme

Overview. The Design Scheme is a design proposal that takes into consideration the existing conditions of the case study site, as well the characteristics of adjacent developments in the urban scale. The identified site boundary for Phases 1 and 2 is used; the existing population and population density are the minimum base for the proposed design. A summary of the design data can be referenced in the tabulation below (Table 4-6).

Site Plan. The same site area of 30.51 ha (75.39 acres) is used for the design. The proposed development is occupied by 35 numbers of mid-rise blocks, laid out with their main axes facing north-south. There are only two typical-planned block types, both rising up to four stories only. One block consists of 76 units for each block, and the other, of 140 units each. 398 units of typical-planned and north-south facing blocks are at the south-western tail of the development. The site is mainly defined by a major thoroughfare that terminates in a rotunda, nearly at the center of the site, which subdivides this big plot of land into three smaller parcels. This major road branches out to minor roads and provides access to a mix of uses at the central area of the site. The mix of use consists of a hundred-classroom school, a complete hospital facility, and a central civic and community center that houses supermarkets, eating places, convenience and services outlets,
Full-scale community facilities are proposed on site including: four nos. of covered basketball courts; outdoor play and fitness stations; seating and landscaped spaces; multi-functional open spaces, and; large areas of greenery are provided.

Designated walkways that double up as bicycling lanes are also designed for; some of which, are covered with a simple profile of continuous shelter, so that each one of the residential blocks is directly accessible via

<table>
<thead>
<tr>
<th>Design Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Information</strong></td>
</tr>
<tr>
<td>Site Area</td>
</tr>
<tr>
<td>Residential Gross Floor Area</td>
</tr>
<tr>
<td>Gross Plot Ratio</td>
</tr>
<tr>
<td>(or Floor Area Ratio)</td>
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<tr>
<td>Dwelling Units (DU)</td>
</tr>
<tr>
<td>Gross Residential Density</td>
</tr>
<tr>
<td>58.42 DUs / Acre</td>
</tr>
<tr>
<td>Site Coverage</td>
</tr>
<tr>
<td>Open Space per Person</td>
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<tr>
<td><strong>Site Area Distribution</strong></td>
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<tr>
<td>Residential Site Area (Footprint)</td>
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<tr>
<td>Roads / Walkways (Uncovered)</td>
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<tr>
<td>Open Spaces / Greenery</td>
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<td></td>
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<tr>
<td>Community Facilities &amp; Covered Walkways</td>
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</tbody>
</table>

Table 4-6. Site data and information for the Model Scheme
Figure 4-32. Development site plan

Legend

01 Mid-Rise Housing Units
(3 to 5-Story Blocks)
02 Low-Rise Row Houses
03 School Complex
04 Medical / Health Complex
05 Commercial / Community Area
06 Materials Recovery Facility
07 Major Access Road
08 Bicycle Parking Facility
covered walkways from the main entry point of the site.

A combined total of 4,404 residential units are proposed on site, effecting a gross residential density of 144.35 DUs / Ha (58.42 DUs / Acre); a floor-area ratio (FAR) of 0.56, and; a total area of 17.1 Ha (5.14 Acres) for greenery and open spaces at 56.05% of the total site area, which then results to a dedicated 9.70 sq. m (104.4 sq. ft) of greenery and open space area per person (Table 4-6).

**Block Design Concept.** The basic housing form for the *base, model and design schemes* are illustrated below (Fig. 4-33) using Alexander, Reed & Murphy's housing typologies (1988), defined in this study based on the general characteristic and configuration of the residential units or blocks: row house type; point block type, and courtyard block type, respectively. The row house type of residential development is characterized by single-story dwelling units, sharing a party wall on both sides (except for corner units), and having front and rear building setbacks. The point block type of high-rise apartments, characterized by the *model scheme*, consists typically of 4 to 6 dwelling units per floor, and sharing common circulation spaces and a central vertical circulation and services core. The *design scheme* uses a modified slab block form of *courtyard blocks*, consisting of more than 20 units per block and forming a central communal
<table>
<thead>
<tr>
<th>Base Scheme</th>
<th>Model Scheme</th>
<th>Proposed Design Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Row house</strong> type of residential development characterized by single storey (mezzanine-ready) dwelling units, sharing a party wall on both sides (except for corner units), and having front and rear building setbacks.</td>
<td><strong>Point block</strong> type of high-rise apartments, usually 4 to 6 dwelling units per floor and sharing common circulation spaces and a central vertical circulation and services core.</td>
<td><strong>Slab block and courtyard</strong> type of mid-rise apartments (4 stories tall), consisting of more than 20 units per block and forming a central communal courtyard space and circulation. Vertical access via stairs are on the two short sides of the block.</td>
</tr>
</tbody>
</table>

Figure 4-33. Illustration of housing forms, representative of the base, model and design schemes (Alexander, Reed & Murphy, 1988)
Figure 4-34. Traditional conservation houses (shophouses) with courtyards at Neil Road, Singapore (Keouna. 2015)

Courtyards are often viewed as focal and positive spaces within the typical Singaporean shophouse. Allowing natural light and breeze streaming through and making the surrounding spaces desirable and socially-appealing, however small the area may be. Courtyards are often perceived as microclimate modifiers due to its ability to provide thermally comfortable environments by affecting humidity, movement of air and passage of daylight in all four seasonal scenarios (Teleghani, et al., 2012)
courtyard space and circulation. Vertical access via stairs are typically located on the two short sides of the block.

The courtyard block configuration is inspired by the dynamics of courtyard spaces in many different settings and building scenarios. The typical shop-house in Singapore (Fig. 4-34) is laid out around a small, yet extremely significant courtyard space that allows natural light through the deep living spaces of its typical plan. Breeze is also allowed to stream through the indoor areas of a shop-house, depending on the size and configuration of the courtyard. Courtyards have also been proven to act as microclimate modifiers, with its ability to provide thermally-comfortable environments by affecting humidity, movement of air and passage of daylight (Taleghani, Tenpierik & van den Dobbelsteen, 2012).

Other block configurations were also evaluated (Fig. 4-35). The double-loaded slab block is a compact and space-saving configuration that is also cost-efficient due to its shared, double-loaded central circulation spine. However, this central circulation space tends to be devoid of daylight, and does not stimulate the flow of natural breeze. And although it promotes a forced sense of closeness among neighbors due to the its tight configuration, the absence of “meeting points”
<table>
<thead>
<tr>
<th>Option 01</th>
<th>Option 02</th>
<th>Proposed Option</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical Plan</strong></td>
<td><strong>Typical Plan</strong></td>
<td><strong>Typical Plan</strong></td>
</tr>
<tr>
<td>1 - Poor</td>
<td>1 - Poor</td>
<td>1 - Poor</td>
</tr>
<tr>
<td>2 - Average</td>
<td>2 - Average</td>
<td>2 - Average</td>
</tr>
<tr>
<td>3 - Excellent</td>
<td>3 - Excellent</td>
<td>3 - Excellent</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
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<tr>
<td>1</td>
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<td>1</td>
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<tr>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

- **Space Efficiency**
- **Natural Ventilation**
- **Natural Lighting**
- **Sense of Community**
- **Privacy**
- **Circulation Efficiency**

This is a very compact and space-saving configuration and is cost-efficient due to the shared, double-loaded central spine. However, the central circulation space tends to be devoid of daylight and natural breeze.

The thin and lengthy block configuration represents exactly, a stacked row house profile. While the block obviously takes in the most amount of natural daylight and cross-ventilation among the three options, Option 02 is also most vulnerable to rain, with both sides fully exposed.

The courtyard block provides a central open and communal space that encourages social interactions among block members. It is a valuable public transitional space for the residents and a tropical design feature that allows light and air movement through.

---

Figure 4-35. Block configurations tested out for the proposed design
or social spaces within blocks is not ideal in trying to promote a real sense of community.

The **single-loaded slab block**, is a linear, lengthy and generally shallow block configuration that represents, exactly, a stacked row house profile. While this block type’s generally strong point centers on its ability to permit the most amount of natural daylight, and good flow or cross-ventilation of air, it is also most vulnerable to strong winds and heavy rainfall; with the block’s front and rear, being fully exposed to all natural elements. This block type also best promotes a sense of privacy, but is inevitably weak in enforcing a stronger sense of community among neighbors. It is also inefficient in terms of space maximization and circulation, with its lengthy stretch of corridor.

The **courtyard block** provides a central open and communal space that encourages social interactions among block members. It is a valuable public transitional space for the residents and a tropical design feature that allows light and air movement through. It is not as strong in terms of circulation and space efficiency as the double-loaded block, nor as good as the single loaded scheme in promoting a sense of privacy; but marries and balances off both scheme’s merits and weak points. The courtyard block is most effective among the three schemes
in establishing a sense of community, in that, the central space is socio-petal in nature, and creates opportunities for “break-out” spaces along the perimeter corridor. Break-out spaces can be informal seating areas or balconies that create a desirable setting for neighborly interactions among residents. An artistic impression of the courtyard as a desirable socio-petal space, a valuable transitional zone from the public to the semi-private sphere, and a tropical green lung feature within the block, is shown in the image on the left (Fig. 4-36).

An Evaluation: Sustainable Urban Form Principles and LEED LT. The remaining details of the design proposal are further expounded as they relate to each of the principles of sustainable urban form below.
1. **Density.** The proposed development’s apartment block profile, which resulted to a gross residential density of 144.28 DUs per ha (58.39 DUs per acre), is a highly-dense development that is also indicated by a translated population density of 721.41 persons per ha (376.95 persons per acre).

   The development scores a full mark of 9 out of 9 under this category.

2. **Compactness.** The apartment block, more specifically the courtyard block type used throughout the site is an attempt to achieve a quality of compactness that is less land-use intensive, in the sense that there is a significant amount of site area dedicated for greenery and open spaces. While it can be argued that the principle of compactness is best exemplified by generally using the least area of land for any specific development, and containing sprawl within a limited and fixed amount of space; the concept of compactness can also be perceived to translate as containing built areas within a limited amount of space, so that bigger areas can be dedicated to the promotion of extensive and diverse green spaces. A significantly lesser building footprint area, exhibited by the design scheme, at 18% of the site, as opposed to base scheme’s 65%, by itself, suggests an improvement in the category This realm of compactness, made more complex, by the inclusion of spatial quality definition will be lightly deliberated in the Discussions portion of this paper.

   A perimeter road around the northwestern zone of the site potentially connects SJDM Heights to neighboring developments via motorized vehicles from the sites major road, while the rest of the area is lined by a perimeter walkway, with a natural hedge lining the boundary edges of the site. This relationship and connectivity of the site to adjacent developments is an important criterion of compactness.
Figure 4-37. Map of major transport points surrounding the site (Google Maps, 2016)
Given the specified limitations of this research project in terms of site selection, the same housing site, along with its history as a previously undeveloped parcel of land, its profile, location and climatic setting, is used for the design scheme. Its weakest point, under this category, as a brand new site that is continuously expanding in phases, repeating the same housing form over and over, and henceforth, generally exemplifying a moderate level of compactness, gives the design scheme a score of 6 out of 9.

3. **Sustainable Transport**. An illustrative map showing locations of the three major transport nodes around the site (Fig. 4-37), and as discussed in sub-chapter 4.2, recapitulates the extremely long walks, as a major travel challenge among SJDM Heights residents. The lack of proper shelter for walking exacerbates the problem, by creating extremely uncomfortable walking experiences (Fig. 4-38). The design scheme addresses these transport issues of the site using the following key strategies below:

A main thoroughfare for motorized vehicles, highlighted in the diagram below, is the central transport spine that branches out to the three major nodes or zones of the site (Fig. 4-39). This 8-meter (26.25 feet) wide central road diverges to 6-meter (19.69 feet) wide minor roads. These minor roads connect to walkways that are meant for pedestrian and cycling use only. From the same figure, it could be inferred that the farthest apartment block is only approximately 348-meters (0.22 miles), and the farthest row house unit, about 396-meters (0.25 miles) walking distance away from minor roads.

The minor perimeter road, also discussed in Item 2 (Compactness), around the northwestern portion of the site, acts both as a connecting road to nearby development and fire engine access way. Bicycle parking facilities are marked using red dots in the site plan (Fig. 4-40).
Figure 4-39. Site plan highlighting major and minor access roads for vehicles

Figure 4-40. Site plan showing perimeter access road as link to adjacent sites, and locations of bicycle parking facilities
A designated covered walkway from the main neighborhood entry point that link each one of the residential blocks, as well as community facilities are provided to ensure comfortable and desirable walking experiences for residents (Fig. 4-41).

However, while the issue of transportation sustainability can only be fully dealt with by holistically addressing the larger urban context, the scope of this research, and consequently, of the design proposal, includes only areas within the designated site boundary. The above strategies, however, such as providing a dedicated covered walkway for pedestrians, bicycle lanes are bicycle parking facilities, are likewise very much applicable to areas outside of the site boundary.

The above improvements and limitations set a score of 7 out of 9 under the sustainable transport category.

4. **Mixed-Use Development.** Referencing the results from the focus group discussion conducted (See Chapter 4.2 and Appendix 1),
a mix of uses within the neighborhood development is proposed at the central area of the site. Three long blocks of 5 story high school facility, housing 100 classrooms, and a 5-story medical complex are provided in the design proposal. A 5-story commercial and community center houses grocery and retail stores, service outlets, eating places, bicycle rentals and other public amenities such as a library, management office, child day care and senior care facilities. etc. (Fig. 4-42). The complex may also incorporate a limited parking area for private vehicles below grade or above ground, when future requirements arise. Its central location, as opposed to a more distributed configuration (potentially at the ground level areas of the residential blocks), is a direct translation of the preferential interview results (See Chaper 4.2 and Appendix 1b).

This strategy helps to reduce residents’ frequent commutes outside of the development in order to fulfill basic needs and services. However, a potential shortcoming in the design can be
seen through the site plan (Fig. 4-42), whereby the farthest point at the southwestern tip of the row house complex remains a lengthy 845-meter (0.52 miles) walk to the central mixed-use area. This is however compensated for, by the improved quality of walking environment throughout the development.

As such, the design scheme scores 8 out of 9 for the category.

5. Diversity. Images were presented to residents during the focus group interview (see Chapter 4.2 and Appendix 1), in order to capture individual preferences and thoughts on the possibility of a diversified aesthetics for the development. These images represent a type of architectural style and various levels of diversity of existing and proposed developments, researched and carefully selected, from where, residents were asked to vote based on their personal preferences. Results from the interview, including scores tallied as shown, as well as views, comments and sentiments from the interview participants, were assimilated into the final design proposal. This addresses the aesthetic layer of the design that is perceived to be an important component in building up a sense of place, which consequently results to a desirably walkable neighborhood.

The following artistic impressions strive to convey the design intent, showing the amount and quality of diversity that is acceptable to end-users (based on the conducted interview), and practical, in terms of cost, at the same time.

The entrance marker at the first roundabout from the main entry point of the development, may seem to be a superficial and impractical street element, but is in fact an important symbol that helps to instill among residents, a sense of association, pride and belongingness to the community (Fig. 4-43).
Figure 4-43. Site's entrance marker (Salvatus, 2016)
Figure 4-44. Mid-rise blocks facade treatment (Salvatus, 2016)
Figure 4-45. Row houses facade treatment (Salvatus, 2016)
Figure 4-46. Residential blocks and Civic / Community Center framing the site's plaza (Salvatus, 2016)
Figure 4-47. Landscaping and a mix of activities at the plaza (Salvatus, 2016)
Mid-rise blocks share typical plans, but are varied in terms of elevation treatment. Play on color combinations, and use of textures through simple applications of grooved patterns, and further varied by a slight play on heights enabled a more diversified façade design (Fig. 4-44). Basic façade module variations are repeated strategically, in order to keep to a level of well-balanced variation throughout the site, while staying within the practical limits of having not too much variety that it becomes impractical to build. Walkway canopies are designed using a simple and repetitive modules of metal roofing on a single steel column support.

The same modularized variation was used for the row house façades treatment (Fig. 4-45).

Residential blocks and the civic / community center frame the vibrant, and activity-filled public plaza, where an amphitheater, pockets of landscaping, informal seating areas and partially covered commercial spaces are proposed (Fig. 4-46).

The civic / community center and its public plaza (Fig. 4-47), at the heart of the development, is the life of the neighborhood. It is a place envisioned to be filled with diverse activities and varying levels of social interactions.

With these efforts to diversify the site’s aesthetic components, as well as neighborhood activities and functions, the design scheme, earns a full score of 9 out of 9 under the category.

6. **Greenery Provision.** One of the key features of the design is its lush landscaping and greenery. There is a strong direction to design towards a maximization of green spaces, and an integration of multi-functional community spaces, which include play and fitness facilities, seating areas and open lawns for informal play and meeting points for residents (Fig. 4-48 to 49).

A selection of native trees and shrubs were studied before identifying the final set of species to be used. Drought tolerance and minimum maintenance are the major selection criteria, as irrigation system will not be in place, and maintenance personnel may not be present on site. Tree species selected consist of: (1) The **Neem Tree**, locally known as *Bacalunga* (*Azadirachta indica*), is a fast growing, medium-sized tree (from 16 to 30 m tall), often used for afforestation. With its large and round crown, the Neem Tree creates a pleasant roadside avenue and provides an adequate amount of shade. The Neem thrives in dry soils and only requires watering once every 10 to 15 days during the summer (non-rainy) months; (2) The **Banaba Tree** (*Lagerstroemia speciosa* (L.) Pers.) is small tree that grows up to 15 m tall. The folkloric use of its leaves as treatment for diabetes mellitus is well known in the Philippines, as well as in India. Generally, Banaba is a good roadside tree that does not require crown pruning to achieve a good-looking crown. The drought –
Figure 4-48. Greenspaces including landscaping and seating areas (Salvatus, 2016)
Figure 4-49. Play and fitness area, interspersed with landscaping
(Salvatus, 2016)
The Neem Tree, locally known as Baculode (Azadirachta indica), is a fast growing, medium-sized tree (from 10 to 30 m tall), often used for afforestation. With its large and round crown, the Neem Tree creates a pleasant roadside avenue and provides an adequate amount of shade. The Neem thrives in dry soils and only requires watering once every 10 to 15 days during the summer (no-rainy) months.

Figure 4-50. Neem and Banaba are native trees, selected due to their drought tolerant features (Plan Verde, 2016) (Livestrong, 2014)

Banaba Tree (Lagerstroemia speciosa (L.) Pers.) is a small tree that grows up to 15 m tall. The folkloric use of its leaves as treatment for diabetes mellitus is well known in the Philippines, as well as in India. Generally, Banaba is a good roadside tree that does not require crown pruning to achieve a good-looking crown. The drought-tolerant tree thrives in dry soils but can tolerate drought, well-drained, and fertile loamy soils as well.

Figure 4-51. Neem and Banaba are native trees, selected due to their drought tolerant features (Plan Verde, 2016) (Livestrong, 2014)

tolerant tree thrives in dry soils but can tolerate drought, well-drained, and fertile loamy soils as well (Fig. 4-50).

Selected shrubs include the following species: (1) The Bougainvillea is a highly drought-tolerant and almost maintenance-free ornamental plant that requires only little water to thrive. Its varied range of flower colors make this shrub a good choice for creating interesting and effortless landscape themes; (2) The Ixora plant, more locally known as Santan (Ixora coccinea L.), blooms year-round and requires little maintenance. Flowers vary at yellow, red, tangerine pink and white colors (Fig. 4-51).

For the above greenery criteria, as exemplified by the design scheme, a full mark of 9 out of 9 is scored.

7. **Passive Design.** It is challenging to achieve a level of thermal comfort in hot humid climates such as in the Philippines. As can be observed from the psychrometric chart (Fig. 4-52), the highlighted blue areas are actual and average year-round levels of relative
humidity, wet bulb and dry bulb temperatures. The pink box shows levels of thermal comfort that has not been achieved. Relative humidity averages at constant high levels not falling below 60% and averaging at 75%.

Air-conditioning is not an option. Not only is it very high in energy consumption, but it is mostly expensive and impractical for the living standards of the case study residents. Passive design strategies such as eliminating as much heat gain on the building facades through proper solar orientation of blocks; designing fenestrations for effective cross ventilation and facilitation of air movement; design of simple yet effective shading devices to eliminate glare and allowing diffused daylight through building interiors, are studied and integrated in this research work.

**Optimum Solar Orientation** (using the Autodek Ecotect Analysis software) is determined by irradiance values or daily average incident solar radiation on a vertical surface of a building, expressed in kwh/m2. The

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**Psychrometric Chart Legend**

- Comfort Zone
- Dry Bulb / Wet Bulb / Relative Humidity Levels

Figure 4-52. Psychrometric chart showing unachieved thermal comfort levels with humidity, dry bulb and wet bulb temperature averages (Autodesk Ecotect Analysis, 2011v.)
Figure 4-53. Optimum solar orientation for the study site (Autodesk Ecotect Analysis, 2011v.)
resulting graph (Fig. 4-53) shows a recommended optimum building orientation at 350 degrees, yielding the least irradiation value facing almost true north during both over-heated and under-heated periods; while the east and south yield the highest intensities. The south receives a considerable amount of irradiation during the under-heated period from December to February, implying that high levels of solar irradiation values are received in the southern face of buildings during these colder months of the year; while receiving drastically lower intensities during the over-heated period from April to June. It then makes sense to orient the longer axes of buildings in this manner, in order to evade high levels of heat transmission and heat gain through buildings.

Solar shading diagrams were taken (using Sketchup software) and used to study shading patterns in the north and south faces of a typical block, using the north-south facing orientation of the block’s long axis. The north-facing elevation is mostly shaded throughout the year, except during the summer period from May to

Figure 4-54. Solar-shading diagrams for south-facing facades during equinox and winter solstice (Skethup, 2014v.)
July. It experiences the most intense and longest solar exposure in June (summer solstice), at 15:00 to 17:00 hours (Fig. 4-54). The southern face of the block experiences longer solar exposure than its northern counterpart almost throughout the year, especially during the winter solstice period in December (Fig. 4-55). With west-facing facades, as having the longest and worst solar exposure of the four cardinal orientations, with the sun casting long shadows near the azimuth and exposing west facing windows or walls to intense and direct heat almost perpendicular to the surface, a north-south facing building is still the recommended solar orientation.

Horizontal sun-shading devices of 0.6 m depth (1.97 ft) are installed above each of the unit’s windows. The diagram (Fig. 4-56) illustrates how effective this simple shading device is, in preventing direct sunlight from coming into indoor spaces through the windows.

**Air Movement and Cross-Ventilation.** The wind rose is a tool used to observe prevailing wind movement and patterns at specific times and locations. Wind rose diagrams (from Autodesk Ecotect Analysis software) were generated throughout the year over a 3-month period. Southwest and Northeast monsoon winds are the country’s prevailing wind directions, carrying with them warm and humid air streams at higher temperature ranges for the former from May to September; and generally cooler and drier air streams from October to April for the latter.

In the hot and humid tropics, it is almost imperative to allow as much air movement as possible through habitable spaces in order to achieve acceptable thermal comfort levels. Facades of each typical block are punctured with large openings or air wells, facilitating the passage of air to the courtyard space at the block’s center, and through a large area of fixed louvered openings at the transom level of the units’ internal faces (Fig. 4-58). Operable louvered glass
Figure 4-56. Cross-section of mid-rise block through the courtyard space, which assists in the cooling process by allowing cross-ventilation of air.

Figure 4-57. Horizontal shading device helps to block off direct sunlight (Sketchup, 2014v.)
Figure 4-58. Longitudinal section of the mid-rise block through the courtyard space, showing opening along the facades, in order to better facilitate cross-ventilation
windows allow for maximum control of occupants over the thermal comfort level of their respective indoor environments.

The above passive design strategies earned a full mark of 9 out of 9 for the Design Scheme.

The LEED LT criteria has been used as guidelines for the design proposal including: the inclusion of a diverse mix of uses centrally located in the proposed site development; the provision of cycle-able lanes, as well as designated cycling paths and bicycle parking facilities, and; the addition of walkable and covered pedestrian paths;

Points earned for the design scheme totaled at 54 out of 63, which is a vast improvement from the base scheme.
4.6 Project Costs and Comparisons

Cost Estimates and Comparison. Table 4-7 summarizes the standards and specifications used as basis for the cost estimates. It can be noticed how the base scheme only had two cost components which consisted of the housing units, and paved areas that included roads, walkways and easements. The design scheme, however, consists of dwelling units, walkway shelter, paved surfaces, landscaping, sitting fixtures, and play and fitness equipment as part of its costs.

Table 4-8 is a summary of the total costs for each of the cost category, expressed in both Philippine Pesos (Php) and US Dollars (US$) are presented for both base and design schemes. Detailed breakdown of cost estimates can be found in Appendix 2.

Unsurprisingly, estimated costs for the design scheme surpassed that of the base scheme by a value of US$ 4.6M. While this may seem to be a considerably large sum for a low-cost housing project, it is ultimately justified in the succeeding paragraphs, and falls in place, together with the sustainable attributes and added livable community features of the new SJDM Heights.

Cost Analysis. Firstly, it is only reasonable to associate the overall added cost of US$ 4.6M of the Design Scheme, with the well-planned and highly usable community spaces, and lushly-landscaped surroundings – qualities of a truly
sustainable and livable neighborhood. With no costs to compare with in the Base Scheme scenario for most of the cost items covered in the Design Scheme, the added amount is clearly justifiable.

A second point, is how the additional cost can be simplified by looking at it in a manner, whereby, this supposed additional cost, when equally divided among the total number of 4,404 households is equivalent to US$ 4,200.74. When spread across the amortization period of 30 years, and assuming that the additional sum is shouldered by homeowners, the added cost of monthly payments is equivalent to USD$ 2.94 (Table 4-8).

Further savings can also potentially be achieved with the incorporation of passive design components such as well-sized windows, courtyard spaces and better building orientation. These strategies improve air movement and cross ventilation within dwelling units, potentially eliminating the use of a second ventilating fan, and consequently resulting to an electric bill reduction of US$ 9.60 (Php 452.66) on a monthly basis (Fig. 4-59).
### Table 4-7. Summary of general specifications and quantities used as basis for cost estimates

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<tr>
<td>Cost per Dwelling Unit</td>
<td>NHA standards for architectural and structural details are used. <strong>Row House = 4202 Units</strong></td>
<td>NHA standards for architectural and structural details are used, except for changes in window types and sizes, as well as façade modifications. <strong>Row House = 398 Units</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Design Scheme</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per Residential Block</td>
<td></td>
<td><strong>Block A (14 Nos.):</strong> 1st Sty = 16 Units 2nd to 4th Sty = 20 Units per Floor <strong>Block B (21 Nos.)</strong> 1st Sty = 32 Units 2nd to 4th Sty = 36 Units per Floor</td>
<td>Galvanized steel pipes or tubular section for columns and beams; Ribbed galvanized steel roof or polycarbonate (whichever is cheaper).</td>
</tr>
<tr>
<td>Total Cost of Walkway Shelter</td>
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<td>(area = 12,653 sq. m)</td>
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</tr>
<tr>
<td>Total Cost of Paved Surfaces</td>
<td>(area = 87,036 sq. m)</td>
<td>(area = 55,192 sq. m)</td>
<td>Asphalt or concrete for roads and colored cement for footpaths</td>
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<tr>
<td>(Roads and Walkways / Footpaths)</td>
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<td>Footpath = 27,514 sq. m</td>
<td></td>
</tr>
<tr>
<td>(area = 55,192 sq. m)</td>
<td></td>
<td>Roads = 27678 sq.m</td>
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<tr>
<td>Total Cost of Landscaping</td>
<td>(area = 110,000 sq. m)</td>
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<td>Low-cost and native plants such as santan, bougainvillae and native shady trees such as Neem Tree and Banaba Tree</td>
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<tr>
<td>(area = 110,000 sq. m)</td>
<td>Trees =30,000 sq. m</td>
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<td></td>
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<tr>
<td>(area = 110,000 sq. m)</td>
<td>Shrub s = 40,000 sq. m</td>
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<td>(area = 110,000 sq. m)</td>
<td>Turf / Grass = 40,000 sq. m</td>
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<td>Total Cost of Open Space, Open</td>
<td>(area = 60,000 sq. m)</td>
<td></td>
<td>Includes benches, playground and fitness equipment: Three-seater simple benches = 200 pcs Playground - 10 sets Basketball Court - 5 sets Fitness Equipment - 15 sets</td>
</tr>
<tr>
<td>Space w/ Benches, Fitness and</td>
<td>Open space w/ pebble wash floor = 20,000 sq. m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Play Equipment</td>
<td>Open space w/ gravel / cinder stone bed for play and fitness = 40,000 sq.m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4-8. Summary of cost estimates and comparison between base and design schemes (Benliro, 2016)

<table>
<thead>
<tr>
<th></th>
<th>Option 01 Base Scheme (Php total)</th>
<th>Option 01 Design Scheme (Php total)</th>
<th>Option 02 Base Scheme (US$ total)</th>
<th>Option 02 Design Scheme (US$ total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Cost per Dwelling Unit</td>
<td>1,594,203,607.68</td>
<td>147,437,659.24</td>
<td>33,478,275.76</td>
<td>3,096,190.84</td>
</tr>
<tr>
<td>2a Cost per Residential Block (Block A)</td>
<td></td>
<td>390,490,550.38</td>
<td></td>
<td>8,200,301.56</td>
</tr>
<tr>
<td>2b Cost per Residential Block (Block B)</td>
<td></td>
<td>1,102,506,585.39</td>
<td></td>
<td>23,152,638.29</td>
</tr>
<tr>
<td>3 Total Cost of Walkway Shelter</td>
<td></td>
<td>256,233,250.00</td>
<td></td>
<td>5,380,898.25</td>
</tr>
<tr>
<td>4 Total Cost of Paved Surfaces (Roads and Walkways / Footpaths)</td>
<td>348,144,000.00</td>
<td>220,768,000.00</td>
<td>7,311,024.00</td>
<td>4,636,128.00</td>
</tr>
<tr>
<td>5 Total Cost of Landscaping</td>
<td></td>
<td>20,925,000.00</td>
<td></td>
<td>439,425.00</td>
</tr>
<tr>
<td>6 Total Cost of Open Space, Open Space w/ Benches, Fitness and Play Equipment</td>
<td>25,987,500.00</td>
<td>545,737.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Total Cost</td>
<td>1,942,347,607.68</td>
<td>2,164,348,545.01</td>
<td>40,789,299.76</td>
<td>45,451,319.45</td>
</tr>
</tbody>
</table>

Design Scheme costs **Php 222,000,937.33 (USD 4,662,019.68)** more than Base Scheme
Figure 4-59. Appliance Calculator application by Meralco, the country's electricity services provider (Meralco, 2016)
CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

Study Conclusions

The following set of conclusion and recommendations summarizes the study findings, addresses the earlier stated objectives of the study and answers the questions asked throughout the research.

1. There is an appropriate density for every unique location and every unique residential profile that a housing design caters for. Technically and generally, a higher housing density and more compact design strategies as exemplified, for instance, by the proposed mid-rise residential blocks are more environmentally-sustainable than the established and extensively implemented, sprawled “subdivision” housing type. Such design uses land more effectively and thoughtfully, promotes walkability and potentially opens up more ground space for open community spaces and greenery.

2. Land scarce cities such as Singapore are effectively able to implement very high density and high-rise public housing
developments, due to their strong and genuine commitment for quality housing delivery; consistent and persistent estate management and maintenance committees; and well-disciplined residents who value their homes and their respective communities. With these key attributes of housing and housing management, housing programs become more sustainable and meaningful for residents.

3. Residents are unwilling to live in multi-level dwellings. Most are only able to accept residing up to the second floor, while a very select few can consider living up to the fifth level. Concerns raised by the residents, such as dangers from earthquake and fire occurrences, safety from falling and accessibility for the elderly can be addressed by a thoughtful design and allocation of units among residents. Residents also need to be educated, generally, on multi-level living: its unique homeownership definitions and features; housing tenure, and; benefits and trade-offs with single-story dwelling unit types.
It is extremely difficult to expect people who have been accustomed to traditional mind-sets of low-rise living, to suddenly embrace the idea of an apartment lifestyle. Land has been a constantly valued asset, without which, people feel as if they have no sense of ownership. However, minds can be trained with proper education and orientation. This has been done and successfully so in cities like Singapore and Hong Kong. Land is a finite resource and it is only good practice to conserve it now.

4. Floor-area ratio (or plot ratio), dwelling units per area and site coverage are indicators of urban density and compactness. Dwelling unit sizes, however, are often overlooked. For low-cost developments such as the SJDM Heights, although floor area ratio may be significantly low, this is not indicative of its density. Since unit sizes are extremely small and household size relatively big, the resulting large amount of dwelling units per area clearly indicates a higher density as well.
5. Site coverage is directly related to land utilization and greenery preservation or provision. A higher site coverage of built-up areas signifies a loss of space for planting and landscaping. Increasing site coverage not only increases potential for greenery, but also for open spaces. A low floor area ratio, with high site coverage, as represented by the existing case study site; versus its high floor area ratio with low site coverage counterpart, and as represented by HDB developments such as Treelodge@Punggol, and with both having equally high number of dwelling units per area, are a good basis for comparison and representation of sustainable urban forms; whereby, the second model better exemplifies sustainability than the first. Sustainability of the two models can also be expressed in terms of green area (or open space that is not inclusive of roads, pavements or easements) per person, where a higher value indicates better sustainability.

6. Open spaces, excluded from Jabareen’s (2006) principles of sustainable urban form, is potentially a huge and instrumental
component of sustainable urban forms. Social sustainability, though only partly and unintentionally covered by this research, has been extensively studied through the years, and has been established as an integral part in achieving overall sustainability. Open spaces, as in the precedent study, effects housing desirability and greater satisfaction among residents. It contributes to social solidarity and neighborliness, and adds a fabric of vibrancy and charm, in the overall appeal of a community.

7. There is a need to determine a minimum standard for open spaces per capita, in order to arrive at a more straightforward and sound guideline in allocating areas of open spaces for housing developments. The reverse was conducted for this study, whereby the site boundary and existing density data (of dwelling units per area) were used as the constant variables, and the resulting open spaces as the changing variables. It then resulted to a comparatively large area of open space per person, which can either be a sufficient or wasteful quantity.
Willingness of residents to cycle will not necessarily and immediately transform SJDM heights into a cycling community. Currently, only 1 out of 13 interview participants own a bicycle. A proper bicycle-friendly lane that doubles up as a pedestrian walkway is proposed for the development. Inclusion of bicycle parking facilities might help to encourage residents to cycle instead of resorting to tricycle rides for shorter commutes. When proper facilities and infrastructure are in place, it is easier to motivate people to make use of them.

8. Interview respondents of the SJDM Heights are willing to tread up to 2 km distance, which is relatively lengthy, when compared to the usual quarter-mile or half a kilometer walking standard. Designing proper pedestrian facilities with designated covered link ways ensure a weather-proof walk from the development’s entry point, to residents’ respective homes.

9. Mix of uses in a community is not only practical, in that, it provides residents with the much required products and services, so that long commutes are no longer required; but also adds vibrancy and a
complete sense of place. A neighborhood with a complete set of amenities is very much walkable; a walkable neighborhood constitutes more people on the streets; and more people is excellent for business. A vibrant community, with a strong social bond and with people constantly filling up streets, is made safer by this self-patrolling attribute.

10. Diversity of form and aesthetics is a matter of opinion. What the focus group interview tried to discover is if people would prefer diversity over homogeneity of housing aesthetics. As it turns out, at least for the 14 interview participants, varied and modern geometric architectural elements on facades are preferred over traditional forms of housing. Varied earth tones with a few bright-colored accent tones are more popular than extremely colorful and extremely plain color motifs.

11. Quality and carefully-planned greenspaces are key to creating sustainable housing forms. The concept of greenspaces and compact cities are generally contradictory in nature, in that, compact
communities are usually highly built-up and do not allow space for extensive greenery; but that many studies have proven the intrinsic value of greenery in compact and highly-dense communities (as discussed more thoroughly in Chapter 4.1). Effective greenspaces that residents appreciate are characterized by a diverse species and aesthetic configuration of plants; a sense of arrival; a mix of activities; areas for sitting, and; opportunities to grow vegetables on site.

12. Although there are easy rules-of thumb when passively designing general climate types, there are specific micro-climates to consider and site-specific conditions that may require varied passive design treatments and strategies. As an example, Singapore and Philippines, both from the Southeast Asian region share the same hot and humid tropical climate conditions; however, Singapore is more humid and much less windy, while the Philippines has higher temperature averages. No tropical cyclones visit Singapore, while the Philippines experience regular lashing of strong winds and heavy
rains during the Southwest Monsoon seasons. These are all unique and yet valid and significant considerations to take, when designing sustainably.

13. Properly orienting buildings and appropriately sizing windows are effective and inexpensive, almost free, passive design strategies. The cost of adding horizontal sun-shading fins on top of windows is easily compensated for by its effective shading of indoor spaces, thereby reducing heat gain inside dwelling units.

14. Well-designed courtyards are not only effective micro-climate modifiers, but are a valuable public transitional area, a central, open and communal socio-petal space.

15. Low-cost housing communities can be sustainable communities too. The material cost equivalent of adding ecological value and improving the state of our built environment, through the inclusion of greenery in the design, is not expensive at all (see detailed discussion in Chapter 4.5). The additional improvement costs for incorporating greenery, decently-finished community spaces, complete fitness and play equipment, and proper sitting fixtures
and street furniture, are easily compensated for by highly-satisfied end-users, a sustainable community, and a truly livable neighborhood.

16. It is important to recognize the inexorable link between principles of sustainable urban form in, and residents’ profile, spatial and functional requirements, and physical or aesthetic preferences, where the need to strike a balance between these two aspects of sustainable design in housing is an essential task for designers and planners.

**Recommendations for Future Works**

Finally, there is a great potential in pursuing this study further: to look more closely at specific issues; to gather more primary data by interacting with a larger number of diversified respondents; to infuse more energy-related and passive design simulations in the study; and to test more case study sites to establish differences and similarities, so that a more deeply founded set of design standards for sustainable housing can be achieved. The following are other potential and future themes and direction of related research studies:

1. It has been discussed above, how the subjective nature of open spaces can be It is worthwhile to study and establish a set of
optimum standards for open space requirements in housing developments.

2. A good design compromise between the compact city model and the sustainable urban form principle of greenery provision, will help in developing a holistic and well-balanced housing community.

3. Open space, as an attribute of sustainable urban forms can be studied in greater detail, in order to realize its actual and concrete role in the building of sustainable housing environments, and to arrive at a measurable and physical shape that it can take in a given housing context.

4. The original intent of this research work was to conduct a “before-and-after” study design, which would have allowed the set of proposed design and design recommendations for the SJDM Heights, to be subjected to another round of dialogue with the same set of original participants. This would have achieved perception-related responses that can further refine the design, in order to best suit the requirements of residents. Future research studies can use
the above research model, in order to come up with a more users-oriented results and set of design proposal.

5. Each of the seven principles of sustainable urban form can be studied individually. A more focused approach on each of these principles, in relation to an actual case study, will yield practical and more grounded set of study results and conclusions.

6. How vernacular forms can take shape in the context of a specific site, can also be studied as another potential criteria or concept for sustainability in housing. Lessons learned from traditional shophouses in Singapore, Malaysia and Vietnam, which were incorporated in basic building designs in the region, is an example of sustainability using vernacular forms. An investigation on the potentials of adaptive reuse of vernacular building types can be part of future research work.

7. Housing site shapes and sizes can vary significantly from one extreme end to another. How the principles of sustainable urban form take physical shape in small sites, as well as in extremely
extensive sites, is an interesting point of comparison for future studies.
FOCUS GROUP INTERVIEW

The focus group discussion was conducted in Filipino, the local language. The following are direct translation of the questions and the corresponding consolidated responses.

Part A

Main Interview

Research Topic: ENVIRONMENTALLY SUSTAINABLE HOUSING DESIGN AND PLANNING THROUGH THE APPLICATION OF SUSTAINABLE URBAN FORM PRINCIPLES IN THE CONTEXT OF A SELECTED CASE STUDY SITE IN SAN JOSE DEL MONTE, BULACAN, PHILIPPINES

Sustainable Transportation-Related Questions

1.1 Please describe your general daily travel experience based on convenience and efficiency.
**Summary of Responses.** Travels on a daily basis is ranked by almost all as okay on the average, with areas of improvement such as traffic problems especially during peak hours in the evening. The first bus schedule from the main terminal at Tungko, Bulacan leaves at 6am to Cubao, while the public jeep leaves as early as 3am, but that, for such long travel of approximately 34 km, a more comfortable journey is preferred using bus service to Cubao. Approximately From SJDM heights, 20 to 30 min to Tungko using public jeep.

Routine daily travel. 20 to 30 minutes going to Tungko using jeep. “Wala na kaming magagawa” (We can’t do much about the situation). Other roads are still considered by residents as very narrow or not wide enough.

**1.2 Where are your usual destinations during weekday? During weekends? For work? For leisure?**

**Responses.** Weekday travels for work for most of the participants are Manila-bound; whereas weekend travels are mostly limited to nearby and newly-opened shopping areas such as Starmall, SM San Jose del Monte and Save More, all within approximately km from SJDM Heights. None of the respondents reported travelling to other places outside of Bulacan for leisure or amusement during regular weekends.

**1.3 What is / are your usual mode of transportation?**
Responses. Buses, jeep, motorized tri-cycle. Currently there are no parking provision for privately-owned cars. A few families own cars. Residents are willing to park in allocated and designated parking areas if these are provided for them, should they own cars in the future.

1.4 What is your average travel for each category of destination (e.g. work and leisure)?

Responses. Two to four hours. Four hours during peak hours (in the evenings, going home). Midnight travel from SJDM to Cubao, without any traffic jam is shortened to 1.5 hours.

1.5 If a designated route towards your main transport terminal is made comfortable, shadier (from rain and sun) throughout, more pleasant and well-kept, would you opt to walk or cycle?

Responses. For residents coming from the farthest areas of the subdivision, walking and taking a tricycle ride to the main road (at the housing’s main entrance) at about 1 km distance are usually the preferred modes of travel. One out of 15 participants has rode a bike to the entrance at 25% of her entire trip to the same area, and mentioned that bicycles may be left to the care of the development’s security personnel, in the absence of bicycle parking facilities.
During times of extreme heat, especially during summer, tricycle rides are preferred and trips to the entrance for a single person or two persons together cost Php 20 (US$ 0.40) per trip, which is considered by residents as a bit expensive.

However, when an ideal scenario is presented to residents, whereby everyone owns a bicycle and knows how to cycle; bicycle parking facilities are available; and roads or pathways are relatively flat and properly paved, all respondents prefer to cycle.

1.6 What circumstances and conditions can impel you to use a designated path for walking and/or cycling? What circumstances and conditions will otherwise prevent you from doing so?

**Responses.** Road pavement and levels. Safety during night time or evenings, due to absence of streetlights.

On a side note, there is a curfew within the development from 10pm to 4am, Alcohol ban at 1am.

1.7 What is the longest distance you are willing to walk to any transportation terminal or any other destination? To cycle?
Responses. Up to Muzon. Up to San Jose. Up to Tungko, 2 to 5 km (extreme). On a daily basis, to Muzon; to San Jose; to Phase 1; around 10 to 15 min walk (to Municipal Hall).

1.8 What to you, is a most ideal transport experience and mode of transportation for your daily or regular trips, aside from using private cars?

Responses. In an ideal scenario, respondents prefer to use train for their daily commute to work, as these are faster and more efficient; but a major concern is travelling during late evenings because of absence of taxi services.

2.0 Mixed-Use Development-Related Questions

2.1 Rank the following community facilities and usage in terms of importance from 1 to 3 (with 3 being the highly important rank) and give a brief explanation why:

2.1.1 Eating places – 21/39
2.1.2 Grocery stores / supermarket – 39/39
2.1.3 Convenience stores – 39/39
2.1.4 Public library – 39/39
2.1.5 Child-care center – 37/39
2.1.6 Fitness center – 30/39
2.1.7 School -39/39
2.1.8 Health center / clinic – 39/39
2.2 Which other facilities do you think are important for yourself, your household and your community, so that no more long distance travels to these facilities are required?

Responses. Public Hospital. Nearest at Sampalay 15-20 km away from the development. 2 to 3 available ambulance are not enough.

3.0 Diversity-Related Questions

3.1 Preference on Architectural Style

A series of photos representing types of architectural styles for both low-rise and mid-rise dwellings were shown to residents, in order to gather votes for each photo, comments and thoughts behind the respondents’ votes. Images and votes tallied can be viewed in another document.

3.2 Preference on Level of Diversity

A series of photos of homogenous versus diversified housing types (single family dwellings, duplexes, townhouses and low-rise apartments) and styles (architectural style, façade treatment, colors, materials or textures) were presented in order to identify residents’ preference.

4.0 Energy Consumption-Related Questions

4.1 What is your level of comfort / discomfort during the summer period?
**Responses.** Windows (although safety is an issue). Electric fan, plants or garden. One to three fans are used to ventilate a story space. Ceiling installations also helps to reduce heat.

**4.2** Do you have any precipitation-related issues inside and outside of your house? If so, what are these and how do you cope with these issues?

**Responses.** Water leakage is a problem. Temporary flooding is a slight inconvenience but is not a great concern as water drains eventually. Mudding of streets after rains also reduces walkability of streets.

**4.3** Are there any extraordinary electricity related problems such as regular power outages or absence of power supply for long periods of time?

**Responses.** Some residents still do not have access to electrical services. Some few residents have solar panels installed.

**4.4** What is your average monthly electrical consumption (in Philippine Pesos)?

**Responses.** 2,300 (6 in a household, with retail store); 1,300 (3 residents); 1,200 (6); 165 (1) – electric fan and lighting; 900(6); 1,300 (3); 600 (4). No aircon facilities among respondents.
APPENDIX 1B
PREFERENTIAL STUDY AND INTERVIEW

The following are the actual powerpoint presentation slides used during the group interview. Responses have also been incorporated in the slides:
Part 1
3.0 Diversity
3.1 Istilo at disenyo ng pang-arkitektura

Architectural style and design
<table>
<thead>
<tr>
<th>Interview Questions</th>
</tr>
</thead>
</table>

3.1a Single to Double Storey Family Dwelling Units
Architectural Style and Design
3.1a-a

Standard low-cost housing design in the Philippines

Residents inquired where this was, and they also quickly assumed this was in the Philippines, though they are not able to read any indications stating that this photo is in fact taken one of the low-cost housing projects in the country.
Villa type of housing form

Some of the respondents appreciated this image for the spacing in between the houses. According to residents, the spacing between houses is important for privacy and noise alleviation. Some thought that the design was more suitable for vacationing only. One remarked that the disadvantage as a non-staffable unit that low height does not allow residents a potential to build a mezzanine or loft for sleeping.
Fig. 3: Low-cost Housing in General Trias, Philippines. Source: http://www.philnews发育.nl/lowcosthousing.jpg

3.1a-c

**A comparatively modern-looking single-story row house**

A resounding remark from interviewees: “This one!” When this photo was presented after the earlier photo, participants responded more positively. This design was appreciated for wide roads in front, and for a wider, cooler front space, cleanliness, and seemingly quiet surrounding.
3.1a-d

Diversified and modern using similar materials throughout.

Initial remarks such as "Ayoko nyan nI don't like that" were expressed. Space in between, again, is appreciated, as well as individuality in the units' design.
3.1a-e

Modern architectural design.

This was better appreciated than the preceding photo.
The parking space was desired.
**Low-Rise / Row Houses**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional low-cost housing style in the Philippines</td>
<td>Simple villa type, log cabin, vacation homes style</td>
<td>Modern and boxy style</td>
<td>Basic geometric forms and solid colors</td>
<td>Simple geometry, neutral tone with color accents</td>
</tr>
</tbody>
</table>

**Low-cost Housing, Philippines**

**Villas**

**Low-cost Housing in General Trias, Philippines**

**Modern Sustainable House in Portland**

**10x10 Housing Initiative at Cape Town, South Africa**
Retrieved from: [http://www.sharwoodis.net/blog/10-project-sharwoodis-affordable-housing-can-be-beautiful](http://www.sharwoodis.net/blog/10-project-sharwoodis-affordable-housing-can-be-beautiful)
3.1b  
**Mid-Rise Family Dwelling Units**

*Diversity of Architectural Style*
Interview Questions

Fig. 3.1b: Public Housing Design for Angkor, Cambodia. Source: http://cambodiafire.com/
content/tables/201603/usually_camb.org
Angkor.jpg

3.1b-a

Typical mid-rise repetitive concrete housing blocks of varied colors.
There were no remarks of like or dislike, only questions on where the project is located.

NRP – PERCEPTION AND PREFERENCE
3.1b-b

Low-rise blocks of traditional architectural form of distinct roofing. There were no positive nor negative responses, except for a few remarks saying that the style looks similar to a dormitory building, and that it is also looking like a “Harry Potter” house.
3.1b-c

Traditional low-rise housing form, characterized by generous spacing and lush landscaping.

Residents refer to the HOUSE in relation to buildings they recall in other areas in the town although it is not. The image was appreciated for its landscaping and trees. According to residents, this would have been made a better impression with a bit more variability and...
Modern low-rise form with varied textures and colors but of similar shapes and profile. The image received not so positive impressions from the residents, such as the design is similar to that of department stores and electronic hubs.
A very modern architectural form using simple geometry colors.
The design and style did not attract any reaction from the respondents.
A diverse and geometric forms and colors.

"Tens". Residents liked the facade treatment for being fresh and condominium style looking, as well as individually and variability. To them, it is something that can be proud of. Balcony is also appreciated. One remarked that there is a "twist", in the design.
3.2 Pagkakaiba-iba ng mga uri at pagkakahalo-halo ng mga bahay

Diversity of housing types and mix
3.2a

Current housing form.
Residents quickly recognized the setting for the image.
Diversified block heights and color treatment.

Respondents expressed approving remark for the design. Softness in between the buildings, presence of gardens and plants, the overall look and feel of the place. Some of the remarks included, "has a casual (vibrant)" looks like a "real house", not a "housing program".
Repetitive mid-rise housing blocks.
Residents remarked that they can easily get lost in a place like this. One said, “Bawa ang tanga! (Stupid people are not allowed)”
3.2d

Moderately diversified blocks using varied color treatments and façade profile, and varying 3 or 4 storeys of block height.

Not much reaction for this photo, except that it has a somewhat commercial feel!
3.2e

Moderately diversified block using different color treatment and various geometries.

Some residents appreciated this image for the choice of colors in the block facades.
Impression of a combination of repetitive forms of low-rise and high-rise housing; traditional and modern forms.

No response was gathered from respondents.
3.2g

Neighborhoods of non-standard block repetitions – all blocks differ from each other. Positive reactions were observed from residents.
## Low-Rise / Row Houses

1. Repetitive mid-rise housing blocks facade

   **HDB Tampines Ria**

2. Moderately diversified housing block using colors

   **Affordable Stapleton Apartments**

3. Modern and moderately diversified block using a range of color tones

   **Glennrio Apartments**

4. Showing an impression of a combination of repetitive forms and varied housing types (low & high rise)

   **Old Town Village West Townhomes with William Green Homes High-Rise on the background, Chicago**
   - Retrieved from: [https://chinajournal.org/assets/files/202012/12/sh_09.jpg](https://chinajournal.org/assets/files/202012/12/sh_09.jpg)

5. Non-repetitive block configuration and style

   **Low-income Housing, USA**

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**MOP – PERCEPTION AND PREFERENCE**
Part 2
1.0 Pananaw ng mga Residente tungkol sa Pagtira sa Mababang Palapag na Pabahay

Residents’ views on low / mid-rise living
Initial Concerns Raised by Residents Regarding Mid-Rise Living prior to showing the succeeding impressions:

- Safety for children
- Difficulty in using the staircase especially for the elderly in the absence of elevator
- Privacy
- Difficulty in moving around
- The property is seen to be "never owned" by the residents
- More prone to fire hazards and earthquake
- Accessibility is an issue
- If living in mid-rise, residents are willing to reside on the 2nd floor only.
- Only 1 respondent is willing to live on the 3rd floor
- If with elevator, only 1 respondent is willing to stay in an elevator
Due to the absence of land or the high price of land, 3 to 5 story options are more viable.
Apartments with units at ground level. The concept is well-received by respondents.
2.0 Pananaw ng mga Residente tungkol sa Pagtira sa Mababang Palapag upang magkaroon ng mas malalaking “open spaces” at “green spaces” para sa komunidad

Residents’ views on low / mid-rise living to open up more spaces for greenery and open areas for community activities.
<table>
<thead>
<tr>
<th>Interview Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 The following images were shown to residents in order to explain the benefits and trade-offs of mid-rise living</td>
</tr>
</tbody>
</table>
Interview Questions

Fig. 2a Morningside Village. Source: http://www.ajcp.nodes.com/nodes/mod/l3/11532460004/c2460004/166512460004/166512460004.html

2a

Open spaces on ground floor area

WCP – PERCEPTION AND PREFERENCE
Fig. 2c: Beyond New Urbanism.
Source: http://www.cadillacarter.com/urbanism/
More activity areas and open spaces
2e

Central courtyard space

Fig. 2e Green Courtyard at Cosmo Gate in England
Source: http://www.cosmogate.co.uk/green-court
3.0 Pananaw ng mga Residente sa lokasyon ng mga pamilihan kagaya ng mga convenience / sari-sari store, drugstore at iba pang mga pangkomersyal na gamit
Residents' views on location of commercial spaces within the neighborhood.
Central Commercial (separate commercial spaces) - 10 votes
1 - Central Commercial (separate commercial building)  
10 votes

New Urbanist Town of Queensville

[Image link]

2 - Ground Level Commercial Spaces - 0 votes

Affordable Units in San Leandro

[Image link]
The following are the residents’ responses to mid-rise living after images were shown and benefits and environmental impact were presented:

- Durability of buildings during earthquakes or other calamities
- Not more than 5 storeys
- The desire to be grounded
- Desirability of 2nd story
- 1st story can be noisy and less private
- Security of tenure and long-term ownership
- Ownership is key
- Water problems
End of Interview
APPENDIX 2
COST ESTIMATES

The following are detailed cost computations of the proposed design scheme:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MATERIAL COST</th>
<th>LABOR COST</th>
<th>ESTIMATED DIRECT COST</th>
<th>TOTAL INDIRECT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. EARTHWORKS</td>
<td>1,010.80</td>
<td>2,813.44</td>
<td>3,824.24</td>
<td>535.39</td>
<td>4,359.63</td>
</tr>
<tr>
<td>II. CONCRETE/STRUCTURAL WORKS</td>
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**ROW HOUSE BASE SCHEME**

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<th>TOTAL INDIRECT COST</th>
<th>TOTAL COST</th>
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<td>22,073.49</td>
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<td>7,084.00</td>
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## Project: ROW HOUSE OPTION 1  
**Location:** San Jose Del Monte, Bulacan

### ITEMIZED COST BREAKDOWN & BILL OF QUANTITIES

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<tr>
<td>Backfilling</td>
<td>2.15 cu.m.</td>
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<td>22.00 sq.m.</td>
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<td>550.00</td>
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<tr>
<td>Gravel Bedding</td>
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<td>460.80</td>
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</tr>
<tr>
<td>Tie Wire</td>
<td></td>
<td></td>
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<tr>
<td>10mm Ø x 6m</td>
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<tr>
<td>VI. WINDOWS</td>
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<td>7,008.00</td>
<td>7,008.00</td>
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<tr>
<td>VII. PLUMBING WORKS</td>
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<td>14,557.32</td>
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222
## PROJECT: ROW HOUSE OPTION 2
**Location:** San Jose Del Monte, Bulacan

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<tr>
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<td>Soil Poisoning</td>
<td>22.00 sq.m.</td>
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<td>550.00</td>
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<tr>
<td>Gravel Bedding</td>
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<td>460.80</td>
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<td>S-1 Sand</td>
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</tr>
<tr>
<td>G-3/4 Gravel</td>
<td>9.37 cu.m.</td>
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<td>Tie Wire</td>
<td>79.00 pcs</td>
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<td>13,193.00</td>
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<tr>
<td>10mm Ø x 6m</td>
<td>108.00 pcs</td>
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<td>CHB 150mm</td>
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<td>6,990.00</td>
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**BLOCK B**

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## ITEMIZED COST BREAKDOWN & BILL OF QUANTITIES

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<td><strong>GRANT TOTAL</strong></td>
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BIOGRAPHICAL SKETCH

At the “Singapore Green Building Week 2015” held at the Marina Bay Sands, Singapore asks the question, “What will green buildings look like in 2050?” The prospect of a “green” future seems to be close at hand. In a media release by Singapore’s Building Construction Authority (BCA), CEO Dr John Keung, highlights Singapore’s vision of “greening” 80% of its buildings by the year 2030.

On a comparative note, the Philippines (my country of birth), has only recently started to grow a positive awareness of sustainable buildings (or sustainable living). In an interview, Raymond Rufino, Chairman of the Philippines Green Building Council, has pointed out that relevant building industry players are only beginning to recognize “green”-labelled products. However, despite the influx of these “green” materials worldwide, the local market has not yet demanded enough of these, for the same reason that these materials are sparse and yet to be made easily or economically available. This vicious cycle then contributes tremendously to the very slow integration of green buildings into the practice of Architecture in the Philippines.

Undeniably though, so-called “green buildings” in the Philippines are starting to rise; although from an observer’s standpoint, they seem to me, as merely superficial edifices. Government initiative, involvement and mandates are lacking, if not totally absent. Environmental and Sustainable Design classes are made part of the college curriculum, but most often, imparting very little understanding why - why environmental sustainability needs to be taught and why we need to learn this by heart.

My Values and Aspirations from Childhood.

From my earliest recollections, my aspirations as a child, has always been set quite high. I have always looked up to achievers and dreamt to be like them. There was not a slight pressure from my parents, not from a single member of the family, and yet, there was always an eagerness and a strong desire within me to progress, to look out and to seek for greater possibilities. Back then, I was quite shy, and yet inquisitive in my own quiet ways; I had preferred to converse less and do more. I had consciously made tremendous efforts to go an extra notch when fulfilling instructions and submitting school works and projects. No part of the process was effortless, and not a single output, a mere product of natural and inherent talents and skills. Each one of the merits I have achieved is fruit of diligent work and a determined attitude.

However persevering though, I thought I was not very prepared for a big turning point in my life that was college. When I chose my bachelor’s degree in Architecture, I was looking at my future from a very personal and limited viewpoint. I have evaluated the course of my decision-making based on my strengths and personal interests alone. To me, there was no prospect or care on the interests of humanities and our society in general; not the air that we breathe, not the world that we inhabit. Back then, it was just me and my personal aspirations, but this would have changed quite drastically over time.

My Undergraduate Projects - Learning the Value of Good Research.

One of the memorable and exciting design challenges from my People & Environment Studies class, during my fourth year in the University of the Philippines, College of Architecture, was to rationalize and create a truly Filipino Home. It would have seemed quite a simplistic and commonplace design task. I had nearly jumped into tailoring my approach and methodologies on vernacular architecture alone, until I realized what the specific assignment truly required - an
understanding of human nature first, before architecture. It entailed a great deal of research on the Filipino cultures and societies, its evolution and history, before translating these into spatial requirements and then enclosed into forms. This has prompted an involvement of research and critical thinking in my search for design solutions and getting to know the “heart” of any specific task before jumping into superficial solutions.

I undertook a “research-based” undergraduate thesis, in collaboration with two other peers. Our study focused on daylight and visual comfort, specific to elementary school facilities in the Philippines, where too little research is employed on how to optimize daylight during school hours, while keeping to desirable visual comfort levels. The methods were simple and straightforward. Lighting levels were measured via “Radians” simulation study models, compared and verified against levels taken from an actual scaled model. Various fenestration typologies and sizes were tested on different building orientations and specific sky (daylight) conditions. The results were reliable and helpful in school planning and designing for energy efficiency. In several public school facilities within remote areas that are deprived of electricity, the study offers inexpensive and effective design solutions to address the inadequacy of lighting when performing daily tasks within the classroom environment. The significance of the study is its specific relevance on a classroom setting within the unique social and economic context of elementary schools in the Philippines.

**The Start of a Meaningful Career with an Aim to Understand our Environment Better.**

My fervent aspiration to become a better architect has brought me to Singapore, where I have decided to practice long enough, to gain sufficient experience and expertise. With its reputable portfolio in the field of architecture and construction, there was no doubt that the country has a lot of opportunities to offer young architects as myself.

For over a decade of persevering enforcement, Singapore has successfully implemented the Green Mark (GM) program via its Building Construction Authority (BCA), launching incentive schemes, year after year, to encourage players of the building sector to be green and sustainable. One major Client / Developer of an ongoing job, in collaboration with a renowned hotel group, has pushed for GM certification, with an incentive worth an additional 2% of the allowed gross floor area, outweighing intricacies imposed by up-front investments, intense and thorough selection of building materials and systems, meeting all other stringent requirements put forth by relevant authorities. Such is the story of most green buildings in Singapore.

It is quite typical to hear the same questions asked by developers over and over again, “What’s in it for us?” The incentive-based approach had only developed an insincere attitude towards sustainable buildings and is clearly not the way the entire concept should be perceived. Care for the environment and love for the future generation is foremost and this has to be understood by all and taken to heart. Green Mark is an excellent quantifying tool for energy efficiency and must be further developed to keep up with the positively growing trends in sustainable buildings. However, beyond scoring points and reaping rewards, I believe that the only real way-forward is in imparting to all, a sense of social and environmental entitlement that can only be achieved through education.

**Looking Ahead – My Academic Journey.**

The traditional method of creating buildings from ideas, relationships, desires, necessities, emotions, human experiences now seemed incomplete when detached from context; the piece of land upon which a building is erected, together with the natural elements of sun, breeze,
humidity, wind, rainfall, vegetation and other factors that are unique and characteristic to the place.

I perceive myself as moving into this course, with my country and the future of its people in mind. I want to learn to develop effective strategies when dealing with varying scenarios and execute these strategies with both precision and flexibility. I want to look at how government initiative and mandates can effectively implement sustainable buildings. I am interested to know how “green” building materials can be made accessible to all building typologies and all sectors of the industry regardless of financial capabilities. I want to help my country.

My informal education on green and sustainable practices in architecture, through immersions and exposure to relevant "green" projects, however significant, is something that I feel to be inadequate. A proper learning environment, with people of equal passion to easily communicate with and mentors who desire to provide genuine guidance will help me immensely to have a better understanding of Green Architecture and hopefully, to help me develop a method of thinking and creating that effectively implements a truly sustainable architecture.

I hope to be truly knowledgeable on sustainable architecture until a point where it becomes a second nature. I want to live it and teach it and help others, especially the young architects and designers of my country, to understand truly and fully what it is. And I dream that every piece of architecture I will build to not be different, but effective, sensitive and meaningful.