THE EXTERNAL BUILT FORM OF DRYING AREA DESIGN IN HIGH - RISE RESIDENTIAL BUILDINGS IN MALAYSIA

By

LEONG HUNG SEK

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Lee Kong Chian Faculty of Engineering & Science,
Universiti Tunku Abdul Rahman,
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ABSTRACT

A simple yet necessity of daily living are to wash and hang laundries to dry. However, in developing countries, adequate drying area or space for laundry in some of the high-rise residential settings are often neglected. In reality, 'hanging laundry syndrome' is an act or habit of blatantly exposing laundries in public view along the building perimeter or façade, with some confined to internal space of the buildings such as bathrooms or internal corridors. This not only inconvenient the residents but create unsightly cityscape. This study intends to explore a social phenomenon from perspectives of human habitual practice and it's inter-relations with the built environment. It will focus on commonly found high-rise residential typologies in Malaysia in discussing the issues and to propose some possible solutions to improve the situation.

Data derives mainly from observation study and sampling survey. The analysis from observation findings is discussed in three parts; i.e. Division according to building typologies, layout and how these affect the laundry practices; division following social stratification of public low cost, private middle cost and high-end housing; and observations in selected housing estates. In addition, sampling questionnaire surveys were carried out at properties fairs in three different states. The survey was tabulated mainly in Likert Scale and analyzed through using Chi-Square tests and cross-

tabulations; it has concluded that socio-cultural elements are not significant factors influencing the preferences on the laundry practices. This is somewhat in contrast with the observation findings, which identified distinctions in habitual laundry practices within several building topologies and housing categories, i.e. whether public or private initiated or low-income or luxurious types.

The study discusses some underlying factors contributing to the dichotomy. The dissertation ends with some preliminary ideas that could be useful in uplifting the current situation. The proposed solutions have taken into considerations criteria on sustainability, costs effectiveness, practicality in mind; and highlight the importance of overall building integrity, form and geometry. The adoption and implementation however, would depend on possible commitment from the society, resident associations, professionals as well as the authorities to resolve the dilemma.

AKNOWLEDGEMENTS

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APPROVAL SHEET

This dissertation/thesis entitled "**THE EXTERNAL BUILT FORM OF DRYING AREA DESIGN IN HIGH RISE RESIDENTIAL BUILDINGS IN MALAYSIA"** was prepared by **Leong Hung Sek** and submitted as partial fulfillment of the requirements for the degree of Master of Science at Universiti Tunku Abdul Rahman.

Approved by:

_____

(Dr. Lim Poh Im) Date:……..
Assistant Professor/Supervisor
Department of Architecture & Sustainable Design
Lee Kong Chian Faculty of Engineering and Science
Universiti Tunku Abdul Rahman

_____

(Dr. Chia Fah Choy) Date:……..
Associate Professor/Co-supervisor
Department of Surveying
Lee Kong Chian Faculty of Engineering and Science
Universiti Tunku Abdul Rahman

LEE KONG CHIANG FACULTY OF ENGINEERING AND SCIENCE

UNIVERSITI TUNKU ABDUL RAHMAN

Date: _____

SUBMISSION OF DISSERTATION

It is hereby certified that **Leong Hung Sek** (**ID No:13UEM03505**) has completed this dissertation entitled **"THE EXTERNAL BUILT FORM OF DRYING AREA DESIGN IN HIGH-RISE RESIDENTIAL BUILDINGS IN MALAYSIA"** under the supervision of Dr Lim Poh Im (Supervisor) from the Department of Architecture and Sustainable Design, Lee Kong Chiang Faculty of Engineering and Science, and Dr Chia Fah Choy (Co-Supervisor)* from the Department of Quantity Surveyor, Lee Kong Chiang Faculty of Engineering and Science.

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Leong Hung Sek

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DECLARATION

I hereby declare that the dissertation is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

Name : Leong Hung Sek

Date _____

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CHAPTER 1

INTRODUCTION

1.1 Background and Issues

In Malaysia, generally the current building typologies can be linked to the buildings emerged since post-independence in the sixties. Many of the high-rise low-income housing in cities grew rapidly as a result of government efforts of resettlement and resolving urban slums. The government thereafter implemented a housing policy under the Five Year Malaysia plan (FYMP). Part of these FYMP was to be able to fulfill housing catering to the growing lower income groups (Hassan, 1977).With technology advancement in the 80s to the 90s high density vertical high-rises were built. These early vertical high-rise housing were built solely to cater and fulfilling the housing quotas within the stipulated housing policies of the FYMP.

The initial vertical high-rise affordable housing was four to five storey walk-up flats having basic one or two bedrooms fronting a common corridor (Fig. 4.1 in page 64 and Fig. 4.4 in page 66) In the early high-rise housing, the

building typology and unit details layout were very basic consisting one room, toilet, bathroom cum small kitchen and living cum dining area. The total built-up area was around 33m to 38.7sq m. As the nation developed and advance, various incentives and housing policies were implemented by the government to entice developers to build low income housing thus resulted to the current varieties of high-rise typologies and layouts (Shuid, 2015).

By and large the different varieties of high-rise residential buildings in Malaysia have thus far, paid attention to the aspect of laundry drying issue, whereas this aspect has huge impacts on the building facades and cityscapes. As a result, the city skyline in Malaysia have become synonymous to this iconic syndrome, an eyesore constantly encapsulates the building envelopes of many high-rise residential blocks. At present, neither the designers, architects, developers nor the authorities have given much attention to this phenomenon. The local building by-laws such as Uniform Buildings by-Law 1984 gave no specific rulings pertaining to exposed laundries (Uniform Building By-Laws 1984).

1.2 Research goals and objectives

This dissertation explores how existing habitual practice of "hanging laundries" can be designed in a way to fulfill the needs of the occupants while complimenting the external built form and facade of the building.

Specifically, the objectives are set as below:

1.2.1 To examine whether drying-area are integrated with external building façades in different types of high-rise housing and building typologies

As there are many types of high-rise buildings in Malaysia, which can be categorized into several categories, i.e. public or private funded, lower and upper ends, as well as the different typologies in building form and layout; it will be interesting and essential to examine and establish the differences among them, in terms of how and whether they have addressed and integrated the aspect of laundry drying properly in these schemes.

1.2.2 To identify and ascertain whether occupants' social-cultural background contribute to choices and preference of drying clothes

Does social-cultural background differ in their preferences on ways and location for drying space? In Malaysia, the different ethnic groups and their cultural practices does play a major influence in the city landscape as well as the micro living environment. Different social strata have their own sub-cultural habits influencing their lifestyles and the resulting physical and surrounding environment. By studying or observing the existing habitual societal practices and lifestyles, we can understand the reasons behind the "hanging Laundry" syndrome mushrooming in the cityscapes.

1.2.3 To establish possible solutions to the issue of laundry in residential high-rise buildings

This study will look into factors that shape and influence the current situations. This include reviewing provisions in regulations such as the building codes such as UBBL (Uniform Building By Law), state regulations such as Selangor Building By-Law and the green building assessment tools such as Green Building Index (GBI). The study will highlight and identify the strengths and weaknesses in each, and possibly explore possible avenues to reinforce current building codes to overcome the dilemma.

1.3 Research Strategy

Two investigation methods were adopted for this research, namely site observation at selected buildings and ground survey interviews of potential high-rise dwellers. Three building types were pre-selected based on a dichotomy of the physical form, social and economy strata group. The physical sitting of the three pre-selected buildings is based on the social strata group and location of the drying area were analyzed to ascertain or reinforced whether the actual physical building and the social strata have any governing or influencing factors on how the laundries are dried. Secondly, questionnaires were used targeting potential house-buyers. Data from both methods will be triangulated together with secondary resources to fulfill objectives of this research.

1.4 Outline and Organization

This dissertation will be organized in seven chapters. Chapter 1 provides a brief overall summary of the laundry syndrome in Malaysia together with the overall strategy, research intentions and objectives; Chapter 2 consists of literature review on the topic, from building science and climatic standpoints to building regulations and environmental assessment; Chapter 3 describes research methodology in details; Chapter 4 reviews current high- rise layout and typologies in Malaysia; Chapter 5 presents the results and analysis and analyzes the differences between private and public housing; Chapter 6 discusses possible solutions for existing high-rise residential buildings in overcoming their current laundries location; while the final chapter, Chapter 7 provides a conclusion, highlighting key findings, discuss achievements of the objectives and possible areas for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses issues contributing to building design, including aspects on policies, climatic factors, design geometry, current housing regulations and green building policies. Aspects of climatic conditions, building codes and recent advocacies on green and sustainable living will are reviewed to explore possibilities and constraints pertaining to the element of drying area in high-rise buildings.

2.2 Housing Doldrums

Since the 1960s, over the span of forty odd years, Malaysian government has launched various low-cost public and affordable housings schemes to fulfill the needs for mass housing. Although generally it has managed to satisfy the housing needs of the populace, some of these housing schemes have not been able to achieve a wholesome livable environment (Tan, 2012). The lack of understanding in addressing societal issues, coupled with the lack of attention to design of interior spaces, are major factors contributing to the on-going doldrums. House-buyers' preferences and needs constantly require upgrading.

Foley (1980) commented that the ability to fulfill the public needs is crucial in a successful housing policy.

Owning a home is a multi-dimensional facet. House buyers will consider various housing attributes. These attributes can include as tenure options, the types of housing, neighborhood and locations (Hurtubia,2010). Housing attributes can be summarized into two types, i.e. extrinsic and intrinsic attributes. Extrinsic attributes refers to exterior design of the building façade and public space (Ibid, 2004) while intrinsic attributes liken the interior living spaces (Cupchik, 2003).According to Krier (1992) the overall external building façade reveal about inhabitants' lifestyles and living habits and give them a collective identity as a community. Thus, there is a need to look in wider settings to ensure success of the public housing schemes.

Figure 2.1: Laundries drying in the sixties
Image :https://www.teoalida.com/world/

In Malaysia, the bulk of current low income and affordable housing schemes are built both by government as well as private sectors.

Understandably private sectors when given the tasks to build lower costs housing, are merely trying to fulfill the requirements and housing quotas set forthby the government. This is fulfilled by apportioning the costs from the housing development through cross-subsidy strategies.

Figure 2.2: Typical housing façade of low income housing. Image from own source

In many cases, this is also carried out through lowering the construction costs in the low-income housing construction, which resulted in sub-standard and defective housing (Bajunid, 2009). When the basic necessities are met, i.e. having basic shelter over their head, the lower income group will less likely to consider details of the housing attributes. Thus, the challenge falls on the government in raising the living standard for this group.

In 2013, People's Housing Program or Program Perumahan Raykat (PPR) was implemented ensuring household earning less than RM2,500 (USD613) a month can live in homes with better facilities and good environment. The PPR low cost housing came with the facilities such as

minimum floor area of 69 meter square (700 sq. ft. unit area). Each unit must have 3 bedrooms and 2 bathrooms, provision of floor tiles and drying area. In the same year the federal government under MHLG, launched the PR1MA – a house buyer assistance program for households not eligible for normal housing loans. A special finance assistance scheme was set up for the low income households to apply under PR1MA housing projects.

Figure 2.3: Public Housing PRIMA Home.
Image from own source.

The opposition led Penang State Government further enhances the housing policies under their Penang Affordable Housing Projects (PAH) by introducing a scheme where all units are provided with one car parking area, ceramic floor and wall tiles finish, sanitary fittings and electrical installations. The developments must incorporate energy efficient buildings and conducive to the environment. Environmental ratings were implemented based on the Green Building Index [GBI] and the Green Real Estate [Green RE] of Malaysia.

Compared to Malaysia, Singapore is a country that has been quite successful in providing quality modern mass housing to its citizens. The Singapore public housing schemes is provided under the quasi-government Housing Development Board (HDB). The Singapore scenario and success stories did not emerge overnight but gone through several major transformations over many decades, from fulfilling very basic necessity in the 60s,to larger and better design flats in the 1970s, ad-hoc upgrading in the 1980s (Eng, 1996), to choices of pre-selected packages and residents' participation in decision-making in the 1990s, all these have made the residents' house proud by contributing to a livable and better environment.

Figure 2.4: HDB housing drying area orderly arranged.
Image https://www.teoalida.com/world/

The ability and intention to provide spacious living quarters with distinctive aesthetically environment resulted in 1995 when the HDB was conferred with Asian Management Award in Development Management. The

award citation described that HDB had “created substantial positive impact on target beneficiaries through innovation, sustainable and effective management” in improving peoples qualities of life (Straits Time, 1995).

Figure 2.5: HDB housing drying area
Image :https://www.teoalida.com/world/

The success in Singapore HDB public housing was attributed to the fact that the government understood societal issues and constantly reviewed their on-going policies in contributing to the housing attributes (Foley, 1980).

Figure 2.6: Typical public housing in Malaysia built in the 70s.
Image own source.

2.3 Climatic Conditions and Drying Clothes

It has been proven that the benefits of natural air together with sun light are indisputable for drying laundry. The sun/solar provide UV light, and UV can be used to disinfect damp laundry. Microorganisms in damp laundry will be killed when UV light reacts with oxygen dissolved in the water (damp stage) to produce reactive form of oxygen. The sun UV also interferes with the reproduction cycle of bacteria by damaging their DNA. By natural air drying the laundry in the sun, it can help to stop bacteria growth in the clothes without any harsh chemicals formation (Tan, 2012).

` Malaysia is located in the hot humid climatic zone with high temperature, high humidity, heavy yearly rainfall, and limited seasonal changes throughout the year. Under such conditions, buildings are generally designed to prevent heat gain by maximizing heat loss. One way is by removing excess heat through openings or using mechanical cooling devices.It is important to have optimum building orientations to reduce considerable thermal heat gain by minimizing solar penetration. Although it is favorable to have rectangular building configuration that has shorter east-west wall exposure, it is impossible for all buildings having the optimum orientation with rectangular configuration. If building orientation is to be compromised, microclimatic design in the form of openings, recesses, corridors, verandahs or favorable sun shading devices have to be incorporated to reduce thermal heat gain (Mimar, 1992).

Drying clothes requires maximum sun-light exposure. As such, the east-west locations are beneficial taking full advantage of the sun path

direction. The unwanted day-lighting with high intensity solar radiation are advantages for drying clothes. A record from Subang Metrological Station indicated an annual maximum intensity solar radiation of 1000 W/m2 on the horizontal plane while vertical surfaces having 850 W/m2 for both east and west surfaces (Lim, 2012). However, within the Malaysia context, drying clothes in high-rise dwelling indicates otherwise. The laundry lines are common sights along the building facades regardless of building orientation. This shows that drying clothes in the Malaysian weather regardless of building orientation proves no major issue.

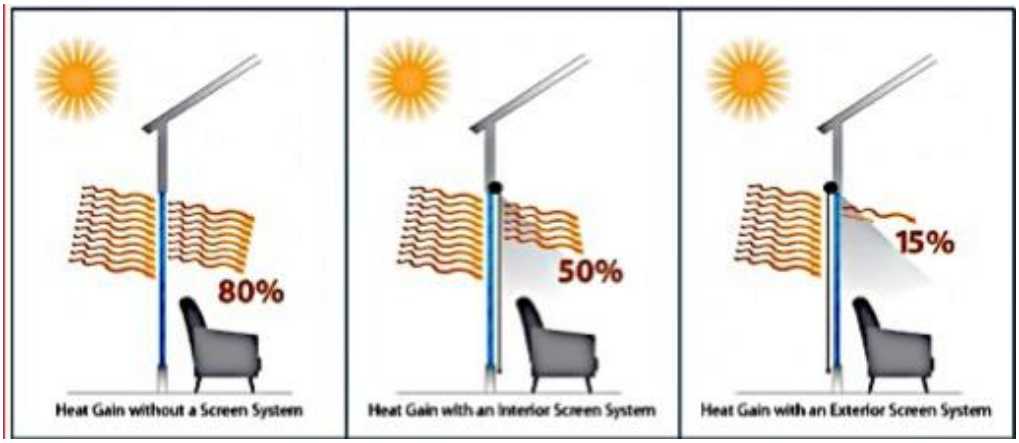


Figure 2.7: Solar heat gain interior of building. Image from (MC, 1986)

2.4 Factors of Ventilation and Window Openings

One of the key components in sustainable buildings design is to introduce solar energy or sunlight into window openings. The opening sizes forsolar penetration can make a significant contributing factor in providing both natural air for drying laundry and energy savings of a building through reducing the consumption artificial lighting. For the drying area to be of significance, two important criteria must be adhered to, i.e.it must be able to accomplish the task while the physical design can express according to its intentional purpose.

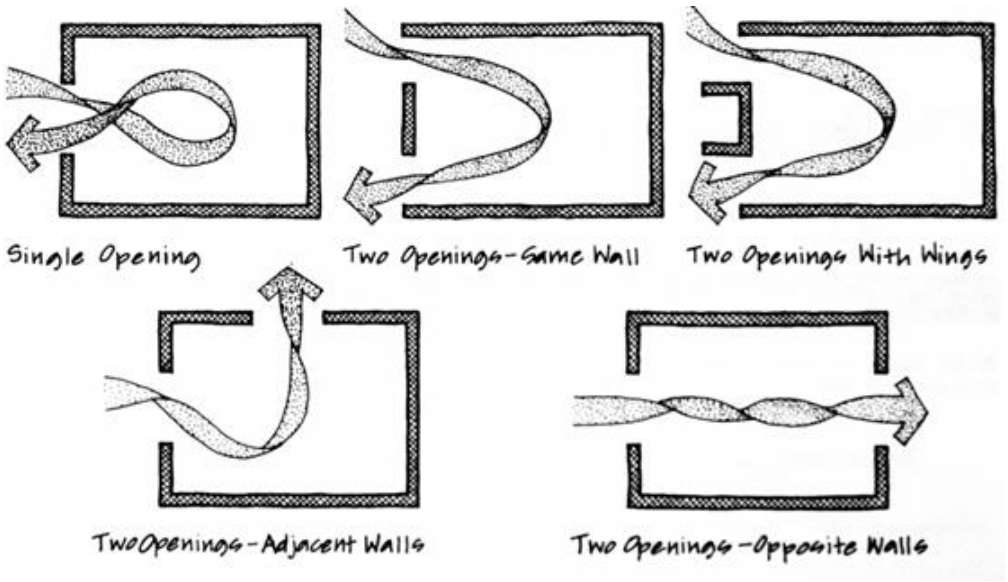


Figure 2.8: Windows opening and ventilation.
Image from (Smith, 2011)

Generally in practice, window openings sizes for inhabitants shall be minimum 8%-10% of the interior space floor area to allow adequate sun lighting penetration. For building having glazed opening, the maximum opening size is approximately 20% to 25% of the floor area. Under the Uniform Building By-Laws (UBBL) all openings must be minimum 10 percent basedon the specific designated total floor area.Excessive heat gain

will occur for open or glazed openings resulting in discomfort for the inhabitants.

However, these applications differ greatly when designing for drying laundries or drying area openings. Openings or glazed openings have to be larger for effective lighting penetration as well as for cross-ventilation to ensure a quicker drying process. The depth of the drying area has to follow the standard balcony width. For effective day-lighting or solar penetration depth through window openings, the openings must have sufficient depth of up to 2 to 2 1/2 times the height of the window measured above the floor. Further beyond the depth, the sun-lighting intensity is varied and not adequate nor effective (Bhatti, 2004).Thus, effective design of openings and depth must consider these factors when designing the drying area.

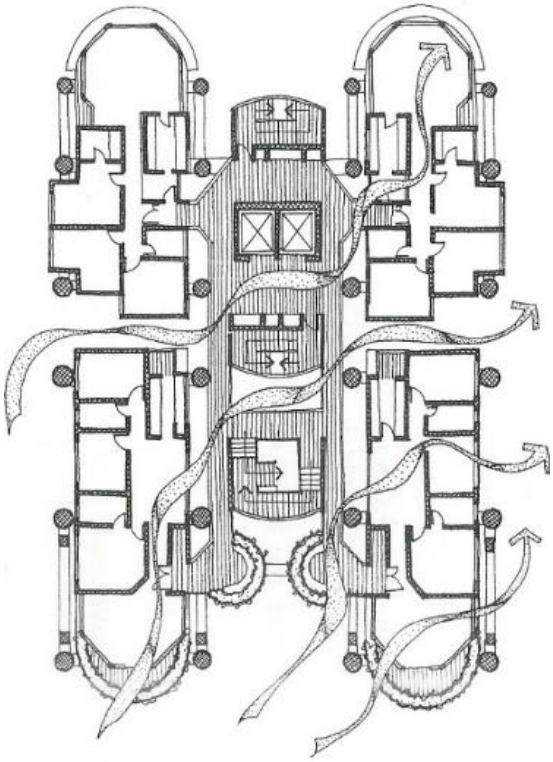


Figure 2.9: Ventilation and openings. Image:Yeang,K.,1992. Designing the tropical skycraper. *Mimar,* pp. 40-45.

Successful window openings for the drying area must take into considerations to provide adequate sunlight, heating and prevent over-heating as well as heat loss. The openings must have adequate ventilations to allow air movement in balancing and off-setting the overall effect in enhancing the laundry drying process.

Other influencing parameters for any openings in considering for the drying area are unit layout, location, geometry and orientation of openings. Square or rectangular openings are effective geometry allowing direct sunlight penetration compared with irregular geometry, which diffuses adequate sunlight to the interior. While the opening area may have a greater influence on solar penetration and heating effect, it is the opening orientation that makes

a difference, in capturing the maximum natural drying effectively, while preventing the unsightly laundry handing. Factors of geometry, location and orientation of the drying area openings further enhances the laundries drying process and aesthetically improve the overall façade and external built form. In addition, incorporating screening panels to screen off the "open" laundry from public view can further enhance the overall effect.

Drying clothes require thermal heat and wind movement to activate ventilation in quickening the drying process. Constant air movement is essential for clothes to dry. The space for drying area constantly needs air movement/ventilation to fulfill its essential function. Without these components, the drying area will not be able to perform to the utmost capabilities.

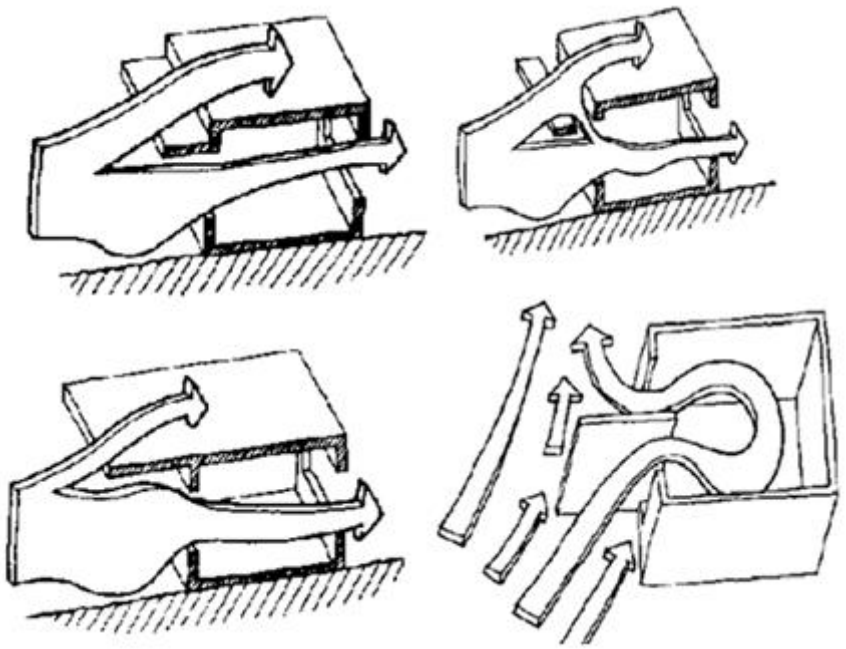


Figure 2.10: Air circulation and openings. Image from (Smith, 2011)

However, the wind speed in Malaysia is generally very low, thus inadequate ‘window’ openings will result in poor ventilation and air movement. The totality within the overall building layouts must be viewed with locations of openings, recesses, corridors/verandas, courtyards, windows orientations and the overall site context crucially affecting the wind patterns (Krier, 1992) One has to identify the optimum location for the drying area in residential high-rise where a detailed analysis of the wind and energy flow patterns is crucial.

In Malaysia, both service and residential buildings generally consume 70% (seventy percent) of total energy consumption (Mahlia, 2010) The bulk of the consumption can be attributed to the use of the HVAC systems in providing for human comfort. However the installation of mechanical operated laundry dryer or drying is not accounted in the 70% of the energy consumption. Mechanical operated laundry dryer are less favorable by the masses partly due to economic reasons such as monetary cost. The assumption that clothes can be easily dried under the sun also dampens this consumption usage.

Nikolopoulos (2010) in a study on “Numerical study of a naturally cross-ventilated building”, has shown that the wind flow pattern stimulation around the building and tunnel effect successfully provide data in considering the optimization the building energy usage. It has provided a detailed wind patterns flow and the natural cross ventilation both for internal and external of the building based on the induced details air flow patterns. The data accurately

conclude that designate “openings” providing wind pressure and air velocity by factoring the building geometry, opening area of building positioning and surrounding building parameters. The study confirmed that other than the building geometry openings and the wind incidental angle, the magnitude of the wind velocity played an important role on the air change rate or building ventilation due to its proportionality of the inlet volume flow rate. The analysis can be one of the tools for designers to identify and capture the key data essence in ascertaining the key optimum location for the drying area

2.5 Provisions of Related Regulations

The choices in controlling the local climatic conditions in relation to ventilation are wind speed, humidity, and air temperature are limited. The only process within the jurisdiction and control of the architects and designers are façade designs making full use of thermal properties in choice of materials, building orientation, windows openings and effective shadings. There must be consideration in passive or indirect ways to get rid of heat within this confined space by allowing adequate ventilation.

In United States there are no standard building uniform by-laws or guidelines on window openings per se (MC, 1986).Assumption can be noted due to the fact the country’s geological factors of a vast nation having diverse and adverse climatic conditions. However under the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) it has

mentioned a minimum of four percent (4%) of the floor area. Australia on the other hand, under the Building Code of Australia (BCA) with reference to window openings and ventilation, allows approximately a minimum of ten (10) percent of the room floor space. Closer to home, in Singapore, under the Building and Construction Authority (BCA), it also allows for no less than five (5) percent of the room floor area. With reference to these countries, we can safely assume the successful drying area design have to take into these climatic considerations of the local context.

Under the Malaysian building code, i.e. Uniform Building by Law 1984 or UBBL 1984, there is no specific provision for drying area. The nearest is the provision for natural ventilation openings, which should be 10 % of the size of a given room floor area (UBBL, 1984). In addition, there was no specific indication about the function of the openings. General assumption will be for air to flow through windows or allowing external air-borne to flow into the building interior or vice versa. It is interesting to note the regulations in manycountries have common similarities with the Malaysian UBBL, whereby the building openings shall have the minimum 10 percent of the room floor space.

2.6 Geometry and Façade Design

As Lam (1960) puts it, “When buildings are designed to take into the account of the natural sunlight, one can witness the marked difference between great

architecture and mere building". The aesthetic appeal of the building can largely be determined by the skills in manipulating the maximum sunlight by the designers or architects.

The overall appearance of the interior is how sunlight and shadows are rendered to create a certain ambient quality. This ambient quality of the interior can be enhanced by the details of the drying area in terms of layout, size and area location along the building facade. Smith (2009) identified that the depth of day-lighting illuminates into the interior space is generally two to two and a half times of the original light source from the 'window' opening. The drying area or 'window' openings and the area orientation, play a deciding factor to ensure adequate sunlight are able to illuminate the interior space.

Figure 2.11: Façade geometry. Image own source.

As reiterated earlier, the depth of day-lighting penetrates into the interior is two to two and a half times from the “window” openings. Beyond this, the lighting levels will reduce. The drying area therefore must take this into account since it is crucial in allowing sunlight penetration. The interior thermal temperature will be another determining factor to ascertain the success of clothes drying. Crucial considerations must take into account on the spatial floor layout, the depth or width, and the geometry layout of the ‘window’ openings in relation to the façade design.

In “Elements of Architecture”, Krier (1992) proposed that interior space can be identified by its boundary – walls, piers, ceiling and floor.

Windows and openings serve as a connection with the exterior. The space can be described by its size, proportion (relationship between length, height and width) and room geometry can be recognized through the varieties of forms either square, cube or mixed together. The relationships of the window and the interior space is further enhanced by the window function as light source and its great importance in allowing light penetrating to the interior. Light ray penetrate into the interior space also create light and dark zones namely shadow.

Thus, the geometry layout and the 'window' openings are two major considerations that will have major impact to the building design and the function of drying area. By exploring the geometry layout plan whether square, triangle or circle and by transforming into the vertical or three dimensional shapes, certain parameters and conclusion can be drawn.

2.7 Connections between drying area and sustainability assessment of buildings

Drying area is an element that potentially influences the energy consumption of buildings. This is due to it's the ability to harness the existing energy within its environmental context without consuming any mechanical operated devices. In Malaysia, sustainable or green assessment of buildings is initiated manly by two bodies, namely the Malaysia real estate properties group (REDHA) and the Malaysia Architects Association or Pertubuhan Arkitek

Malaysia (PAM). GreenRE is a sustainable assessments tool of REHDA while Malaysia Green Building Index [GBI] was a tool initiated by PAM. The aim of these green building assessment systems are to ensure all facets of the proposed buildings design are assessed based on their environmental performances. This is to encourage sustainability and reduce dependency on mechanical operation based on 'green' solutions. In general terms, green sustainable buildings should takes full advantage of the existing environment conditions and use minimum mechanical energy with low or minimum wastages.

2.7.1 GreenRE Assessment by Association of Real Estate and Housing Developers (REDHA)

GreenRE is the sustainability arm of (REHDA) Malaysia to promote sustainability within the property industry. It is recognized as one of the leading building certification in Malaysia and it is also accepted by the federal government for their tax incentive schemes. The aim is to at promote greater adoption of green practices and technology amongst the real estate corporations. The green certification is based on points scoring systems in crediting the various energy efficiency design, practices and features used. The higher the scores accumulated, the better is the building efficiency. The certification ranges from Bronze, Silver, Gold and Platinum.

Some of the assessment criteria of GreenRE related to drying area are:-

Part 1 – Energy Efficiency

This topic focuses on the building design and system to optimize the building energy efficiency.

Part 4 – Indoor Environmental Quality

This category focuses on the design strategies that can enhance the indoor environmental quality of the air, thermal comfort, acoustical control and day-lighting.

Part 5 – Other Green Features

The ability to adopt green practices and new technologies that are innovative and having environmental potential benefits.

2.7.2 Green Building Index [GBI] by Pertubuhan Arkitek Malaysia [PAM]

Green Building Index [GBI] is initiated by PAM. It is a rating for completed buildings based on the overall efficiency use of natural resources such as energy, water and materials usage, and how the building are able to impact the inhabitants' lifestyle through the building sitting, design, construction and the overall operation maintenance efficiency.

There are a total of six key criteria for the Green Building Index [GBI]. Out of the six, three criteria are related to drying area, namely: Item 1 Energy Efficiency [EE], Item 2 Indoor Environmental Quality [EQ] and Item6

Innovation [IN]. The details breakdown of the Green Building Index [GBI] can be referred in Appendix I.

2.7.3 Comparing REDHA GreenRE and GBI

By comparison both the sustainable assessment base on the green assessment criteria that are related to drying area, it is found that both tools has almost the same items as in Table 2.1 below.

Table 2.1: Redha GreenRE and GBI Comparison

Redha GreenRE		Green Bldg Index (GBI)	
Part 1	Energy Efficiency	Item 1	Energy Efficiency
Part4	Indoor Environment Quality	Item 2	Indoor Environment Quality
Part5	Other Green Feature	Item 6	Innovation

Item 1: Energy Efficiency [EE]

Energy consumption improvement by optimizing building orientation, minimizing solar heat gain through the building envelope, harvesting natural lighting, adopting the best practices in building services including the renewable energy, ensuring proper testing commissioning and regular maintenance.

Item 2: Indoor Environmental Quality [EQ]

Indoor air quality, acoustic, visual and thermal comfort will involve the use of low volatile organic compound materials, application or quality air filtration, proper control of air temperature, movement and humidity.

Item 3: Innovation [IN]

Any innovation design and initiatives are able to meet the objectives of the GBI index.

Energy Efficiency

Both GreenRE Part 1 and GBI Item1-Energy Efficiency [EE] have highlighted minimum the use of non-mechanical operated energy. This is to ensure the ability to fully capture and optimizing natural resources. The design for the drying area within this context has the ability to capture full advantages of sunlight in ensuring laundries is effectively dried without any mechanical assisted devices. A clearly defined designated drying area for individual dwellers units will further reinforce the success of Part 1 and Item 1. Energy Efficiency [EE].

Indoor Environmental Quality

The interior air movement for the drying area is largely contributed by the geometry and the size of the opening. The geometry and layout of the drying area opening play a crucial part in allowing air movement from exterior to the

interior of this space. Different geometry patterns will either maximizing volume of air into interior space as compare with screen vent blocks which filter and substantially reduce air to the interiors. A simple large square or rectangular openings in contrast a screen block will definite filter substantially air movement from the exterior to the interior space. It was highlighted that for a normal fly screen installation at the opening window, air movement penetration from the exterior to interior will be substantially reduced by almost 30 percent.

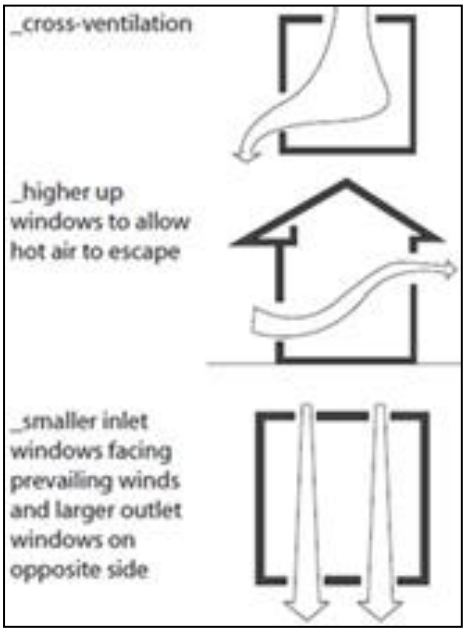


Figure 2.12: Indoor air movement. Image from (Smith, 2011)

Green Features/Innovation

Within the context of the *GBI –Innovation,* the overall space design for the drying area must able to enhance the occupants lifestyle and bring successful contribution to laundries drying process without further eroding the

sustainable environment by using mechanical operating method. The overall design layout and three-dimensional drying area spaces must bring out the design essence and not an afterthought process.

By reviewing the three categories as highlighted in Table 2.1, both assessment tools when reviewed in totality, are able to address the integration of drying area in building design. The use of green assessment can encourage the professions and the authorities to pay more attention to the aspects of drying area, it can potentially provide additional information to potential consumers in making choices to viewing and purchase the houses.

2.8 Clothes Drying Using Rejected Wasted Heat

In Malaysia, due to the hot humid climatic, it is quite common to use air conditioners or condensers'. Unlike newly constructed high-rise condominiums, which has well-designated services locations, the high-rise affordable housing is much lacking in this. There have been some researches done looking at recovering wasted heat from air condensers' as energy source. Mahlia (2010) has proposed using wasted heated to be part of the drying clothes process. The prototype functions to harness and transport/direct the wasted energy to a drying chamber or drying room where clothes are dried. He proposed 'Room Air Conditioner Dryer or RACD. It is to recover wasted

energy. Unwanted or blow out hot air is harvested in an attempt to reduce the use of installing drying machine. In return, the overall process saves electricity bills. The RACD proposals are based on the followings:

1. Limited sunlight (cloudy days) and restricted air flow for house types such as high rise apartments.

2. Natural drying is prohibited in some housing areas due to aesthetic reasons.

3. Conventional domestic electrical dryers are too expensive and inefficient.

Mahlia (2010) concluded that using RACD has many advantages. It was suggested that if a household use air conditioning for two hours daily, with the applications of the RACD, it will significantly shorten the moisture contents in the clothes drying process. The findings were based on :

4. The RACD drying times where temperature is set at 17°C the moisture contents were reduced to 19.05% as compared to 33.33% for clothes dried indoor and outdoor.

5. If temperature set at 21°C, drying times with RACD were 16.67% and 29.17% for the latter drying process.

6. If RACD temperature is set at 25°C, the drying times were 16.67% as compared to 29.17% for outdoor and indoor drying process.

If we take into considerations the assessment criteria of GreenRE and GBI context, the RACD system seems to fulfil the requirements set forth

under Item 1 and Item 2. The potentials in implementing and incorporating this into high-rise residential buildings seem feasible. There is possibility the RACD concept can become a reality especially the proposed Cage Grilles where air condition condensers are located, laundries can be dried using the excessive heat from waste heat coming out from condenser as shown in Figure 2.15 and Figure 2.16. However, to date only a prototype research was available. In reality and practice, there is no real installation found. Further research will be interesting to ascertain the actual performance, in considerations on both the aesthetic and practicality values. Fig 2.13 and Fig 2.14 show the prototype based on a laboratory scenario.

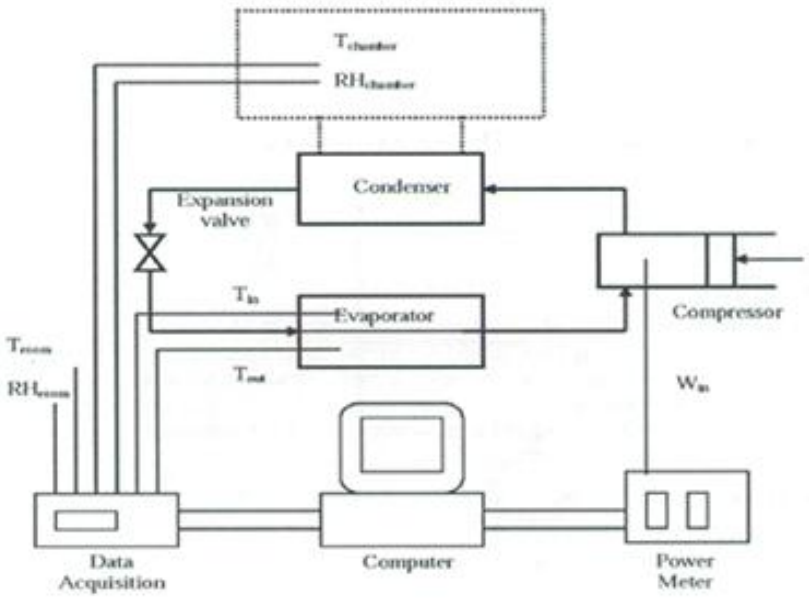


Figure 2.13: Diagrammatic view of RACD (Mahlia, 2010)

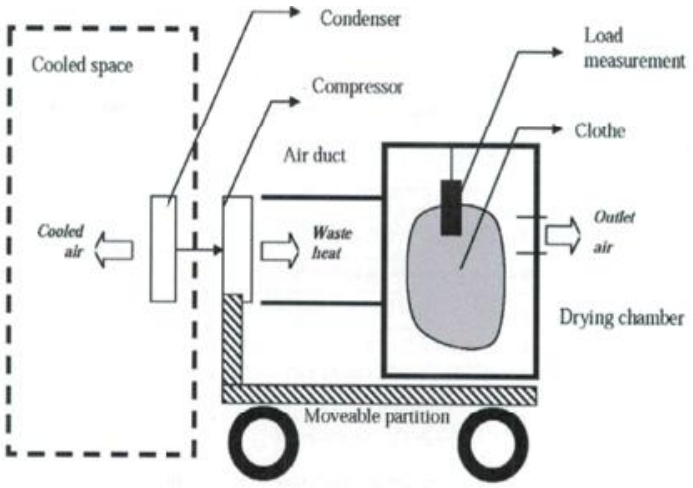


Figure 2.14: Side elevation view of RADC prototype
Image from (Mahlia, 2010)

Figure 2.13: Possible using RACD at laundry area. Image own source.

Figure 2.14: Proposed RACD inside the Cage Grilled where laundry can dried faster. Image own source.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This research employs a mixed method methodology combining both qualitative and quantitative approach in obtaining and analyzing the data. Qualitative data derived mainly from field observation while quantitative data from a sampling survey using a questionnaire. The empirical methods are complimented by secondary resources to arrive to the final recommendations and conclusion.

3.2 Field Observations

Complete Observer method is used to focus on the selected site to provide indicative insights, especially to answer Objective 1 of the study, i.e. examining whether the design of the drying area and how it has integrated to current high-rise residential buildings. The complete observation encompasses observing the overall environmental context, focusing on occupants' habits in locating their laundries and analyzing the general unit layout directly affecting the laundries activities.

Three selected sites comprises of different social strata and income group. They are the public housing - low cost housing, and private housing (both medium and high-end) groups. The three sites were chosen for the field observation due to reasons that they present a clear dichotomy for three social economic strata of high income, middle income and the low income. The observations include the locations of existing drying area, dwellers' habitual routines in drying their laundries, and daily lifestyles. Site visits were conducted for these selected housing types and field notes were collected. The physical layout conditions were analyzed by gaining access into the premises. Issues to consider were including unit and drying area layout, and 'window' openings since both are closely intertwined. Analysis was conducted to ascertain whether the geometry design of these two areas have climatic influences towards the clothes drying effects. This was reviewed from the geometry patterns of the 'window' openings and drying area. The implications and effects were analyzed to ascertain the functionality, the complementary and aesthetic roles.

Other observations include the external built form in relations to the overall facade design. Does the existing drying area establishing the likely success both in the design location? Whether the overall building façade have detrimental or complimenting affects? What are the strengths and weaknesses for the different schemes incorporating the function of laundries? In addition, comparative case study using scenarios from public housing in Singapore were included.

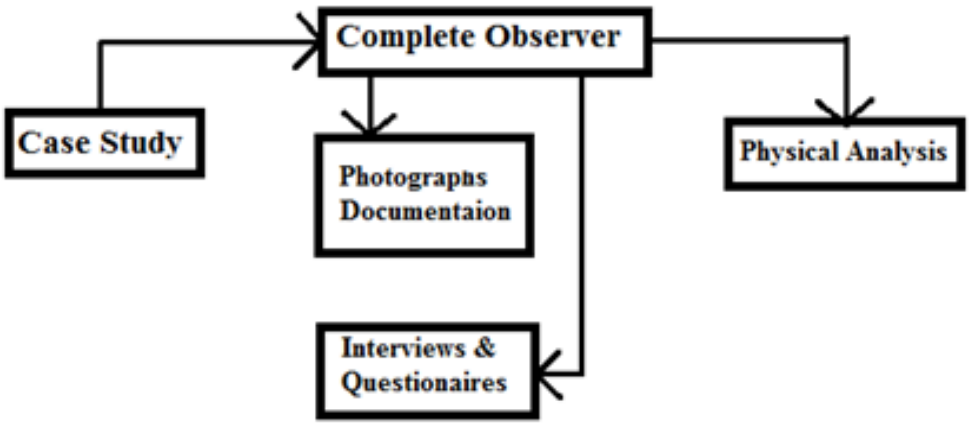


Fig 3.1: Scope of Research Study.

3.3 Face-to-Face Sampling Survey

A face-to-face questionnaire sampling survey was carried out to support and verify the findings from the observation method. Specifically, the survey was employed to answer Objective 2 – to identify and ascertain to what extends socio-cultural background contributed to the choice of drying clothes. The surveys provide descriptive data from the perspectives of a wider general population on the preferences on type of housing and their living habits. It was carried out in five main property fairs held in three major locations, in north, central and southern Peninsula Malaysia.

Questions related to this study were incorporated as part of a survey on housing affordability among potential buyers (Refer Appendix II). The survey was carried out via face-to-face interview assessed by enumerators. The

respondents were sourced via convenience random sampling targeting visitors to the property fairs. They were approached randomly to participate in the questionnaire survey voluntarily. The surveyed respondents were potential buyers of the property. The purpose of the sampling was to identify firstly, their preferred types of high-rise residential buildings layout. Secondly, their preferred methods of laundry, and lastly their preferred laundry zones. Table 3.1 indicates the event and dates of sampling survey.

Table 3.1: Location of property fairs

Name of property fairs	**Dates**
1.Malaysia Property Exhibition (MAPEX) 2015 KL Mid-Valley	4 -5 April
2. The Star Property Fair 2015 KL Tropicana City Mall	12-14 April
3. The Star Property Fair 2015 Penang Gurney Plaza	9-12 July
4. Malaysia Secondary Property Exhibition (MASPEX) 2015 Penang Queensbay Mall	13-16 August
5. The Star Property Fair 2015 Johor Bahru - City Square	21-23 August

3.3.1 Profile of respondents

A total of one thousand and eleven respondents (1011) were surveyed from the four property fairs held in peninsula Malaysia as shown in Table 3.1 above. A total of 1030 responses were captured. The reason why the total respondent target was more than one thousand was because it was believed that this could generate a more meaningful data from each of the three regions. The surveyed respondents were potential house-buyers interested in purchasing a property. Data from respondents profile shows that a fairly mixed demographic background from diverse ethnic and social strata. Of the total 1011 respondents, Chinese respondents consist of six hundred eighty six (686) equivalent to sixty eight percent (68%), Malay respondents consist of two hundred sixty seven (267) equivalent twenty six percent (26%), Indian respondents consist of forty nine equivalent of five percent (5%) and Others consist of nine (9) or les than one percent (0.1%).

Table 3.2: Key data of respondents

Gender	Frequency	Percentage
Male	588	59%
Female	415	41%
Total	1,003	100%
Marital status		
Single	930	53%
Married	772	44%
Divorced/ separated	33	2%
Widow	6	0%

Total	1,741	100%
Ethnic		
Malay	265	26%
Chinese	680	68%
Indian	49	5%
Others	7	1%
Total	1,001	100%
Religion		
Islam	127	13%
Buddhist	624	62%
Christian	141	14%
Hindu	38	4%
Others	73	7%
Total	1,003	100%
Occupation		
Labourer/Odd job	19	2%
Factory worker	33	3%
Clerical/Admin/Police/ Army	92	9%
Managerial	156	16%
Business	211	21%
Professional/Technical	407	41%
Student	28	3%
Unemployed	2	0%
Housewives	18	2%
Hawker/small trader	3	0%
Retiree	21	2%
Nanny/ working from home	4	0%
Total	994	100%

Education		
No formal education	5	1%
Primary school	4	0%
Secondary School or Form 3	25	3%
High School/SPM/STPM	145	15%
Certificate/Diploma	235	24%
Bachelor	460	46%
Postgraduate	117	12%
Total	**991**	**100%**

3.3.2 Data analysis

For the data analysis of the survey data, Chi-square analysis was used since it can generate the actual count instead of basing on percentage and the results reported can be tested with the statistically significance. Chi-squared test was used to determine the statistically significant differences among the expected values as compared with the observed situation.

3.4 Secondary Sources

Secondary sources from literature reviews, journals, reports, newspaper were reviewed to strengthen the findings. Topics reviewed include the drying clothing process, it's linkage and any possible application that can be

incorporated to actual site situation and the sequential implications towards the overall façade design.

3.5 Data Triangulation

The combination of various methods, i.e. observation, survey data and secondary sources managed to answer most of the objectives set forth for this research. The overall process and components of the research methodology is summarized in Figure 3.2 below.

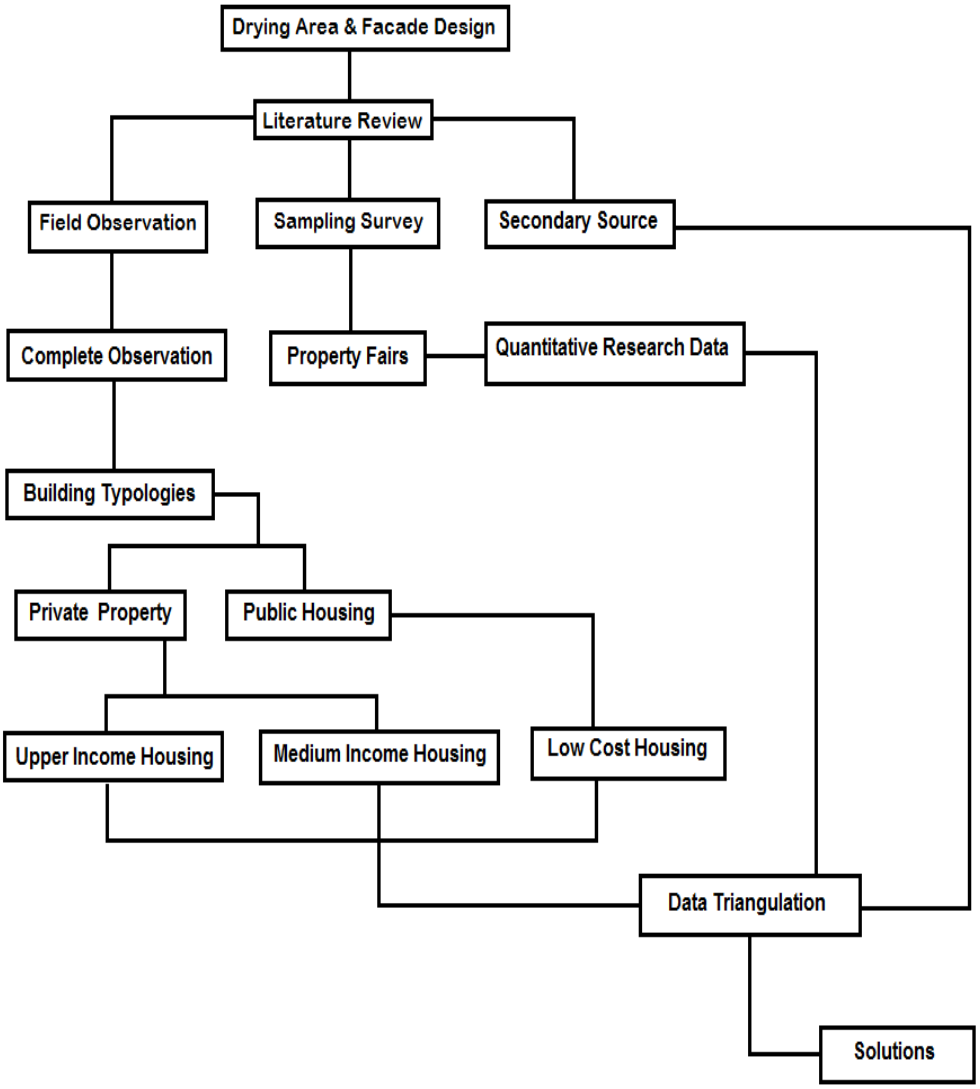


Fig 3.2: Research methodology chart. Image own source.

CHAPTER 4

ANALYSIS FROM FIELD OBSERVATION

4.1 Introduction

This chapter includes findings mainly from the field observation. A complete observation method was used to discover and analyze the general societal practice and social behavior in relations to handing laundry and the relationships with the building design and layout. The high-rise residents' behavior practices were observed to establish the common attributes by the majority occupants. The observation processes attempt to establish building principles constituting the structural attributes among the building typologies.

The chapter begins by discovering major differences in drying area design based on different typologies in the building form of high-rise housing. It then goes on to dissect scenarios based on public and privately provided housing under three social strata groups. Lastly, four specific case studies were selected for further comparative analysis and discussion.

4.2 Observations from commonly found building typologies

Attilio (1998) highlighted that generally, building design typology can be established based on functions, building types and building design expression within the context of the environment. Within such contexts, the building typologies for high-rises in Malaysia can generally be organized under several principles. Firstly, the distinctions in building characteristic based on its forms and layout; and secondly, the linkages for the common group of buildings in their functionality pertaining to the design criteria which contribute to the same requirements. It was within these parameters that four types of building typologies were established for the purpose of the study. The residential high-rise buildings are categorized into four main primary types, based on their building planning layout typologies or their obvious external building façade profiles. They are:

- Single Sandwich Block(SSB)
- Double Sandwich Block (DSB) Option A, Option B and Option C
- Single Tower Point Block (STPB)
- Combination Blocks (CB)

Figure 4.1: Single Sandwich Block (SSB). Image own source.

Figure 4.2: Variations of the Single Sandwich Block (SSB). Image own source.

Of interest to note in public housing, both SSB and DSB are common housing blocks built in the early 1970s by the government and they are still found today. Their purposes are catering to mass housing for the lower income group, resulting in basic no-frills unit. DSB housing layouts have more varieties andare more favorable due to its ability to accommodate higher density and additional number of units as compared with SSB. The development of STPB is usually more confined and common in private housing. However of late under the government housing initiative, more low cost and affordable housing schemes are been built in STPB. CB is another variation of housing form having two to three combined characters within a

single housing development. This variation and combination enable it to be built within a confine and limited land area.

Due to the variations in building configurations and typologies, various laundry habits emerge, resulting in current states of affair with many ‘styles’ and ‘expressions’ of laundry displays along the building facades. The different laundry practices by the inhabitants expose diverse social and living lifestyles and how people make the best out of their physical living conditions based on their circumstances.

4.2.1 Single Sandwich Block (SSB)

Figure 4.3: Single Sandwich Block (SSB). Image own source.

SSB was the earliest vertical high-rise built in the 70s to cater to the lower income groups. The basic unit layout comes without many facilities. Not much consideration was given on how laundries were to be dried. A typical SSB building typology consists of individual units fronting a common corridor

where it is the only means of circulation. The common corridor is usually exposed to the building external façade. Display of drying laundry is a common view of SSB as the laundries are hanged along the common corridors juxtaposition the building façade.

Figure 4.4: Laundry Location of Single Sandwich Block (SSB). Image own source.

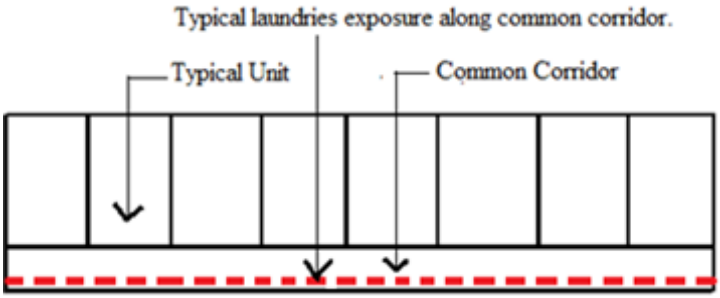


Figure 4.5: Diagrammatic SSB Plan Layout. Image own source.

4.2.2 Double Sandwich Block

4.2.2.1 Double Sandwich Block (DSB) - Option A

Double Sandwich Block Option A - DSB has no central or punctuated air-wells. It has internal common corridors fronting individual units. It was one of the early public housing typologies, where all the units face each other and divided by common long corridors. There is no central air well to ventilate the building block. Ventilation is from two openings at the end of the blocks thus creating wind tunnel effects along the common corridor. The diagrammatic layout is shown as Option A in Fig 4.6. It is very common for the inhabitants to have their laundries sun at their balcony. Without the balcony it is indiscrimately exposed at their window openings.

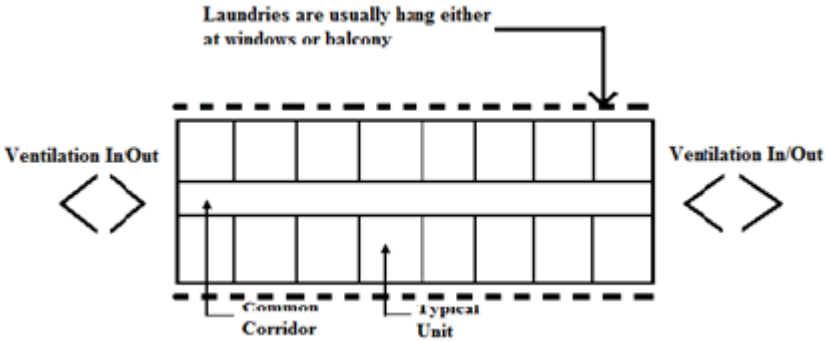


Figure 4.6: Typical DSB central Air Well Option A. Image own source.

4.2.2.2 Double Sandwich Block (DSB) - Option B

Figure 4.7: DSB-Option B central common air well. Image own source.

DSB – Option B layout incorporate a central common air well for ventilation and natural lighting. This common air-well performs dual functions acting as a buffer between opposite units, thus providing some levels of privacy from the opposite neighbors. The central air-ventilator/cooler allows wind passage to the two blocks. It is common to witness laundries hang at the ledge of the central corridors or above the corridor ceiling to take effect of the wind movement at the air-well area. However, the down-sides are that the laundries are in full public exposure and can be a nuisance obstructing pedestrian movement.

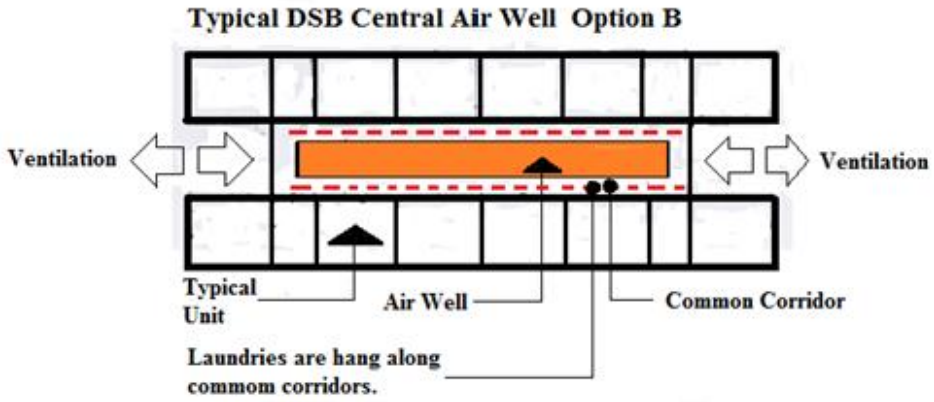


Figure 4.8: Typical DSB Central Air Well Option B. Image own source.

4.2.2.3 Double Sandwich Block (DSB) Alternated Air-wells along Common Corridor – Option C

Over a period of time DSB typology evolution resulted in a more sophisticated air-well design from having a single common air well to variations air-wells or punctuated air-wells alternating in various configurations but still framed

along the common corridor. These punctuated air-wells become individual ‘space’ or buffer zone between public (common corridor) and the individual units. The alternate air-well also functioned as designated drying area for the residents.

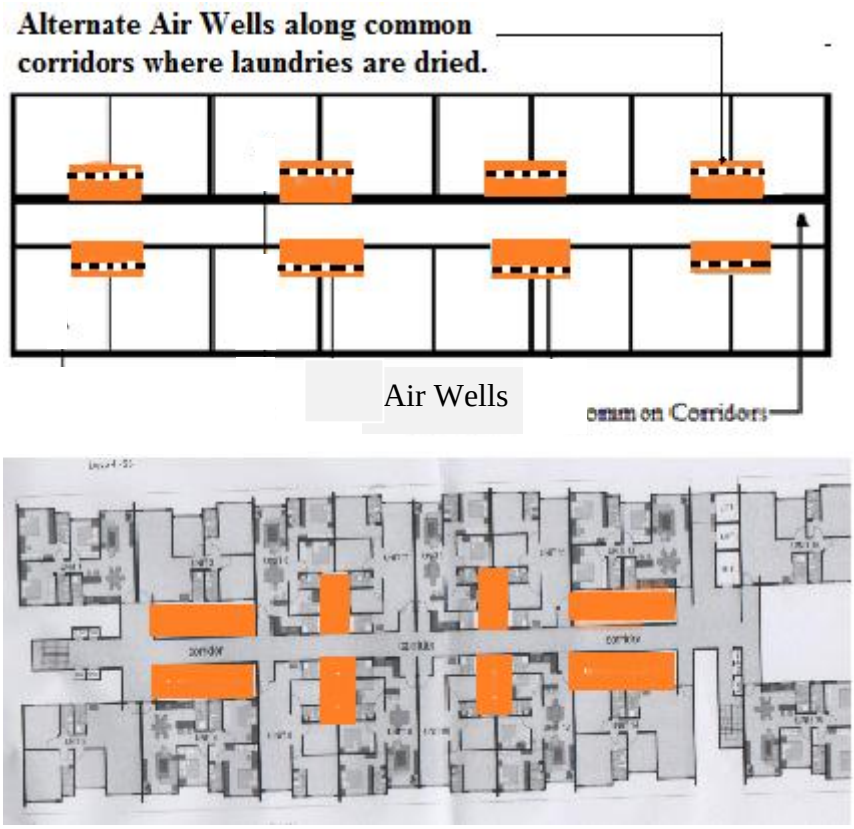


Figure 4.9 (a) and (b): Typical floor layout for -Option C Alternate Air Wells. Image own source.

4.2.3 Single Tower Point Block (STPB)

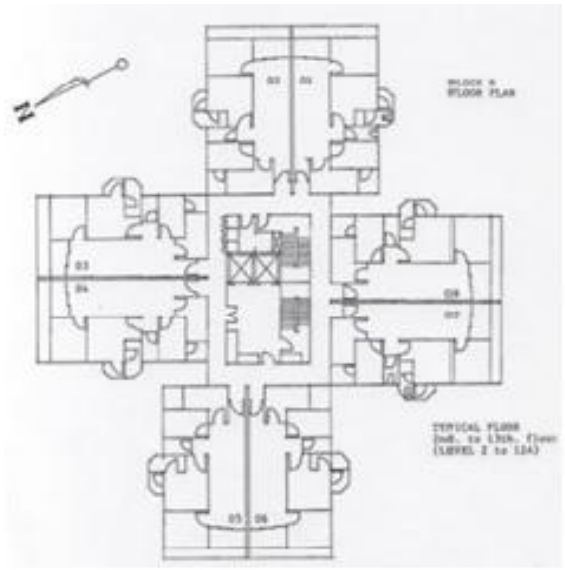


Figure 4.10: Typical STPB layout plan. Image own source.

The phallic singular blocks are usually more than five storeys in height. It consists of a central lift core in transporting residents to the upper levels. STPB development is commonly associated with private housing but of late, public housing under the government's programs such as low-medium cost housing (LMC) in Penang, are built in STPB configurations. For the private STPB housing, generally the units are not so compact with built-up area of approximately 70 to 100sq.m, with facilities such as swimming pool, gymnasium, community hall,. However, the LMC comes with the bare minimum facilities and unit size around 550sq.ft.

Figure 4.11 shows two examples of STPB housing that are developed by private developers. A designated drying area is located at a specific location either along the unit's balcony or 'caged' laundry. The locations are

considered since most of the residents are from middle-income households. Unfortunately, STPB housing built for the lower income groups do not have the luxuries of designated drying area. Thus, it is common to witness drying laundries at window openings or ‘caged laundries’ in these buildings.

Figure 4.11: Balcony and auxiliary area for laundry drying in STPB Image from own source.

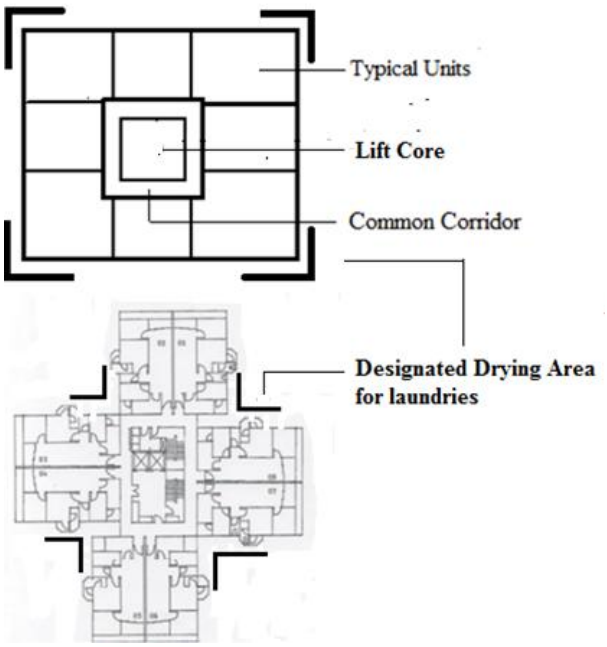


Figure 4.12: Diagrammatic layout of the STPB. Image from own source.

4.2.4 Combination Blocks (CB)

CB forms of housing generally are larger scale with higher density, since they usually combine extensional blocks of either Single or Sandwich Blocks with Tower Block. The land size must be large enough to cater to this type of development. It is basically a combination of SSB with either DSB or STPB in different configurations. Below examples show the typical layouts and the general spatial planning (Fig 4.13 to Fig 4.16) The laundry locations are similar to those mentioned earlier in SSB, DSB and STPB.

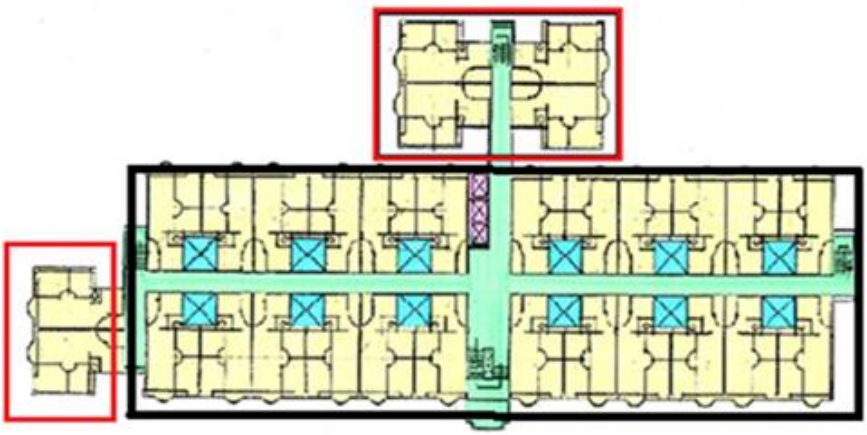


Figure 4.13: Combination Block Option 1 – Combination of one Double sandwich Block (DSB) with two Single Tower Point Block (STPB). Image from own source.

Figure 4.14: Combination Block Option 2 – Combination of one Single sandwich (SSB) with three Single Tower Point Block (STPB). Image from own source.

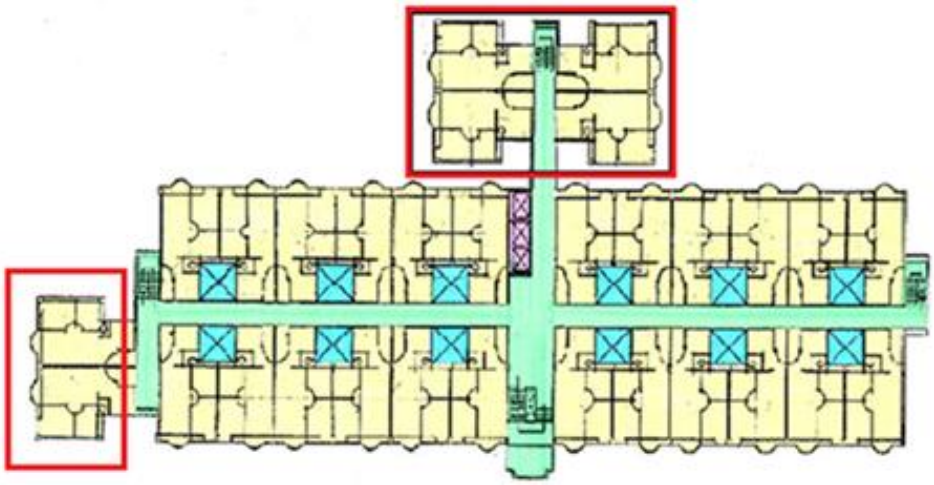


Figure 4.15: Combination Block Option 3 – Combination of one Double sandwich (DSB) with two extensions Single Tower Point Block (STPB). Image from own source.

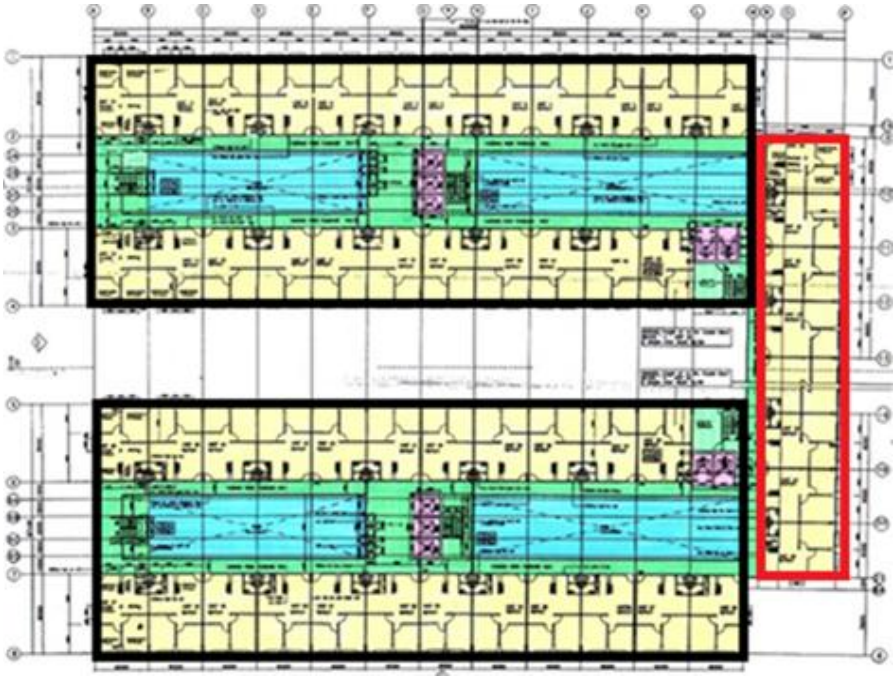


Figure 4.16: Combination Block Option 4 – Combination of two Double sandwich (DSB) with common Air Wells extension link to Single Sandwich Block (SSB). Image from own source.

For the above variations and extension blocks, the air-wells can be punctuated either in square, rectangular or a long common air-well along the corridor. In this kind of layout, sun penetration is limited for the lower floors. Generally only the upper two floors from the roof level downwards will have adequate sunlight penetration. Thereafter, no sun-light will be able to permeate into the lower floors. The long corridors will become dark alleyway thus the use of artificial lighting becomes necessary. Thus, the lower or ground level designs must be given great considerations to ensure adequate lighting and good ventilation.

CB typologies are the recent trends to house larger population within a single development. The unit's typologies are better designed compared to the

earlier ones. There is designated laundry space allocations for individual units ensuring clothes are dried at specific area, resulting in a more orderly situation without affecting the overall building façade.

4.3 Differences in drying areas between public and private residential high-rise buildings

Both public and private residential high-rise developments share a common salient feature by having no consideration on drying area. This is more apparent especially among high-rise buildings for the lower-middle income group as compared to the higher income categories. It is often left to the occupants' discretion through their whims and fancies on where and how the laundries to be dried. In many cases, it is usually auxiliary spaces that are allotted as drying area or none are provided.

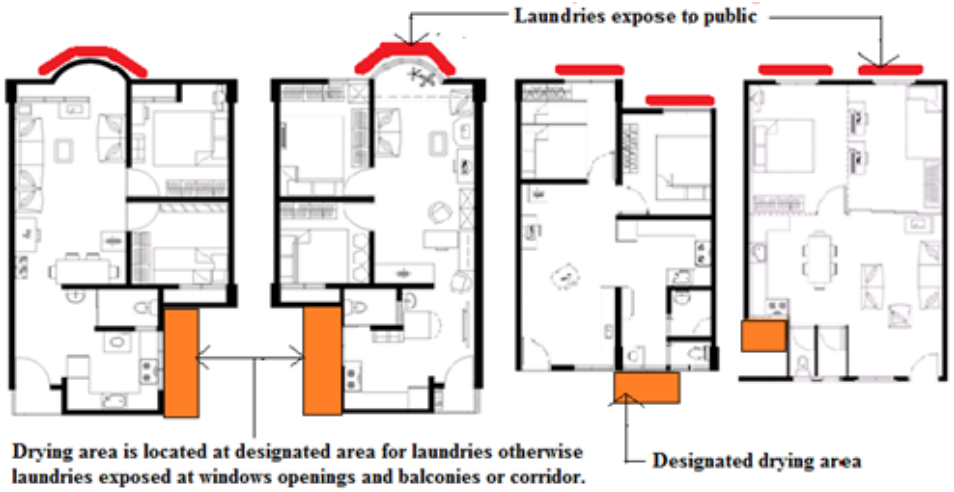


Figure 4.17: Existing method of drying clothes with and without drying area. Image from own source.

4.3.1 Private high-rise residential buildings

In the Malaysian context, private high-rise housing generally are built by developers to cater for the open market. Generally the development caters to the middle to high income groups. Most of the private residential high-rise built in Malaysia generally has two or three bedrooms with two bathrooms or more depending on the scale of luxury.

Figure 4.18: Cage laundries and screen panels for laundry location. Image from own source.

Figure 4.19: Exposed balcony is a common laundry location. Image from own source.

From our observation, generally private high-rise housing catering to the low and middle income group does not have designated drying area. Sometimes the balcony and space allocated for services such as air condensers and water down pipes are used as drying area. These are screened off by metal grilles to complement the overall external façade. Without specific drying area, indiscriminate hanging laundries are still rampant. The occupants would install ‘window cages’ at the balconies or service area as ‘make shift’ measures. Generally, there is no consensus on the patterns and ways of installation, the deciding factor depends on individual dwellers’ capacity, practicality and economic considerations. Thus, the ‘caged effects’ become sporadic, chaotic and inconsistence throughout the external building façades.

4.3.2 Public (Low Cost) high-rise residential buildings

Generally, in Malaysia, public housing is government imposed whereby housing developments are to surrender a minimum ten to thirty percent of the total units for public housing. Sometimes a monetary value can also be paid to the authorities in lieu of not building the low-cost quotas. Due to the non-profit nature of social housing, the developers will try their best to just provide the minimum requirements as stipulated by the authorities. Thus, the issue of providing designated drying area is seen to not as a priority as it is not taken as a ‘compulsory’ feature. This has resulted in chaotic manner in handing laundries decorating facades of many such housing. The unassuming ‘internal air-well’ space has also been unofficially relegated as designated drying area for the dwellers. Due to their easy access to public and passers-by, pilfering

can be quite rampant with laundries go missing at times. Valuable clothing and lingerie are sunned indoor near the window openings or private balconies (if there is any). Those who occupy corner units are more fortunate as these are non-accessible to public, thus providing additional spaces to dry their clothes outside.

Figure 4.20: Common Air Well is another popular location where laundries are. Image from own source.

Figure 4.21: Drying area at common corridors, central air wells and main entrances to the individual units. Image from own source.

Figure 4.22: Typical two bedrooms apartment layout (mirror image) Image own source.

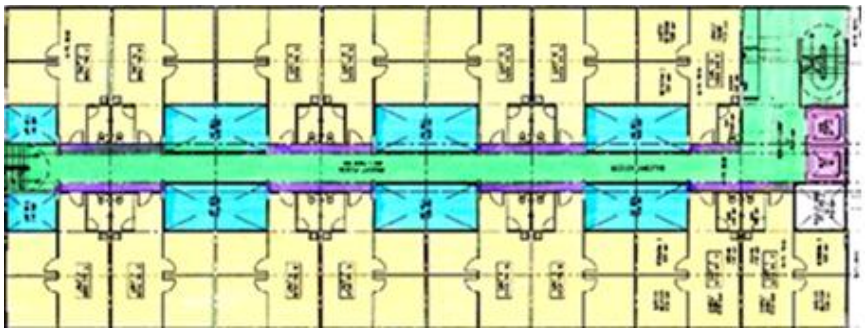


Figure 4.23: Building typology and layout of DSB. Image from own source.

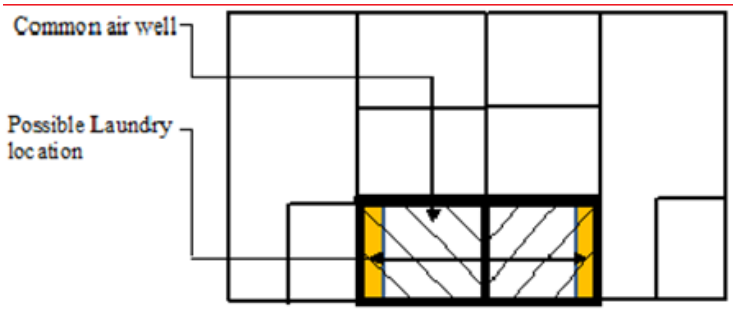


Figure 4.24: Typical unit (mirror image) having shared common air well. Image from own source

Figures 4.23 and Fig 4.24 show the two most commonly found solutions of laundry locations, i.e. kitchen and balcony area. The hatched

areas indicate the common open air-well fronting the common corridor. The occupants would dry their clothes at the open air well due to its proximity to the kitchen area. However, inhabitants will still sun their laundries at the balcony if needed.

Figure 4.25: Typical Alternate Air Well of Double Sandwich Block (DSB) and laundry locations. Image from own source.

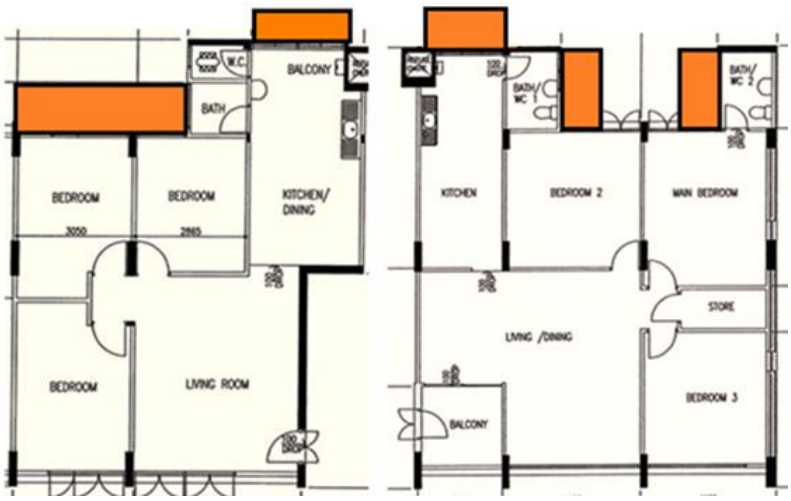


Figure 4.26: Typical unit typologies from Singapore HDB flats. Image from own source.

Figure 4.27: 'Hanging flag poles' at Singapore HDB flats Image from <https://www.teoalida.com/world/>

4.3.3 Distinctions between Public and Private high-rise residential buildings

In reviewing these two (2) income groups building layout typologies, certain characteristics and commonalities can be distinguished. Public residential high- rise are often equated to low-cost and affordable housings types,

whereas private residential housings are geared towards medium to upper income groups. Commonality in these building layouts and typologies built can be identified and co-related with the resident's socio-economic background.

Public housing is considered as housing for the masses, thus the building layout typologies are often found in configurations like SSB, DSB, CB and STPB. Public housing is generally developed in larger scale to maximize a higher and denser plot ratio. Private housing development has lower building footprint with lower density, and lesser units per floor, in view of privacy and other considerations.

Figure 4.28: A common sight to see laundry exposed along common corridors. Image from own source.

Figure 4.29: Laundries typically exposed to the balcony to dry where no specific or designated drying are allotted. Image form own source.

4.4 Observation in selected case studies

This section discusses findings from observation in selected case studies. Four case studies are presented here. Three of them are found in KlangValley, Malaysia and the forth case study discusses practices from Singapore Housing Development Board (HDB) examples.

For the first three case studies from three social strata, they provide an indication on the living lifestyles and habits based on the type of housing layout. Stonor Park Condominium is located within the Kuala Lumpur City Center. It represents upper high-end income group where privacy and luxury are highly demanded. Whereas for the middle income category, the site selected is Desa Impiana Condominium in Puchong, Kuala Lumpur. This isa typical middle income housing with facilities such as gymnasium, swimming pools, tennis court and guarded with security. For the lower income category, San Peng flats in Kuala Lumpur, which is one of the earliest public high-rise

housing schemes built by the government to shelter the urban poor. https://www.teoalida.com/world

Singapore public housing built by the Housing Development Board (HDB) was included in the observation study to highlight the evolvement and improvement made over the decades. Current HDB housing has become model quality housing in contrast to its humble beginnings. The HDB housing layout evolution varies greatly in physical form and in layout. The case on HDB housing provides good examples and lessons to be learnt for the Malaysian practice.

4.7.1 Stonor Park Condominium (Private medium to high-end housing)

Located in the heart of the Golden Triangle Stonor Park Condominium a high-rise condominium catering to upper-end of corporate top management figures and the expatriate communities. The typical unit is200 sq.m. with three bedrooms and a utility cum maid room. The details in space planning are well thought-off without losing sight for laundry requirements. The kitchen area comprises both dry and wet kitchen adjoined to each other. The wet kitchen is located towards the rear of the unit along the building façade where the service area is located. This wet kitchen is also the drying area, this is where the laundry wash basin and washing machines are placed. Immediate fronting the drying area is the perimeter wall, the external building façade are installed with aluminum screen louvers where air-conditioner condenser are located and screened off from public view.

As can be seen, the designers provide screen grilles to shield off the laundries. The overall installation is also part of the architectural façade treatment of the building, which is tastefully designed. When laundries are placed along the screened balcony and when the condensers are in operation, the hot air from the condensers further enhance the drying function. This is actually in line with the concept of Room Air Conditioner Dryer (RACD) utilizing rejected wasted heat as mentioned earlier. Figure 4.32 to Figure 4.33 show the examples of the functional drying area.

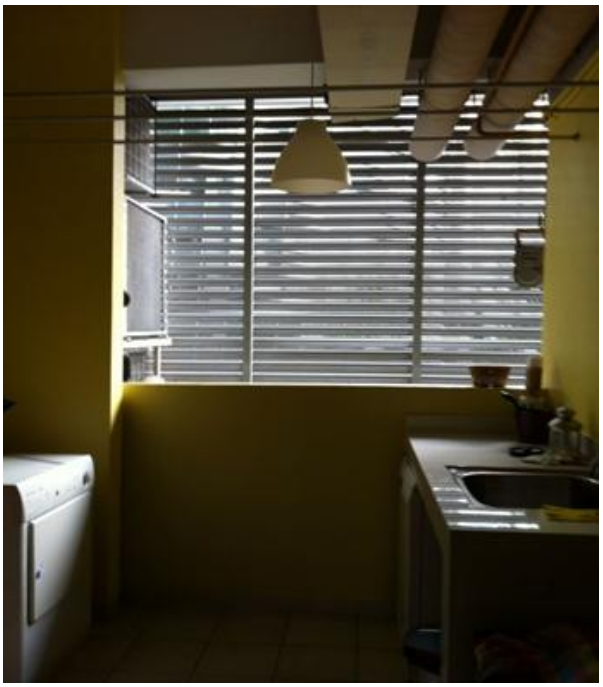


Figure 4.30: Screen panels to screen off laundries area at private housing. Image own source.

Figure 4.31: External facade of screen panels at private housing. Image from own source.

Figure 4.32: Condensers location at balcony of the drying are been screen off by aluminum grills panel. Image from own source.

Figure 4.33: Drying area with services location and screened aluminum panels. Image from own source.

4.4.1 Desa Impiana Condominium (Private medium cost housing)

Desa Impiana Condominium in Puchong, Kuala Lumpur is a typical medium cost condominium commonly found in Klang Valley. Like most of its similar categories of houses, the development comes with standard facilities such as swimming pool, gymnasium, squash court and multipurpose hall. What is lacking however is a designated drying area. It is not uncommon to see laundries hanged at the balcony or near the windows. If a space is used for drying it is usually an auxiliary space shared with other services area.

Figure 4.34: Middle class private development, no laundry area provided. Image from own source.

This middle class condominium was designed neither with open balcony nor drying area. The service area where the air condensers are located, is example of ‘left over’ space used as drying area. The space provided is not an ideal drying area location as it is a services area where down piping and air condensers are located. Occasionally, the screen grilles are incorporated to shield off the exposed services. Some laundry items are hanged at the vicinity of the glazed windows due to the limited drying space. The limited ‘drying area’ can only accommodate loose laundries or small items.

Figure 4.35: Screen panel service area where laundries are dried. Image from own source.

4.4.2 San Peng Flats (Public low cost housing)

The infamous San Peng Flats are one of the early government initiatives to house the lower income group in the inner city of Kuala Lumpur. The overall building typology isa double sandwich block having a common single air well. The total building layout is a 48 sq. m. with one bedroom, one toilet, kitchen, dining cum living area and a balcony. The layout is boxy and basic with the assumption that dwellers dry their laundries along the balcony or along the common air-well area. In view of security to prevent pilfering by other occupants it is common to witness occupants dry their laundries within their own balcony. Due to aesthetic reasons as the flats face a major city thoroughfare of Jalan Loke Yew, the City Hall of Kuala Lumpur (Dewan Bandaraya Kuala Lumpur) had imposed a screening panel at the balcony.

However, the blocks of flats at the rear not fronting the main thoroughfare, no screening panels were installed.

Figure 4.36: Improvised balcony with panels as screening device for unsightly hanging laundries. Image from own source.

The original balcony was installed in steel rods grilles which expose the laundries in full public view. Additional screen walls or shields were incorporated at the latter stage by City Hall with the hope that the hanging laundries will be shield off from frontal views. The metal deck shield is the extension from the balconies. The roofing railings are exactly the same fabrication for the balcony railings. In Figure 4.37, additional metal deck roofing extensions are incorporated by the residents to prevent water drips from laundries above staining their clothing.

Figure 4.37: View of "Add on" aluminum screen panels screening off the existing open balcony. Image from own source.

Figure 4.38: Original open balcony without screening panels. Image from own source.

4.4.3 Housing Development Board (HDB) Public Housing Schemes in Singapore

Public housing in Singapore is provided through its government body, Housing Development Board (HDB). Generally, both Singapore and Malaysia share common traits in culture and climatic background. In the early years, it

was a common sight for HDB housing to be famous for its ‘Hanging flagpoles’ for their building façades. Over several decades the syndrome has been curtailed by designing pragmatic screens to shield off the laundries from public view. The current HDB housing are tastefully designed with pleasing color scheme and there is an attempt to have the laundry locations to face the rear of the apartment. Most of the rear blocks are facing each other where laundries are exposed, which is a more sensible and tolerable solution. In addition, there are also attempts to conceal or screen off the very obvious with tastefully designed elements and colors. Within the confinement of the HDB housing layouts, the ‘hanging flag poles’ are given new interpretations by incorporating colors and unique design elements to shield part of the facades and create a quality urban sky line.

Figure 4.39: Early HDB housing built in the sixties and late eighties.

Figure 4.40: Current HDB housing are well planned and colorful.
Image from : <https://www.teoalida.com/world/>

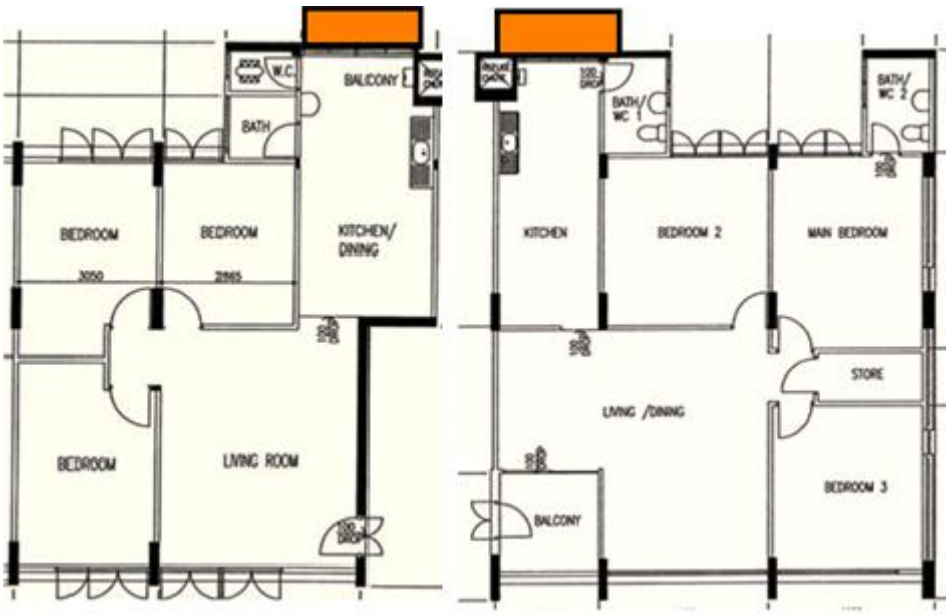


Figure 4.41: Typical Singapore HDB apartment's layout. Shaded colors are the laundry locations from kitchen balcony. Image from own source.

Figure 4.42: Additional screen laundry design in current HDB housing. Image from : <https://www.teoalida.com/world/>

Residential high-rise external façade having recessed profiles are designed to cater for the location of the hanging laundries. In the recent HDB developments all these external drying laundries are designed not to have frontal exposure from the main building façades, but be located at the back portion towards the kitchen vicinity.

Figure 4.43: Orderly and well-planned laundry screen panels. Image from : <https://www.teoalida.com/world/>

4.5 Conclusion

The findings highlighted a fact that most high-rise residential buildings have failed to provide essential laundry space as part of the overall façade design. Where no laundry space is provided, balcony is being used as laundries drying. The review of the various building block typologies provides a better understanding on the ways and challenges of how different building forms incorporate drying area. Both public as well as private housing development generally has not resolved the laundry consideration as part of the high-rise housing design. It is also apparent that there is a distinction between housing for the low to medium income compared to those from the higher income categories. Comparatively the Singapore HDB housing are better planned and given thought process in ensuring the laundry requirement is an essential feature of the physical façade.

CHAPTER 5

ANALYSIS FROM SAMPLING SURVEY

5.1 Introduction

This chapter discusses and presents the data from the survey findings. The sampling survey data derived from a face-to-face questionnaire interviews, conducted with potential home-buyers in three main property fairs held in the Klang Valley, Johor and in Penang Island. The details of the property fairs can be referred in Table 3.1 page 49.The main objectives are to ascertain whether socio-demography and cultural backgrounds have influence on the preference and choice of housing and ways and means of laundry.

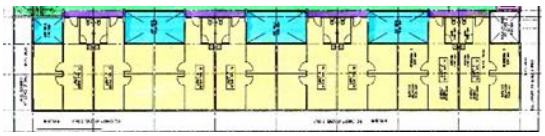
A total of 1011 samples were collected. The respondent's data are presented in Table 3.2 in Page 50 of this dissertation. The survey was part of a research of housing affordability. The questions include graphic picture of apartments or and unit layout typologies. Two sets of graphic pictures were presented to check on their choices. Likert Scale was used to measure respondents' attitudes and opinions and the level of agreement based on the questionnaires and the pictorial information.

Chi-square tests were used to determine whether there was any significance difference between the normal expected value from the observed value. The overall survey results were analyzed to ascertain and provides approximate idea on respondents' preference based on their lifestyles or habits of laundry.

5.2 Preference on building typology

Likert Scale was used to check on their levels of agreement on their preference of housing types. Four images of the buildings typologies were provided to allow respondents to choose based on a scaled preferences from 1 to 5 where scale 1 suggested least preferred as compared with scale 5 being the most preferable. Refer to Appendix II page 130 and the images in Table 5.1 indicated four primary high-rise residential block layout typologies commonly found in Malaysia.

Table 5.1: Question on preference of building typology

C8.1	**A**. Single slab layout having common corridor along building facade  

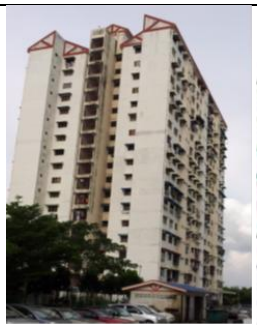
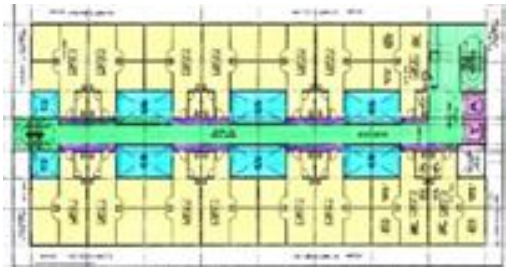
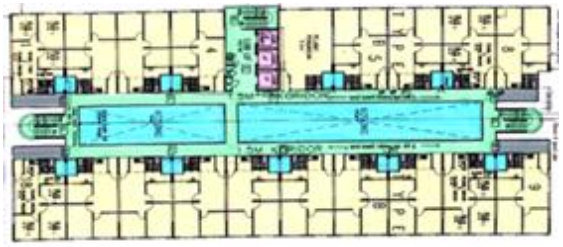
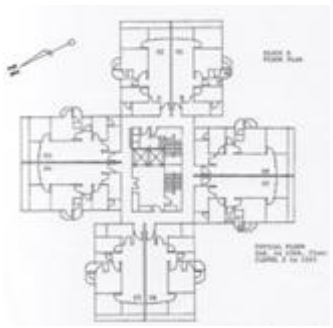
C8.2	  **B.** Double sandwich block with internal courtyards (Type A)
C8.3	**C.** Double sandwich block with internal courtyards (Type B)  
C8.4	**D.** Tower block   

Table 5.2: Preferences of building typology based on gender

Bldg Typologies	Gender	No	Mean Rank	Chi-Square	Asymp. Sig
C8-1	Male Female	592 419	507.08 504.47	0.021	0.884

C8-2	Male Female	592 419	512.45 496.89	0.751	0.386
C8-3	Male Female	592 419	506.60 500.91	0.232	0.630
C8-4	Male Female	592 419	520.33 485.75	3.700	0.054

Referring to Table 5.2 shows that gender does not have any significance to determine preferences of building typologies. Both gender choices are equally the same on the choices for the types of building typologies.

Table 5.3: Preference on building typology based on marital status

Bldg Typologies	Marital status	No	Mean Rank	Chi-Square	Asymp. Sig
C8-1	Single Married Divorce/separated Widow	545 443 19 4	524.53 489.28 368.71 484.13	8.615	0.035
C8-2	Single Married Divorce/separated Widow	545 443 19 4	509.69 508.69 360.53 396.75	5.818	0.121
C8-3	Single Married Divorce/separated Widow	545 443 19 4	493.53 521.81 501.18 476.63	2.499	0.476
C8-4	Single Married Divorce/separated Widow	545 443 19 4	491.68 521.44 570.66 439.63	3.964	0.265

The results in Table 5.3 above indicate that there are significant differences in terms of marital background on the preferences of building typology.

Table 5.4: Preferences of building typologies based on ethnic

Bldg Typologies	Ethnic	No	Mean Rank	Chi-Square	Asymp. Sig
C8-1	Malay	267	511.75	4.481	0.214
	Chinese	686	508.36		
	Indian	49	428.81		
	Others	9	576.22		
C8-2	Malay	267	516.87	0.687	0.876
	Chinese	686	503.04		
	Indian	49	487.54		
	Others	9	509.72		
C8-3	Malay	267	498.43	2.078	0.556
	Chinese	686	506.81		
	Indian	49	512.36		
	Others	9	634.28		
C8-4	Malay	267	501.12	0.795	0.851
	Chinese	686	509.14		
	Indian	49	480.40		
	Others	9	550.50		

The results in Table 5.4 failed to proof there are any differences among ethnic groups on preference of building typologies.

Table 5.5: Preferences of building typology based on education background.

Bldg Typologies	Education	No	Mean Rank	Chi-Square	Asymp. Sig
C8-1	No formal education	5	338.00	18.978	0.004
	Primary School	4	726.00		
	Secondary School of Form 3	25	661.28		
	High School SPM/STPM	148	499.66		
	Certificate/Diploma	238	488.31		
	Bachelor	462	511.37		
	Postgraduate	117	444.04		
C8-2	No formal education	5	376.50	20.599	0.002
	Primary School	4	866.25		
	Secondary School of Form 3	25	610.38		
	High School SPM/STPM	148	520.30		
	Certificate/Diploma	238	472.87		
	Bachelor	462	513.56		
	Postgraduate	117	445.14		
C8-3	No formal education	5	574.20	11.523	0.073
	Primary School	4	690.25		

	Secondary School of Form 3 High School SPM/STPM Certificate/Diploma Bachelor Postgraduate	25 148 238 462 117	539.30 537.47 507.87 495.14 437.75		
C8-4	No formal education Primary School Secondary School of Form 3 High School SPM/STPM Certificate/Diploma Bachelor Postgraduate	5 4 25 148 238 462 117	519.50 189.00 495.46 483.16 530.16 496.44 484.78	8.789	0.186

Table 5.5 above fails to proof there is any significant difference between the education back ground for C8-3 and C8-4.

5.3 Preferences on laundry method

Table 5.6 indicated six methods proposed (shown pictures) on methods of laundry. Respondents were a chance to select their preferred methods ranging from the most preferred to the least favorable.

Table 5.6: Question on methods for laundry

C9.1	Exposed outside buildings	
C9.2	Using poles to dry clothes	

C9.3	Windows drying	
C9.4	Concealed drying	
C9.5	Having ‘birdcage’	
C9.6	Screened panel	

Table 5.7: Preference of laundry based on gender

Laundries Drying Options	Gender	No	Mean Rank	Chi-Square	Asymp. Sig
C9-1	Male Female	592 419	502.09 511.52	0.338	0.561
C9-2	Male Female	592 419	508.12 503.00	0.096	0.757
C9-3	Male	592	507.00	0.018	0.893

	Female	419	504.58		
C9-4	Male Female	592 419	495.91 520.26	1.826	0.177
C9-5	Male Female	592 419	518.59 488.21	2.809	0.094
C9-6	Male Female	592 419	525.20 478.87	6.533	0.011

Table 5.7 suggested there is a significant relation in terms of gender on laundry method of C9-6. Male respondents appeared to favour towards "screen panel" as compared with the female. For other drying options, there are no significant results in terms of gender

Table 5.8: Preferences of laundry options based on marital status.

Laundries Drying Options	Marital status	No	Mean Rank	Chi-Square	Asymp. Sig
C9-1	Single Married Divorce/ separated Widow	545 443 19 4	515.99 491.43 525.24 667.75	4.028	0.258
C9-2	Single Married Divorce/ separated Widow	545 443 19 4	514.24 495.68 465.37 718.25	4.402	0.221
	Single	545	499.06	2.525	0.471

C9-3	Married Divorce/ separated Widow	443 19 4	510.19 584.37 615.25		
C9-4	Single Married Divorce/ separated Widow	545 443 19 4	499.77 517.39 429.18 458.25	2.2510	0.473
C9-5	Single Married Divorce/ separated Widow	545 443 19 4	496.46 521.83 408.32 474.88	4.250	0.236
C9-6	Single Married Divorce/ separated Widow	545 443 19 4	495.97 518.91 555.50 208.38	6.568	0.087

Table 5.9: Preferences of laundry based on ethnicity

Laundries Drying Options	Ethnic	No	Mean Rank	Chi-Square	Asymp. Sig
C9-1	Malay Chinese Indian Others	267 686 49 9	500.99 511.12 457.91 526.22	2.194	0.533
	Malay	267	521.84	1.639	0.651

C9-2	Chinese Indian Others	686 49 9	499.34 517.64 480.00		
C9-3	Malay Chinese Indian Others	267 686 49 9	512.57 506.95 456.97 505.44	1.653	0.647
C9-4	Malay Chinese Indian Others	267 686 49 9	500.98 505.62 547.96 455.44	1.458	0.692
C9-5	Malay Chinese Indian Others	267 686 49 9	515.15 502.82 499.26 513.33	0.387	0.941
C9-6	Malay Chinese Indian Others	267 686 49 9	514.20 504.10 479.08 554.22	0.953	0.813

Then result of both Table5.8 and Table 5.9 respectively failed to proof any significant relations in options of drying locations based on the marital status or ethnicity.

Table 5.10: Preferences of laundry based on education background

Bldg Typologies	Education	No	Mean Rank	Chi-Square	Asymp. Sig
C9-1	No formal education	5	508.30		
	Primary School	4	413.75		
	Secondary School of Form 3	25	591.40		
	High School SPM/STPM	148	512.00	6.577	0.362
	Certificate/Diploma	238	510.60		
	Bachelor	462	494.22		
	Postgraduate	117	469.13		
C9-2	No formal education	5	493.80		
	Primary School	4	441.88		
	Secondary School of Form 3	25	534.26		
	High School SPM/STPM	148	520.11	2.568	0.861
	Certificate/Diploma	238	496.08		
	Bachelor	462	500.09		
	Postgraduate	117	477.11		
C9-3	No formal education	5	403.20		
	Primary School	4	440.75		
	Secondary School of Form 3	25	501.24		
	High School SPM/STPM	148	529.10	5.895	0.435
	Certificate/Diploma	238	516.32		
	Bachelor	462	493.84		
	Postgraduate	117	460.22		
C9-4	No formal education	5	235.50	6.208	0.400

	Primary School	4	574.13		
	Secondary School of Form 3	25	516.28		
	High School SPM/STPM	148	502.97		
	Certificate/Diploma	238	494.89		
	Bachelor	462	508.80		
	Postgraduate	117	477.20		
C9-5	No formal education	5	404.00		
	Primary School	4	411.88		
	Secondary School of Form 3	25	552.16		
	High School SPM/STPM	148	508.23	2.724	0.843
	Certificate/Diploma	238	503.97		
	Bachelor	462	491.08		
	Postgraduate	117	512.68		
C9-6	No formal education	5	191.90		
	Primary School	4	250.63		
	Secondary School of Form 3	25	585.28		
	High School SPM/STPM	148	453.74	20.386	0.002
	Certificate/Diploma	238	530.56		
	Bachelor	462	508.34		
	Postgraduate	117	466.91		

The results above for Table 5.10 above indicate that there are significant differences for C9-6 in terms of education background. However, for the rest of the laundry methods, no significant relations were detected in terms of respondents education background.

5.4 Preference of laundry location

In Figure 5.1, respondents were asked to choose their preferences of the location of the drying area. Four zones in two typical two bedroom apartment were presented with zones marked out as possible drying area, namely: Zone A balcony; Zone B windows; Zone C outside the kitchen windows facing the internal air-well and Zone D outside the windows facing the internal air-well or internal corridor.

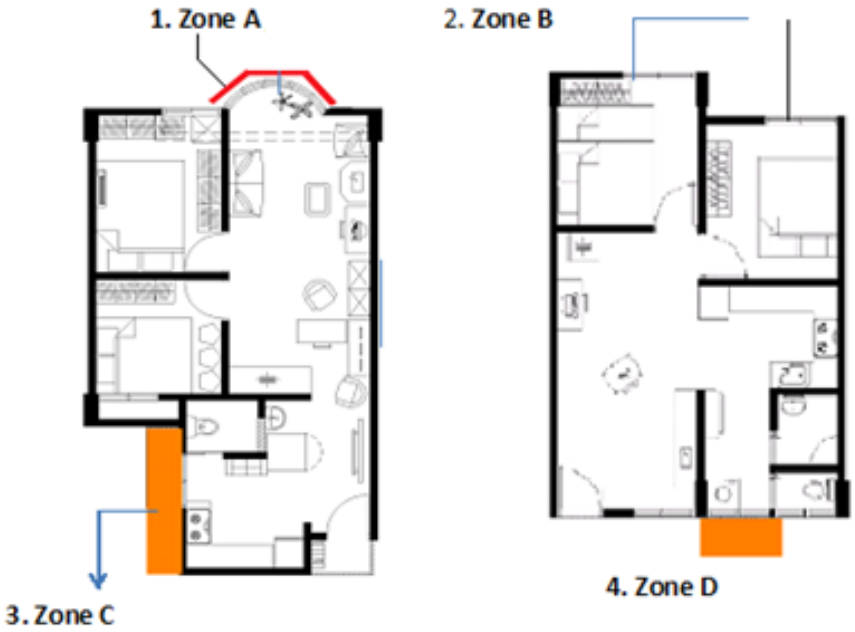


Figure 5.1 Preferences for laundry location

Table 5.11: Preferences for laundry location

	Number of respondent	**Percentage**
Zone A	237	27%

Zone B	140	14%
Zone C	230	23%
Zone D	362	36%
Total	1005	100%

Results from Table 5.11 with reference to Figure 5.1, highlighted the overall the most popular location for laundry is Zone D, which is a zone immediately outside a window facing internal air-well or common corridor. This is followed by Zone A, Zone C and Zone B, which seemed to be the least popular.

Table 5.12: Preferred laundry locations based on ethnic

	Ethnic	No	Percentage	Chi-Square	Asymp. Sig
Zone B	Malay	50	5%	12.858	0.012
	Chinese	83	8%		
	Indian	3	0%		
	Others	4	0%		
	Total	140	14%		

In terms of ethnic background, Table 5.12 indicates that for preferences on Zone B, more Chinese than the Malay community have made the choice. For Zone A, C and D, no significant relations in terms of ethnic background were detected.

Table 5.13: Preferred laundry location based on gender

	Gender	No	Percentage	Chi-Square	Asymp. Sig
Zone D	Male	194	19%	7.964	0.019
	Female	168	17%		
	Total	362	36%		

In terms of gender, Table 5.13 suggested only Zone D has significant differences in choices among male and female respondents.

5.4 Conclusion

The purpose of this survey data to ascertain whether the social cultural backgrounds of the inhabitants has any influences on preferences in living in high-rise dwellings, and the ways and methods of laundry. Generally, it can be concluded that there were no strong correlations in terms of social-cultural backgrounds in the various options given to them. Thus, with reference to the second objective, "To identify and ascertain the extent of the existing dwellers' social-cultural background and habits contribute to the choices and preference of drying clothes", our results have shown that socio-demographic factors such as gender, ethnic, marital status and education background

generally do not significantly affect the occupants choices. The choices perhaps could be attributed to other reasons that are geared towards functionality, practicality and comfort, which goes beyond the socio-cultural factors.

CHAPTER 6

POSSIBLE SOLUTIONS INCORPORATING DRYING AREA AT THE EXTERNAL FAÇADES

6.1 Introduction

The building typologies as highlighted earlier in Chapter 4 page 56 varied greatly in the Malaysian context. Generally, all the drying area are incorporated at the external balcony together with other functional or services area (water down-pipes outlets or air-condensers) or using the internal air-wells. Therefore in designing drying area, one has to take into considerations the positioning and locations of these elements. The placement of drying area either along the building facade or within the inner court yard of the air-wells may have major detrimental consequences in terms of design quality. Planning and designing such an important component in new high-rise housing right from the start should be the practice. It is less of a hassle compared to resolving it afterwards when the buildings are occupied.

In this chapter, possible solutions are discussed along two major categories, i.e. private middle income residential buildings and public low cost housing. This is because many solutions are bound to costs implication while a

clear dichotomy can be drawn from such categorization. In addition, the chapter also discusses other issues from the points of legality and enforcement.

6.2 Possible solutions for private middle income housing

6.2.1 Screening at the balcony

In private housing development, the function of having a balcony should be for leisure purposes, in creating a sense of openness and connectivity to the outside. Balconies are normally recessed or flushes projected from the external building façade. Unfortunately such delightful features are used for a mundane usage such as handing the laundry during the day time, especially the low and middle costs types. To overcome this, in case where the functionality becoming dual purpose, efforts can still be put in to think of dual purpose solutions with both function and aesthetic in mind.

The exposed balconies are either installed with full iron grilles railings, full masonry or concrete structure or a combination of both grilles and masonry or concrete type. They can be further classified as:-

i. Exposed balcony - Iron grilles railing

ii. Semi-screen balcony

iii. Glazed installation for full screen balcony

iv. Vent block screening panels

v. Pre-cast panels as geometry design

i. Exposed balcony – Iron grilles railing

The exposed balcony with railing provides semi-screen railing above normal railing height of 1200mm to become 1800mm to 2000mm. Screening panels can further enhance the external façade, as shown in Fig 6.1.

Figure 6.1: Existing exposed balcony with iron grilles railings. Image from own source.

ii. Semi-screen balcony

The usage of screen grilles can actually enhance the overall building façade compared to just ordinary railings as shown in Figure 6.2 and figure 6.3.

Figure 6.2: Semi enclosed screening grills at exposed balcony. Image from own source.

Figure 6.3: Tastefully designed screen enhances the external building façade. Image from own source.

iii. Glazed installation for full screen balcony

Recessed balconies incorporating tastefully designed screen panels can complement the overall building facades as shown in Figure 6.4. The

advantages of glazed windows are that they can prevent rain penetration and ease of slide open-close.

Figure 6.4: Glazed installations at the exposed balcony add character to the building. Image from own source.

iv. Vent blocks screening panels as full screen balcony

Another form of screen panels is using concrete vent blocks as façade treatment. This fulfills the function of screening the laundries from public view while allowing clothes to dry. As shown in Figure 6.5, the precast panels with vent bocks provide interesting texture to the building envelope.

Figure 6.5: Vent adds character and texture to the building.
Image from own source.

v. Precast panels as geometry designs

Figure 6.6: Precast screen panels with geometry design enhance the overall building façade. Image from own source.

The use of pre-fabricated design panels from factory can be one of the many options to be considered. Figure 6.6 suggests primary geometry shape design using precast treatment is one possible form of screening panels to create visually interesting external design yet fulfilling the dual purposes. The prefab panels can come in different design geometry, be it square, triangle, etc. to suit the external building form and envelopes.

6.2.2 Existing service area at the balcony

For balconies where the air condensers and piping are located, this area can be optimized by utilizing the existing condensers to enhance drying process. This is based on the concept of rejected air-con waste heat (RACD) as discussed in the earlier chapter. Using screen panels at the services location, it can further enhance the façade and conceal the laundries in an orderly manner. The designed screen panels add character to the overall external envelope. Figures 6.7 to 6.10 are some of the examples that can be considered and incorporated into the existing services area without adding new ones.

Figure 6.7: Screen panels at service area add character while concealing the laundry. Image from own source.

Figure 6.8: Utilize existing service area. Image from own source.

Figure 6.9: Exposed screen panel for air-condensers within window vicinity. Image from own source.

Figure 6.10: Metal screen panels at balconies. Image from own source.

6.3 Possible solutions for public low cost housing

Figure 6.11: Cage laundry installed at window openings. Image from own source.

Figure 6.12: Exposed laundries along corridors. Common sights in public low cost housing. Image taken from own source.

In terms of public low cost housing, the building form has not changed much for a few decades. The external façade remains a boxy wall panels without much fenestration or details. Drying area is second to none since the main agenda for public housing is fulfilling only the basic necessity. However, the possible solutions can be still be standardized and simple, yet with variations. Where no drying area be found, external wall facade especially windows can be further enhance to provide tasteful “caged” designs to add rhythm to the monotonous wall. Likewise, at the internal central common air-well along the common corridors, provision of alternate screen “cage” can be considered. The possible solutions are as follows:-

6.3.1 External Façade treatment

Some of the current cage grilles installed at the external window façades are ad-hoc solutions initiated by the occupants. A systematic design and installation of caged grilles from the beginning could enhance the overall character. Regulations and guidelines should be set aside for control and standardizing the installation of caged grilles.

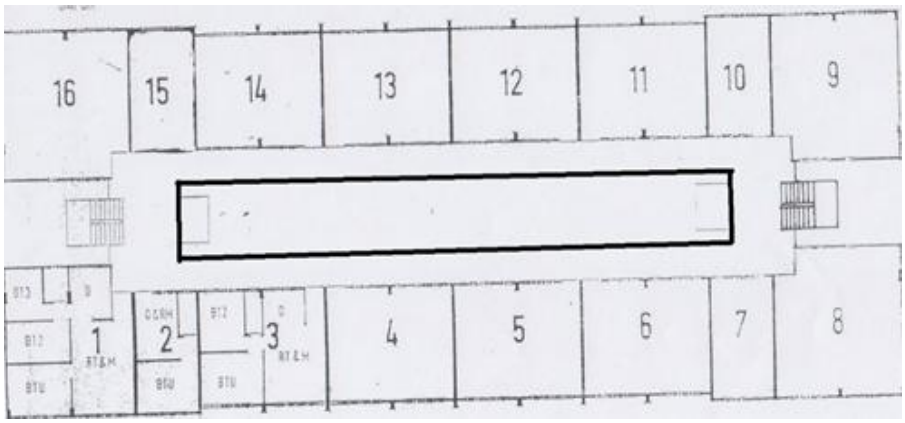
Figure 6.13: Uncoordinated cage. Image from own source.

Figure 6.14: Proper design, control and standardization of caged laundry appear to be more orderly. Image from own source.

6.4 Internal air well arrangement

Internal central air wells are common in most public housing with varieties of layouts ranging from common single elongated air wells to a series of smaller ‘broken’ alternate air wells. The air wells are usually located next to the common corridor. Drying cloths near the common corridors are unsightly and compromise the privacy although residents tend to choose locations nearest to their units. The sunlight penetration is only felt on the higher floors while the lower floors can just depend on wind velocity to dry the clothes.

(a)



(b)

Figure 6.15: (a) Common air well (b) Alternate air wells along common corridors at public housing. Image from own source.

Cage laundry is a simple and easy fabrication for public as well as private high-rise apartments. The followings are some of the examples for ‘caged’ solutions proposed for public housing in solving the daily practicality, yet ensure orderliness and aesthetic appreciation. The possible solutions are shown in Figures 6.16 to Figure 6.19.

Figure 6.16: Proposed vertical cage grilles or perforated prefab panels grilles. Image own source.

Figure 6.17: Perforated venting hole installed along common corridors. Image from own source.

Figure 6.18: Installation of individual cage grilles for the punctuated air-well. Image from own source.

Figure 6.19: 'Before' and 'After' views of cage laundry along the Common corridor for the corner unit. Image from own source.

6.5 Mandatory ruling and enforcement

One way of controlling the ad-hoc and indiscriminate installation of caged grilles and handing laundry is having regulations that the residents need to abide along with strict enforcement. The local authorities can make it mandatory to all developers and/or high-rise occupants to follow a standardized practice to ensure consistencies and orderliness for the external

building façades. Enforcement based on the local authority by-laws has advantages over Resident's Association (RA) guidelines since it carries a legal authority. Rulings based on RA leaves much to be desired as some dwellers choose not to follow.

Figure 6.20: Standardized grilles cage compliments the overall building envelope. Image from own source.

The current doldrums can only be resolved if the authority are able to muscle in reinforcing or amend the existing by-laws incorporating such compulsory ruling. This however, may be tricky for the older public housing built in the early decades. They may need special allocations to do so. The existing pool of public low cost housing could undergo an over hall or regeneration effort in order for them to address the issue. Guidelines should be given on the installation of additional 'caged grilles' and 'screening' for laundry practice. Enforcement should be carried out to deter unwanted practices. The solutions proposed in this chapter are attempts to provide

simple alternatives and strategies in correcting the existing dilemma. The proposals are not the detailed or conclusive rather suggestive immediate solutions to consider.

CHAPTER 7

CONCLUSION

According to the Department of Statistic Malaysia, the urbanized population in Malaysia has already reached over 71 percent (Mohit, et al., 2010). With population increases and depletion of resources, the only option is for the cities to build upwards. Living off the ground has been a common feature and ingredient to cityscape and modern urban living, so much so that certain habitual habits are ingrained to become acceptable part of lives and common sights in cities. This dissertation begins by exploring this unresolved and challenging issue confronting most residential high-rise in Malaysia. It dwells into a seemingly mundane yet necessity part of our living habitat – 'hanging laundry syndrome', a common phenomenon and sight, which decorate many high-rise residential buildings in other developing Asian countries.

Our analysis has dissected the issues from several perspectives, i.e. historical development, differences in terms of housing typologies and categories, and the some of the socio-cultural influencing factors. While acknowledging that climatic and economic factors are important contributing factors to the situation, the importance of legislations, enforcement and strong local residents associations were other issues highlighted. This dissertation has proposed some preliminary ideas and viable solutions that can be integrated

positively to the overall building design. These sustainable design solutions should maximize natural resources, yet they must be cost effective and able to contribute to the visual aesthetics of the buildings. The proposed solutions should consider non-mechanical operation for laundry while fulfilling similar functions; it should also be complimentary to both internal and exterior building facades.

Generally, the study has managed to fulfill most of the objectives set up in the beginning of the study. With reference to Objective 1– "To examine whether drying-are are integrated with external building façades in different types of high-rise housing and building typologies", our field observations concluded that there was clearly a lack of proper drying area allotted in the high-rise apartments regardless whether they are private or public initiated. However, for the high-cost luxurious private housing, generally more well-designed and coordinated drying area are incorporated into the overall building design.

For Objective 2- "To identify and ascertain whether occupants' social-cultural background contribute to choices and preference of drying clothes", our findings in Chapter 5, highlighted that generally, the Malaysian public by and large, are lassie faire when comes to drying laundry in high-rise living. There were not many statistically significant relations between social, cultural and demographic factors with preferences on drying clothes. The survey suggests existence of other influencing factors that may geared towards functional, practical and comfort considerations that are universal in nature.

For Objective 3 - "To establish possible or viable solutions to overcome the current doldrums for the drying area in all existing residential high-rise housing," This aspect is presented in Chapter 6, which outlined some of the possibilities and solutions that can be implemented for both existing and new housing development. It is up to the stakeholders and parties concerned such as designers, developers and authorities to consolidate their roles, together with proper review on the by-laws and stepping up the mark to improve current doldrums.

This dissertation has highlighted an important societal habit and daily necessity that professionals must take into account in the design of high-rise residential buildings. Since buildings are built to last for a long period of time, any conscious planning will have long-term impacts to people's lives and the image of a city. Vision of a fully developed nation can only be realized when visitors are able to appreciate standards and quality of its citizenry, seen though minute details of their living habits and manifested in physical urban structures decorating city skylines.

This research mainly relies on field observation, survey findings and secondary sources. Findings from the field observation survey are comprehensive and were able to document and analyze the issue covering major typologies and categories of residential high-rises found in Malaysia. However, due to time constraints, our study has not been able to include some

of the more recent and luxurious types of housing development, including the 'not-so-traditional' housing of SOHO and SOFO categories. The bulk of the analysis and discussion has focused on the lower and mass housing situation, mostly affecting the general urban populace.

Findings from the sampling survey although was sizable, it was based on data collected from potential buyers and visitors to properties fairs in three major cities in Malaysia. These respondents may or may not have lived in high-rise buildings. The proposed options in the survey were based on typical and simplified situations on commonly found typologies, thus they are not comprehensive to cover all building layout and laundry patterns, which could provide broader and more objective assessment. Thus, assumption cannot be the generalized for the whole population. The demographic view points from the sampling data may not be consistent with the overall population.

However, from the richness of evidence in the information and analysis provided, has demonstrated that it is indeed a neglected aspect in housing design that should be studied in greater details. The opportunities are wide for further research to provide critical sustainable solutions not only to improve the quality of living in the high-rise buildings but how it can be incorporated or integrated as part of the high-rise residential building design, regulations and enforcement.

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APPENDICES

Appendix I

Green Building Index [GBI] Malaysia

1. Energy Efficiency [EE]
2. Indoor Environmental Quality [EQ]
3. Sustainable Site Planning [SM]
4. Materials & Resources [MR]
5. Water Efficiency [WE]
6. Innovation [IN]

Appendix II

In Part Survey Questionnaires On Housing Choice And Affordability of Urban population In Malaysia

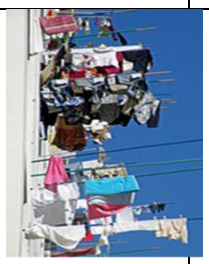
1. From the pictures there are 4 types of high rise residential buildings been built in Malaysia. Which are is your preference if you have a choice to choose and to live.

	Single slab layout having common corridor along building façade.	
	Double sandwich block with internal courtyards	
	Tower block	
	Not Important	
	Not sure	

2. One of the issues living in high-rise housing is doing laundry and hanging the clothes to dry.

Based on the ways of hanging clothes below, pls. indicate your preference:

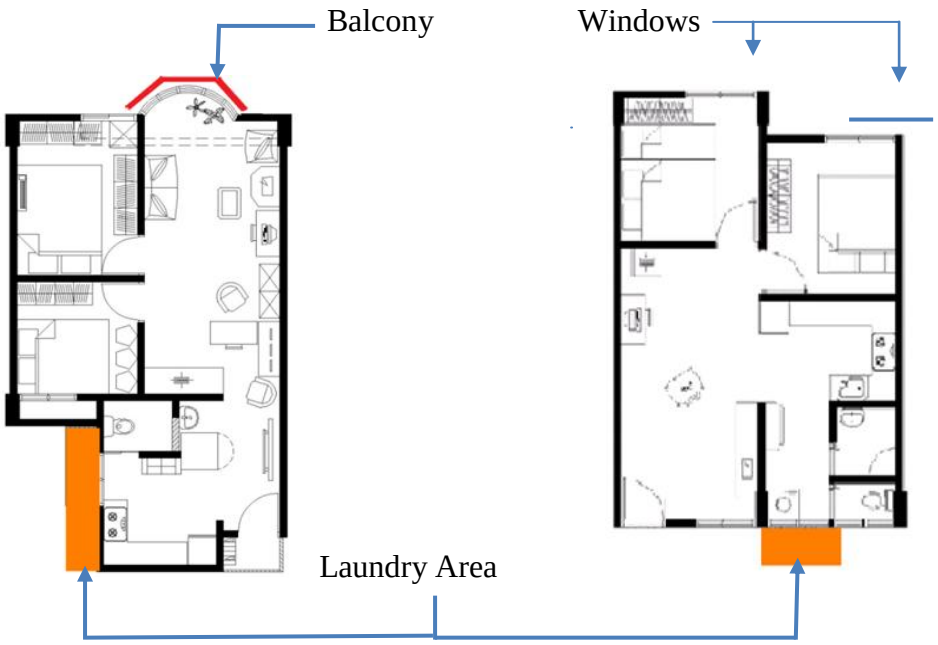
1- Least preferred; 2 – Not likely to choose; 3 Neutral; 4 – Likely to choose; 5 - Most preferable.

	Types of laundry						
9.1	Exposed outside buildings						
9.2	Using poles to dry clothes						
9.3	Windows drying						
9.4	Concealed drying						
9.5	Having ‘birdcage’						

9.6	Screened panel						

3. From the pictures below, rank the importance of drying clothes location.

	Balcony	
	Window	
	Laundry Area	
	Don't Know	



4. Solutions to consider to overcome drying clothes in high rise living. Rank the importance of the following factors regarding drying area.

	Types		SA	A	N	D	DK
	Balcony						
	Windows						
	Concealed Drying						
	Exposed Drying						
	Don't know						

SA- Strongly agree, A- Agree, N- Neutral, D- Disagree, DK- Don't know