

**DEFICIENCY ANALYSIS
AND RECOMMENDATIONS
FOR IMPROVEMENT OF
HOUSING IN YANGON**

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Abstract

The main intention of this research is to provide a basis for improved solutions for the future development of housing in Yangon, Myanmar. Yangon has expanded from 348 km² in 1985 to 599 km² in 2003. Due to the development of new satellite towns in order to meet the rapid growth of the urban population and the accordant housing demand after 1988, the government and private sectors tried to supply housing by various strategies. However, there appeared weaknesses with respect to functional, social, cultural and climatic aspects in the design and planning, especially in the low and middle class apartments in Yangon. Analyzing these weaknesses is the precondition to develop recommendations for a better design and planning.

In order to develop the recommendations on a scientific basis, the research deals with four main questions:

- 1) What are the special conditions of housing in Yangon?
- 2) What is the method to detect deficiencies?
- 3) What are the deficiencies of housing in Yangon?
- 4) Is there a potential input by German experiences and problem solutions for better planning in Yangon?

Concerning the first question, the historical development of housing projects and supply strategies is shown. Furthermore, the point and block type (as housing types) and the hall and room type (as apartment types) are presented in details. In order to substantiate the special conditions in Yangon, the main functional, social, cultural, economic and climatic factors which influence housing are reported.

Regarding the functional aspect a result is that there happened a transformation of the spatial arrangement in rural area houses to that of urban apartments, but holding some characteristics at the same time. As factors of the social conditions, average household size, age distribution, in and out migration rates are reported. The social relations inside families and with neighbors as well as the way of people's living style, habits and their behaviors are presented as they are important for the understanding of Myanmar people's way of housing. The spatial arrangements of urban apartments are reflected in relation to these social behaviors. With respect to the cultural conditions, the traditional beliefs concerning constructing the house together with the orientation of floor plan give important hints to understand the spatial arrangement in Myanmar residential architecture. The existence of a shrine in every apartment as well as of the space for leaving shoes at the entrance also belongs to the findings. Regarding the economic condition, it is learned that rent cost is cheap. Examining the

cost factors in relation to Plinth Area Estimate (PAE) rate developed by Department of Housing Settlement and Housing Development (DHSHD), the costs with respect to room dimensions, to the numbers of storey, and the form of the apartment influence the economic aspect. Climatic conditions with relevance to architecture such as the amount of sun shine, sun angles, rainfall, temperature, relative humidity and wind velocity are presented. In addition, architectural features and components affecting natural ventilation, natural lighting and sun control devices are shown.

The method to detect deficiencies in an ordered and transparent way uses an aspect tree. The main aspects, by which judgments on certain objects or features of objects are made, are divided in sub aspects and sub sub aspects. The whole tree is thought to map the important performances of the selected apartments and buildings.

The deficiency analysis is focused on the four performances: functional, social, cultural and indoor environmental quality. The selection of cases was done by five defining factors: location, time, financial organization, types of housing compound and building. The examination of the adequacy of functional areas by four main areas: communication and access area, public area, private area, and cooking and supplying area indicates some deficiency of the order of functional areas. The analysis of the area sufficiency using the comparison of occupancy rate, examined by average household size, with the standards of international institutions' results in the inadequacy of areas in some selected cases.

The investigation of the social performance looks for the suitability of available spaces for social activities. The examination was carried out at hand of the questions: which activities are mostly done at which space and whether there is enough space for these activities. Main deficiency has been detected that there is not enough and no adequate space for the social communication of residents as well as with neighbors.

Examining the cultural aspects, which strongly influence the spatial composition of apartments, the result was found out that there is only poor space for praying, depositing shoes, and donating activities. The indoor environmental quality is inspected by two aspects, natural ventilation and natural lighting. The analysis of various aspects such as air flow system, ratio between opening and floor area, room depth as well as orientation of building shows various weaknesses of the indoor environmental quality in most of the selected apartments.

To deal with the last question, some comparable projects of German housing after the First World War are considered. They have been selected by their similarity concerning urgent housing demand for poor and low middle class people in Germany at that time. Some of the transferable problem solving tools for minimizing space has been: to supply double used space by sliding doors, to provide foldable beds, as well as to plan long outside corridors with common stairways for social communication.

The deficiency analyses and solutions of German cases enable it to access improvements of design and planning of housing. They are presented in form of recommendations and schematic proposals. Thereby a rich repertoire of improvements is offered. The advantages and disadvantages of the proposals are named. Single recommendations and proposals concerning a certain aspect (like e.g. the functional one) can improve that aspect, but at the same time can come into conflict with a solution of another sub system (like e.g. the cultural one). Therefore a decision is to be made by taking into account the special situation and special users' needs. Finally it is concluded, that a general recommended step is the linkage between users' needs and design. The negotiation between users, developers and designers is an important issue to achieve a better quality of future housing in Yangon.

Zusammenfassung

Das Hauptziel dieser Arbeit ist es, eine Basis für verbesserte Lösungen für die zukünftige Entwicklung des Wohnbaus in Yangon, Myanmar zu schaffen. Yangon hat sich von 1985 bis 2003 von 348 km² auf 599 km² ausgedehnt. Bedingt durch die schnell anwachsende Stadtbevölkerung und den daraus resultierenden Wohnungsbedarf entstanden nach 1988 neue Satellitenstädte; dabei erprobten Regierung und Privatunternehmen verschiedene Strategien, um Wohnungen bereit zu stellen. Dabei traten jedoch Schwachpunkte auf in Bezug auf funktionale, soziale, kulturelle und klimatische Aspekte im Entwurf und in der Planung, ins besondere in den Armen- und Mittelstandswohnungen. Diese Schwachpunkte zu analysieren ist eine Vorbedingung, um Empfehlungen für bessere Entwürfe und Planungen zu entwickeln.

Um Empfehlungen auf wissenschaftlicher Basis zu entwickeln, beschäftigt sich die Arbeit mit vier Hauptfragen:

- 1) Was sind die speziellen Bedingungen für Wohnungen in Yangon?
- 2) Was ist die Methode um Mängel zu ermitteln?
- 3) Welche Mängel haben Wohnungen in Yangon?
- 4) Gibt es Möglichkeiten, deutsche Erfahrungen und Problemlösungen in eine bessere Planung in Yangon mit einzubeziehen?

Hinsichtlich der ersten Frage wird die historische Entwicklung von Wohnungsprojekten und Versorgungsstrategien gezeigt. Außerdem werden der Punkt- und Blocktypus (als Gebäudes Arten) und die Hallen- und Raumtypen (als Apartment Typen) ausführlich dargestellt. Um die speziellen Bedingungen in Yangon zu konkretisieren, werden die wichtigsten funktionalen, sozialen, kulturellen, ökonomischen und klimatischen Faktoren, die das Wohnen beeinflussen, dargestellt.

Ein Resultat in Bezug auf den funktionalen Aspekt ist, dass eine Umwandlung der räumlichen Anordnung in ländlichen Häusern hin zur städtischen Wohnung stattfand, bei der aber gleichzeitig einige Eigenschaften beibehalten wurden. Faktoren der sozialen Bedingungen wie durchschnittliche Haushaltsgröße, Altersgliederung, Zu- und Abwanderung werden aufgezeigt. Die sozialen Beziehungen innerhalb der Familien sowie mit Nachbarn, der Lebensstil der Bewohner, ihre Verhalten und ihre Gewohnheiten werden dargestellt, da sie für das Verständnis der Art und Weise, wie die Menschen von Myanmar wohnen, wichtig sind. Die räumliche Aufteilung der städtischen Wohnungen wird in Bezug auf das Sozialverhalten reflektiert.

Die kulturellen Bedingungen geben wichtige Hinweise auf die Raumaufteilung der Wohnungsarchitektur von Myanmar. So bestimmt der traditionelle Glaube Konstruktion und Raumplanung des Hauses. Zu den kulturellen Besonderheiten gehörten der Schrein sowie der Platz für Schuhe am Eingang. Als wirtschaftliche Bedingung ist festzuhalten, dass die Miete sehr gering ist. Die Untersuchung der Kostenfaktoren für den Bau von

Wohnungen beruht auf der Plinth-Area-Estimate (PAE), entwickelt von Department of Housing Settlement and Housing Development (DHSHD). Danach beeinflussen die Raumdimensionen, die Anzahl der Geschosse und die Form der Wohnung die Wirtschaftlichkeit. Klimatische Bedingungen, die von Bedeutung für die Architektur sind, werden aufgezeigt, wie die Sonneneinstrahlung, der Sonneneinfallwinkel, der Niederschlag, die Temperatur, relative Luftfeuchtigkeit und die Windgeschwindigkeit. Zusätzlich werden Architektureigenschaften und -komponenten gezeigt, die die natürliche Belüftung, natürliche Belichtung und den Sonnenschutz beeinflussen.

Die Methode, um Mängel aufzudecken, beruht auf einem Aspekte-Baum. Dabei sind Hauptaspekte, bezüglich derer Güte- bzw. Mängelurteile gefällt werden, in unter-Aspekte und unter-unter-Aspekte aufgesplittet. Der vollständige Baum dient als Orientierung, um die wichtigen Leistungen der ausgewählten Wohnungen und Gebäude darzustellen.

Die Mängelanalyse richtet Ihr Augenmerk auf vier Hauptpunkte: funktionale, soziale, kulturelle und Innenraum-Qualität. Die Auswahl für die Fallstudie wurde durch fünf Faktoren bestimmt: Ort, Zeit, Finanzorganisation, Siedlungs- und Gebäudetyp.

Die Analyse funktionaler Mängel bezieht sich auf vier Hauptbereiche: Kommunikations- und Zugangsbereich, allgemeiner Bereich, privater Bereich sowie Koch- und Sanitärbereich. Diese Bereiche zeigen Mängel hinsichtlich der Raumanordnung. Die Analyse der Angemessenheit der Raumgröße basiert auf der durchschnittlichen Haushaltsgröße und den Standards internationaler Institutionen. Die Analyse der sozialen Leistungsfähigkeit befasst sich mit der Eignung vorhandener Räume für soziale Aktivitäten. Die Untersuchung folgt der Frage, welche Tätigkeiten überwiegend in welchem Raum erfolgen und ob es genügend Platz für diese Tätigkeiten gibt. Als Hauptmangel stellte sich heraus, dass der Raum für die soziale Kommunikation der Bewohner weder ausreichend noch angemessen ist.

Untersucht wurden auch die kulturellen Eigenheiten, die den räumlichen Aufbau der Wohnungen beeinflussen. Dabei stellt sich heraus, dass es nur unzureichenden Raum für das Beten, das Ablegen der Schuhe und die Ausführung von zeremonielleren Aktivitäten gibt. Die Innenraumqualität wird durch zwei Aspekte bestimmt, natürliche Belüftung und natürliche Belichtung. Die Analyse bezieht sich auf verschiedene Aspekte wie Belüftungssystem, Verhältnis von Öffnungen zu Bodenfläche, Raumtiefe sowie Ausrichtung des Gebäudes. Die Ergebnisse zeigen verschiedene Schwächen der Innenraumqualität in den meisten der ausgewählten Wohnungen.

Zur Frage möglichen Inputs aus Deutschland werden einige vergleichbare deutsche Fälle nach dem ersten Weltkrieg betrachtet. Diese Zeit wurde wegen ihrer Ähnlichkeit hinsichtlich des dringenden Wohnungsbedarfs der ärmeren Bevölkerung sowie des niedrigen Mittelstandes ausgewählt. Einige der übertragbaren Lösungsverfahren für die Minimierung

des Raumes sind: Der Einsatz von Schiebetüren, um eine Doppelnutzung von Räumen zu ermöglichen, Bereitstellung von zusammenklappbaren Betten, Planung von langen äußeren Fluren in Verbindung mit gemeinsamen Treppenhäusern, um eine bessere soziale Interaktion zu gewährleisten.

Die Mängelanalysen und einige Lösungen in deutschen Fällen ermöglichen es, Verbesserungen in Entwurf und Planung von Wohnungen anzusteuern. Sie werden in Form von Vorschlägen und schematischen Darstellungen präsentiert. Dabei wird eine große Anzahl von Verbesserungsmöglichkeiten aufgezeigt. Die Vorteile und die Nachteile der Vorschläge werden genannt. Einzelne Empfehlungen und Vorschläge hinsichtlich eines bestimmten Aspektes (wie z.B. des funktionalen) können diesen verbessern, aber gleichzeitig in Konflikt mit der Lösung eines anderen Problems geraten (wie z.B. dem kulturellen Aspekt). Folglich sollen Entscheidungen die spezielle Situation und die jeweiligen Bedürfnisse der Benutzer berücksichtigen. Die Verhandlungen zwischen Benutzern, Entwicklern und Entwerfern sind eine wichtige Möglichkeit, um eine bessere Qualität des zukünftigen Wohnens in Yangon zu erreichen.

1.

INTRODUCTION



CHAPTER 1: Introduction

The development of living standards in urban areas mainly depends on the interplay between economic, social and cultural organization, transportation and communication facilities. It is also strongly bound to the development of suitable housing.

Yangon, formerly known as 'Rangoon', is the old capital city of Myanmar. It is one of the most important urban centers of the union of Myanmar. Yangon has a present population of 4.5 million, accounting for 8 % of the total union population. With the present population growth rate of 3.4 %, Yangon population will reach ca. 10 million by the year 2030. The city has grown rapidly in recent years and new suburban satellite townships have been developed by the government to accommodate the increasing population and to resettle the inhabitants.¹

Housing is one of the most important aspects of architectural and urban planning. Due to the development of new satellite towns since 1988 and a change of Government policy, the north-wards sprawl of the city has changed into a cross pattern on an east-west axis. Many projects and actions affecting the current level of housing and urban development were launched at that time.²

Because of the increasing growth of the urban population and also because of the importance to avoid consequential social problems, there is an ongoing and even increasing necessity to deal with the housing problem. The housing problems in Yangon are especially enhanced by some serious deficiencies in housing design. This thesis will attempt to analyze these deficiencies and, on this basis, to develop improved proposals.

1.1. Defining the problems

Yangon serves as the center of government and is an important population center. It is responsible for half the industrial output, has the largest financial and marketing centers, and is the largest provider of important services in education, health, culture, tourism, research and development.

Because of the great and fast growing demand for housing and the lack of suitable planning concepts, the existing housing facilities are subject to critique on several levels: insufficient sleeping and living space, unavailability of fresh air due to the housing floor plan design and lack of recreation areas and open spaces.

¹ National Housing, Town and Country Development Board, Housing in Burma, (Yangon, Myanmar, 1980).

² Swe Swe Aye, Proposal for improvement in walk-up apartments in Yangon, (Ph.D. Preliminary Research Report, Yangon Technological University, Myanmar, 1997), p. 10.

In trying to meet the demand for housing, high density environments need to be built urgently. However, this was done in such a way that some housing does not harmonize with the Myanmar cultural and social conditions, taking little consideration of the traditional living habits which are still common. Therefore, this research is intended to support and improve the housing planning in Yangon with respect to the local requirements.

1.2. Hypothesis

The hypothesis is that there can be improved solutions for the housing in Yangon by analyzing the deficiencies using a systematic method and taking into account the important local influencing factors. These local conditions include functional interior spaces, indoor climate, social and cultural conditions. In relation to this, special mention will be given here to experiences in Germany (Chapter 5). Recommendations and schematic proposals can be developed with different qualities according to the respective criteria. Therefore the main interest is on a detailed and transparent analysis of the named dissatisfying features and the possibilities of improvement on a systematic basis.

1.3. Research questions

The main focus of this research is the development of housing designs, suitable for the residents' needs as well being compatible with Myanmar culture and society. The research questions that arise are as follows:

1. Are the people living in Yangon housing facilities satisfied with their functional interior spaces and outdoor public spaces?
2. How can the indoor spaces in housing be improved in order to achieve a better well being and quality of life for the residents?
3. What are ways of designing housing concepts, which harmonize with inhabitants' needs?
4. Could potential inputs from foreign case studies, specially in Germany, contribute to solve the contemporary housing problems in Yangon?
5. Can better designs be developed for the implementation of functional and affordable spaces for inhabitants?

1.4. Current state of research

Only a few research theses carried out at the Architecture Department, Yangon Technological University, have been submitted to solve the housing problems of Yangon from the urban density, functional, landscape and social point of views. Among them, five research theses are related to housing design and planning.

In "Formulation of Guidelines for Urban Design in Yangon Residential Area", 2000, by Swe Swe Aye, research was carried out on urban density and experimental planning of residential estates in medium and high den-

sity areas in Yangon. This work focused on the use of density ratio calculation to develop proposals for medium and high density areas in Yangon. Another research thesis titled “Norms and Space Standards for Multi-Storeyed Residential Buildings in Yangon City” was published by San San Moe in 1998. Here the basic types of the multi-storeyed apartments before 1988 and after 1988 were studied. The existing space utilization and building space were analyzed by selected case studies. Finally, proposals for single family units were designed, each leading to improved standards for each room in the apartment.

In “Analysis on Recently Built Housing Estates in Yangon” by Htay Htay Myint, 2002, physical planning and design in housing estates was analyzed with special focus on density and existing building spaces.

In “Correlation between Health and Housing for Walk-Up Apartment in Yangon” by Yuzana Lwin in 2006, the research concentrated on recommendations and suggestions with respect to health factors in housing. Firstly, selected local cases were analyzed with respect to space utilization, overcrowding, natural lighting, sanitary facilities, stairs and height of apartments. Finally, design calculations and recommendations for space and density, natural ventilation, and stair ways for walk-up apartments were carried out.

Also in 2006, Moe Thae Phyu published a thesis on the “Analysis on Housing for Low Income Community in Yangon”. It concerns an analysis to the minimum space in low income housing with respect to the existing conditions for the life style of low income families and their living spaces. Moreover, cost factors were studied. Finally, three designs were proposed comprising apartment types with 0, 1 and 2 bedrooms.

Although there are some research projects in Yangon Technological University which have tried to solve the problems of apartments in Yangon from different approaches, there still lacks a comprehensive knowledge basis for the development of strategies for the improvement of the inadequate housing situation.

1.5. Research method

The main object of this research is to contribute to an improvement of housing design in Yangon. In order to do this scientifically, the following strategy will be used: Firstly, in the “analytical step”, data of selected Yangon housings, built since 1980 up until to now, are collected. Selected cases are taken as the central material for the investigation along with existing literature related to them. The deficiencies of the most important aspects, including the functional efficiency, indoor climate, social and cultural conditions in Yangon housing, are analyzed. Also, selected cases of German social housing with special interest in their transferable potential are compared and analyzed.

On the basis of the above analysis, the input for the development of new planning concept for Yangon Housing is considered and developed. Recommendations and different possibilities of housing types as schematic proposals are developed. The advantages and the disadvantages of the proposals are named by a transparent assessment on the basis of the criteria, which have been elaborated in the theoretical approach. The instrumental part with its recommendations and proposals is thought to be an input for the planning agencies of Yangon.

1.6. Structure of thesis

With respect to the named problems and the main hypothesis (see section 1.2), this research explores the government and private sector.

This thesis consists of five main chapters:

The first part (Chapters 1 and 2) provides the historical background and housing conditions in Yangon. Two main types of buildings are categorized: point type and flat type. In these building types, two apartment types can be identified, i.e. the hall and the room type apartment. Numerous complications are encountered due to the impact of different aspects, e.g. functional, social, cultural, economic and climatic conditions. The functional condition can be evaluated with the help of the following basic questions:

1. How is the spatial arrangement of Yangon apartments?
2. How have traditional spatial arrangements changed?
3. How do they interact with the domestic setting in the new (modern) Yangon apartments?

With respect to the social condition, analysis focuses on the social spaces and the habits of family members and the interactions between neighbours. These social relationships are discussed in Chapter 2.

Regarding the cultural condition, the analysis concentrates on the role of Myanmar traditional culture, the role of ceremony and rituals in the construction of houses in Myanmar. This extends also to the location and alignment of buildings and the orientation of floor plans, the location of the shrine, and the entrance space. As for the economic factor, the average household expenditure, Plinth Area Estimate (PAE) rate, from the Department of Human Settlement and Housing Department (DHSHD), and cost factors affecting the housing are considered. Finally, climate conditions are reported, as they are the main factors influencing the building design. General climatic conditions such as the amount of sun shine, rainfall, temperature, relative humidity, wind velocity and other climatic data are presented.

In the next part (Chapter 3), an instrument is developed to detect the deficiencies by a transparent and systematic procedure. The method is developed in order to observe the bad and weak points of each selected case. The core of the method revolves around an ordered set of criteria guiding the evaluation of the selected cases. The order resembles that of a tree, here called, “the aspect tree”, with a clear hierarchical order. The main aspects are functional performance, social performance, indoor environmental quality, and cultural performance. Sub aspects and sub-sub aspects are developed for each criteria in order to explore the requirements of the selected cases. The deficiencies of each case will be named.

Before further investigation of each case, it is necessary to limit the area of research. The limitation is done with respect to five points. They are: location, construction time, financing organization of housing supply, type of housing compound and type of building. According to these five points, the final selection of cases is decided.

Chapter 4 focuses on the critical analysis of the specific cases. The selected cases are evaluated according to the different aspects and sub aspects of the deficiency criteria. At the end of each analysis, conclusions are summarized.

Chapter 5 examines the potential input from German cases. Selection of the German cases depends upon: whether they can be used for housing development in Yangon. Some German cases after the First World War are taken, since several characteristics of these cases share common ground with the current problems in Yangon. The potential inputs mainly concern the design consideration for a minimum m² and the design of functional spaces with low cost. These inputs are valuable in giving recommendations on the development of housing design in Yangon.

Chapter 6 concentrates on the improvement of housing planning in Yangon. A list of recommendations will be given. The recommendations are desired from the critical analyses of the respective deficiencies along with the potential input from German cases. Schematic sketches illustrate possibilities based on the recommendations. The advantages and disadvantages of each proposal are discussed.

2.

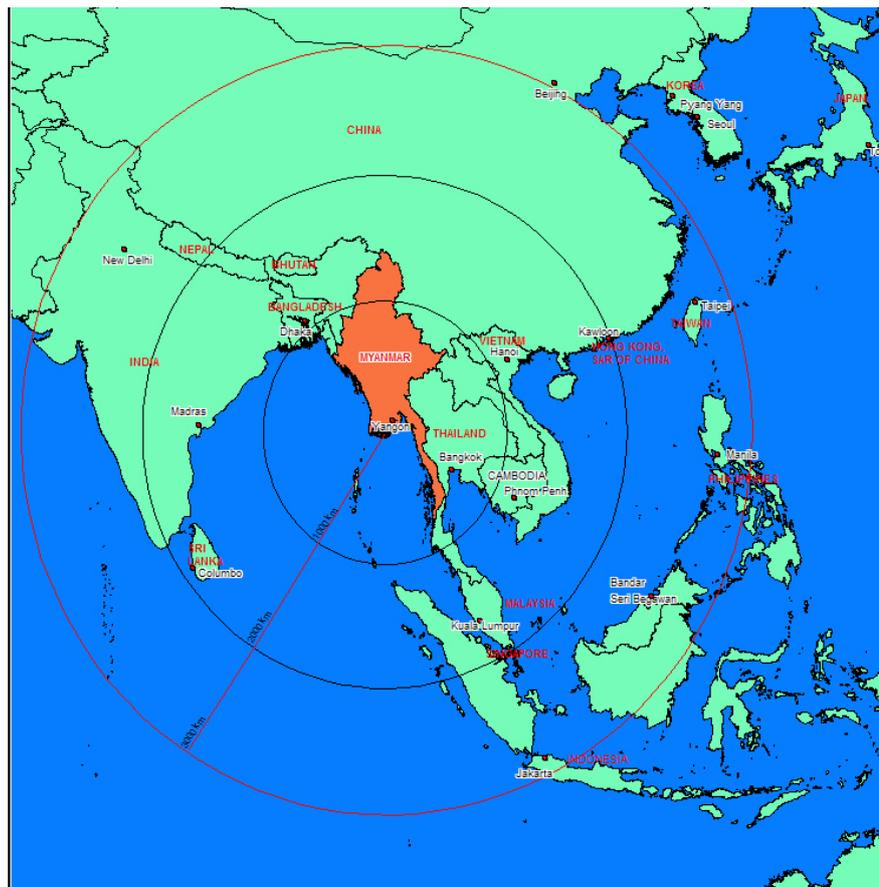
HOUSING IN YANGON - HISTORY, TYPES, AND CONDITIONS



CHAPTER 2: Housing in Yangon

2.1. Yangon background, history and site conditions

Yangon is the old capital of Myanmar, which is the largest country in South-East Asia. It has a total area of 678,500 km². It is located between latitude 10-30 degrees north and longitude 92-101 degrees east. The country is sandwiched in between two of the largest countries in Asia: China to the east and India to the west, providing it with enormous trade opportunities.³ (Map 1)



Map 1: Location of Myanmar

Source: Malaysian Industry Government Group for High Technology, Interim Report, Yangon Strategic Development Plan, Yangon, April 2005, p. 1.

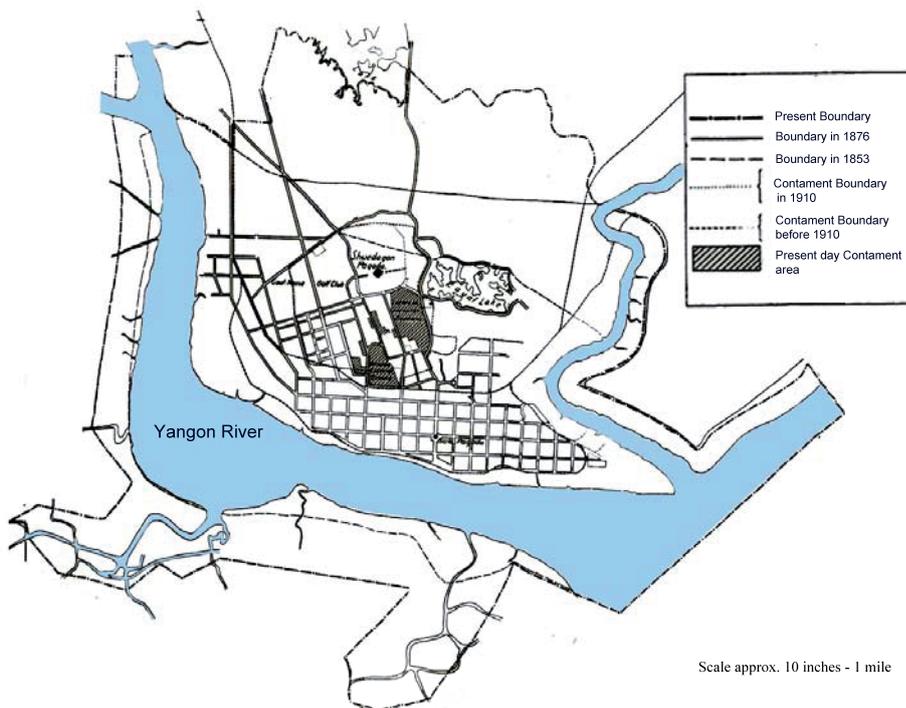
“Yangon owes its history to two factors, the ‘Shwedagon Pagoda’ and the ‘River’. The former made it a place of note in earlier ages; the later has made it the chief port of Burma today. Yangon (former name: ‘Rangoon’) must have been a centre of religious life from very ancient days. The hill on which the Pagoda stands, rising high above the level flats of the Irrawaddy Delta, would be an obvious place for a shrine even in primitive ages; and probably the Hill was a place of worship centuries before the Buddhist era.”⁴

³ Swe Swe Aye, Proposal for improvement in walk-up apartments in Yangon, (Yangon, 1997), p. 8.

⁴ B.R. Pearn, History of Yangon, (England, 1939), p. 3.

“It was founded as Dagon in the 500s by the ‘Mon’, who dominated the lower portions of present-day Myanmar at the time. It is situated in the southern part of the Pegu Yoma Mountains. Dagon was a small fishing village centered around the Shwedagon Pagoda. In 1753, King Alaungpaya conquered Lower Burma, and renamed ‘Dagon’ to ‘Yangon’, which derives from the words ‘Yan’, which means enemies, and ‘Koun’, which means end. The city was destroyed by a fire in 1841, and suffered extensive damage in the Second Anglo-Burmese War of 1852. The British Empire seized Dagon in 1852, and transformed it into the commercial and political hub of Burma. As lower Burma became integrated into British India, the city’s present boundaries were established, with the Cantonment’s streets (downtown area) paved in a chessboard fashion along the eastern banks of the Hlaing River.”^{5,6}

The plan of Yangon city was made in 1852 by Dr. William Montgomery.⁷ His plan was modified with the help of local engineers and the final plan was put up by Lt. A. Fraser in the year 1852.⁸ The area of the city at that time was “about 10 square mile (25.9 km²)”⁹ (Map 2).



Map 2: Plan of Yangon in 1852

Source: By author
Data bases on B.R. Pearn, History of Yangon, England, 1939,
Map no. 4, Appendix.

5 The ‘Mon’ are an ethnic group of Myanmar, living mostly in Mon State, Bago Division, near to the southern Thai-Myanmar border.

6 Spiritus-Temporis.com, Yangon History, online available at < <http://www.spiritus-temporis.com/yangon/history.html>>: accessed on 8.12.2009.

7 Dr. William Montgomery was the army superintendent surgeon and learnt his city planning skills from Sir Stanford Raffles in Singapore.

8 Swe Swe Aye, Formulation of guidelines for urban design in Yangon city residential areas, (Yangon, 2000), p. 8.

9 Pearn, History of Yangon, p. 23.

Yangon is an administrative region of Myanmar which is located in the heart of lower Myanmar (Map 3). The division is bordered by Bago Region in the north and east, the Gulf of Martaban in the south, and Ayeyarwady Region in the west. It is the smallest of Myanmar's 14 states and divisions. It has a land area of approximately 10,276 km², or only 1.5 percent of the total land area of Myanmar (678,500 km²). Yangon Region is dominated by its capital city of Yangon, the former national capital and the largest city in the country (Map 4). In 1990 the population of the Yangon Division was approximately 4.7 million people. The population in year 2000 increased to approximately 5.8 million and its population in 2003 is estimated to be about 6.2 million. The Yangon City Development Council (YCDC) or Yangon City area comprises 33 townships. In addition there is a new township, called 'Dagon'; it covers a total area of about 795 km². The total estimated population in 2005 was 4.4 million. It is largely concentrated in the downtown area and the old townships of Okkalapa and Tharketa. The city is located in the area between the Hlaing (Yangon) River and the Bago River, about 34 km from the Andaman Sea.



Map 3: Location of Yangon

Source: Manas Informatics Pvt. Ltd., Yangon, Myanmar, available online at <<http://www.topnews.in/files/Yangon-map.gif>> accessed on 20.08.2009.



Map 4: Yangon Map

Source: Google Map, Yangon Map, available online at <http://maps.google.de> accessed on 20.08.2009.

The development of Yangon is embedded in the general international trend of developing countries, where capitals become attractive destinations because of the working and living opportunities. A general movement from the primary sector of economy, the rural one, to the secondary and the tertiary sector can be observed. Connected with the respective migration and the growth of the cities also there has been a change from traditional housing in rural areas to the conditions of modern urban living; however the cultural binding is still strong. The expansion of Yangon from 1963 to 2003 is depicted by Map 5.

The physical relief of the city has affected its growth to a great extent. From its origins in the inner city area, the city generally grew towards the north with expansion to the east and west, constrained by the Pazundong River and the Hlaing River, respectively. The higher terrain in the city runs in a north-south direction with flatter plains to the east and west. There are several recreational lakes in the region, for example Hlawga Lake or the Kan Daw Gyi Lake.¹⁰

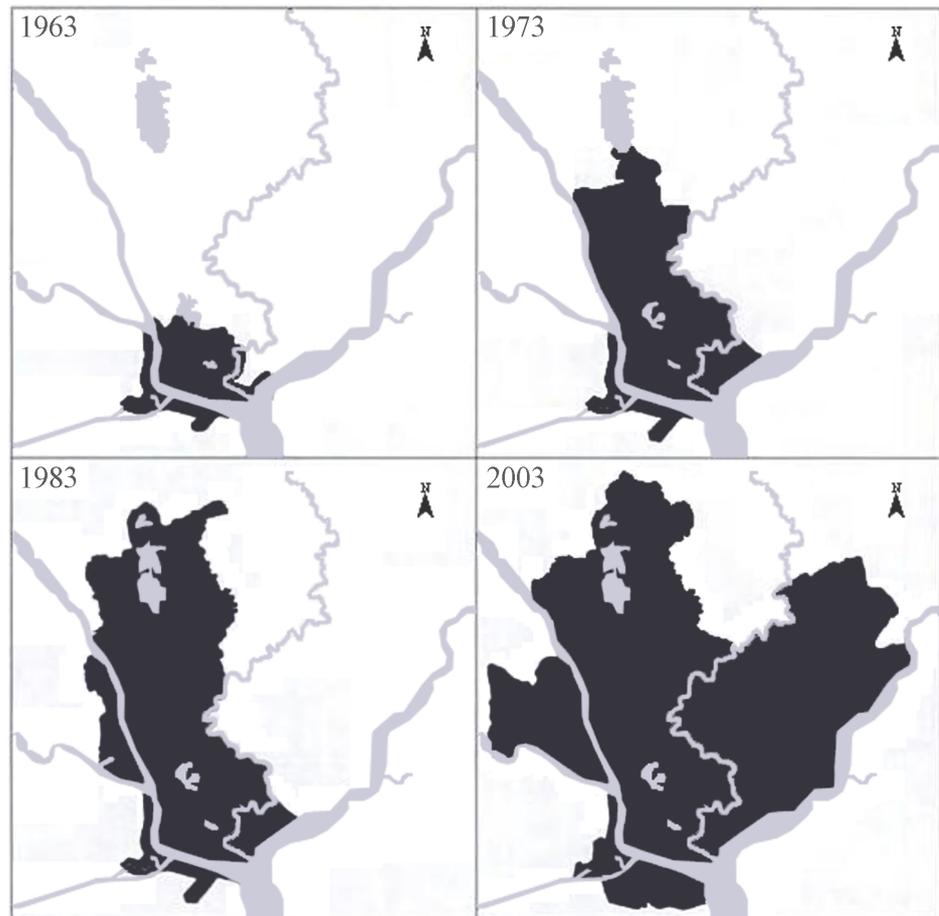
The ravages of war combined with the general post-war population explosion have created a serious housing problems in the newly- independent Myanmar. In Yangon, vast colonies of temporary bamboo huts and thatch appeared like mushrooms.

¹⁰ National Housing and Town and Development Board, Housing in Burma, (Yangon, 1980).

In order to solve this problem, the government set up the National Housing and Town and Country Development Board Act of 1951. During the seventeen years of its existence, this government agency provided 13,000 families with modern homes, mostly apartments, equipped with water-borne sewage facilities and electricity. Due to the development of new satellite towns since 1987 under the planning of National Board, the northwards sprawl of the city has changed to an east-west and north-south pattern.¹¹

Map 5: Expansion of Yangon

Source: By author.
Drawing based on
< <http://wiki-images.enotes.com/thumb/4/49/Yangon-expansion.JPG/250px-Yangon-expansion.JPG> > accessed on 01.03.2010.



2.1.1. Housing supply strategies

Various methods have been implemented to initiate housing and urban development. Some of them were necessary due to the uncontrolled developments of residential buildings in public or private land known as squatter housing.

The task of providing housing has been carried out by using several approaches:

- (1) Public and rental housing
- (2) Government joint housing

¹¹ National Housing and Town and Development Board, Housing in Burma, 1980.

- (3) Programs for individual housing
- (4) Sites and services schemes
- (5) Slums and squatter upgrading
- (6) Urban redevelopment projects
- (7) Low cost land plots for squatters resettlements with the creation of new satellite towns.

Currently, the more popular programs are (5) Upgrading and (7) Low cost housing. Another possible strategy for urban development which the government is exploring is the application of land readjustment.

1) Public and rental housing

Since the early 1950s the Department of Housing Settlement and Housing Development (DHSHD) has been providing public rental housing. There are two kinds of budgetary allocations for the rental housing scheme, one for government employees and the other for the public. The housing units were usually constructed and maintained by the government budget and allocated at a minimal rent.

“Around 1000 dwelling units per year had been constructed in the 1960s, but went down gradually to around 100 units in the early 1980s. From 1995 to year 2000, only 98 units of public housing have been constructed on the expense of government budget.”¹²

2) Government joint housing

Government’s joint housing scheme was introduced by the DHSHD. The idea was to help out the people in ‘saving for their houses’. The down payment of 50 % of the total cost had to be paid by the beneficiaries while the rest including 5 % interest was to be paid out in installments within fifteen years. After total repayment, the houses were to be handed over to the beneficiaries. However, as it was becoming more difficult for the DHSHD to sustain the scheme with the rise of building material costs and inflation, the scheme was abandoned in 1988.¹³

3) Programs for individual housing

In 1974, the ‘Single Family Housing Scheme’ was introduced for people who already owned residential land. However the program benefited only a handful of people. Consequently, the DHSHD handed over the program to the ‘Public Works’ which carried out the scheme for higher level officials. Since 1988, the department has been trying to revitalize individual

¹² Department of Human Settlement and Housing Development (DHSHD), Ministry of Construction, A report on construction activities, (Yangon, 2000), p. 9.

¹³ Khin Wynn, Housing delivery system in Yangon, Powerpoint presentation to 4th Asean Forum Conference, (Tokyo, 2004), p. 6.

housing scheme targeting the lower level budget group by building smaller area individual houses on currently developed plots.¹⁴

4) Sites and services schemes

Sites and services schemes were occasionally practiced since 1989 in and around Yangon for new town extension, squatter resettlement, fire victim resettlement and upgrading projects. The services included roads, drains, electricity and community tube wells. The infrastructure development costs were usually subsidized by the state. Significantly large sites and services schemes have been implemented after 1989. Approximately 160,000 plots for a round about 400,000 persons have been developed in three new settlements to the east, west and north of Yangon. About 200,000 squatter settlement dwellers have been provided with land lease on plots with basic infrastructure. 93050 plots have been developed from 1995/1996 to 1999/2000 and 88180 plots have been allocated to senior government employees and squatter settlement dwellers.¹⁵

5) Slum and squatter upgrading (hut to apartment scheme)

This program was introduced in 1994 in various parts of the inner city area. The concept is based on relocation of the squatters and the families of the beneficiaries to the apartment units built on-site, rather than resettling them in new satellite towns. A minimum 600 ft² (55.7 m²) to a maximum of 1000 ft² (93 m²) of floor space equipped with water and power supply is usually provided. By mobilizing private sector participation in slum and squatter upgrading schemes, the role of the DHSHD has changed from provider to facilitator.

6) Area redevelopment projects

This kind of project was introduced in 1989 to enhance the general physical appearance of the urban area and to free up important sites for public use such as parks and commercial developments. There have been about 56 urban development projects developed by DHSHD in coordination with private developers. Total investment costs for these projects were about 5599 million kyats (about 5.6 million €). 611 buildings such as high class and high rise apartments, i.e. condominium, plaza, commercial, service and mixed used buildings, have been integrated into the project.

14 Khin Wynn, Housing delivery system in Yangon, p. 7.

15 DHSHD, Report on construction activities, (Yangon, 2000), p. 9.

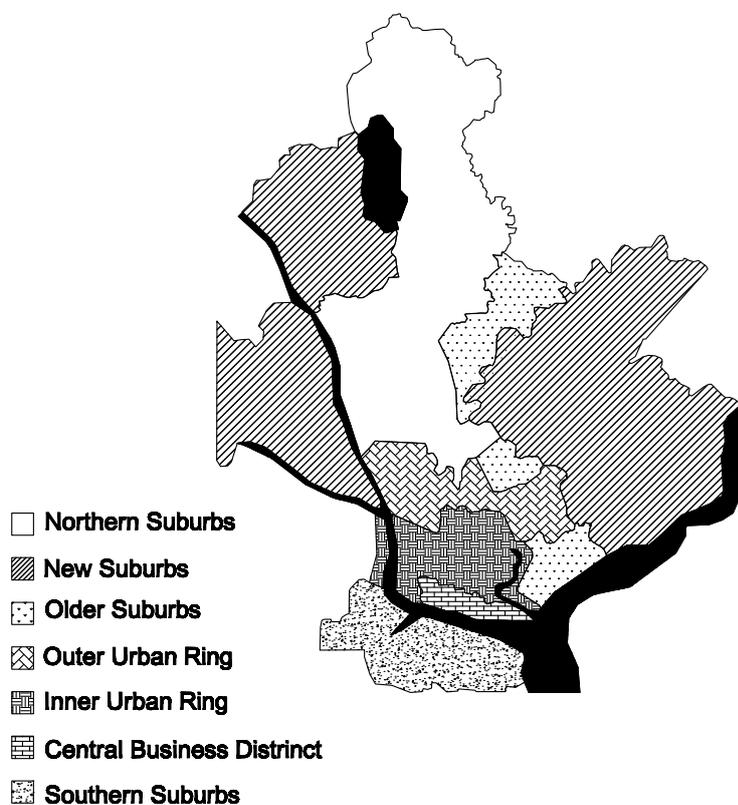
7) Low cost housing

An emphasis has been given to low cost housing since 1997. Low cost apartment housing units have been constructed in Thaketa, Dagon, Hlaing Thayar, North Okklapa and Danyingone targeting lower and middle income people. Unit prices have been charged only for the construction cost of buildings and basic infrastructure excluding the land costs. For several years the DHSHD has been striving to provide housing for the majority of the population. Several housing delivery systems had to be abandoned due to their non-sustainability, while some had to be upgraded and modified to become sustainable in the long run.¹⁶

2.2. Landuse Zones of Yangon City

Yangon city consists of 33 townships which can be classified into the following seven zones (Map 6).

1. Central Business District (CBD)
2. Inner Urban Ring
3. South of CBD
4. Older Suburbs
5. Outer Ring
6. Northern Suburbs
7. New Towns



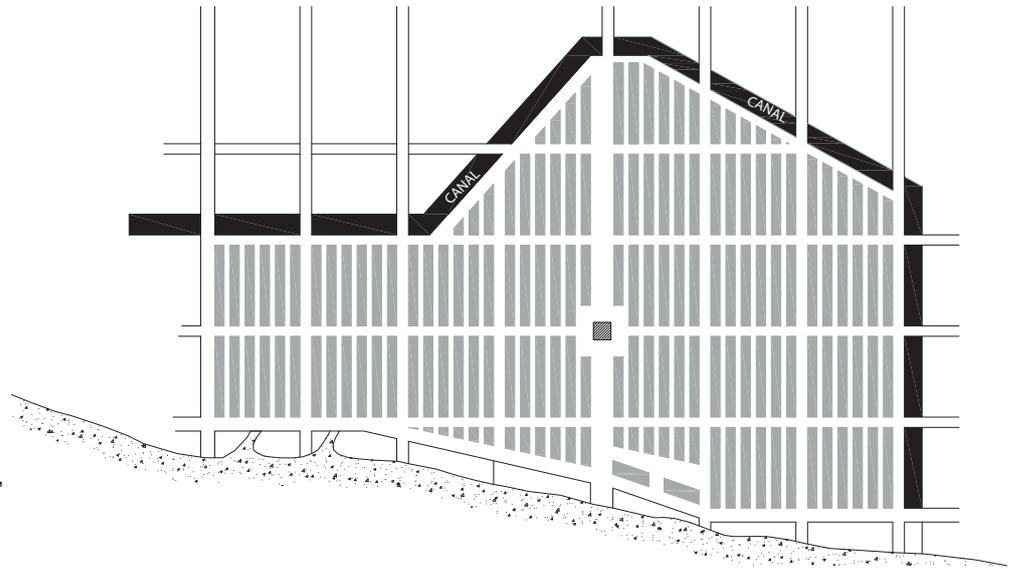
Map 6: Landuse zones of Yangon city.

Source: By author.
Drawing based on Swe Swe Aye, 2000, p. 114.

16 DHSHD, Report on construction activities, p. 10.

Map 7: Plan of officially adopted Yangon

Source: By author
Drawing based on
B.R. Pearn, History of
Yangon, England, 1939,
p. 197.



Sule Pagoda road was chosen as the centre of the road system. The city was founded as a rectangular system, parallel to the river. This area has been the central business district since that time. By that plan, Yangon city was designed for a population of 36000 (Map 7). However the city has outgrown this figure several times over. The city boundary has changed with the passage of time, and expanded to 400 square miles for the whole urban area while the city area has increased to 222 square miles.

Among these zones, Central Business District (CBD) has the highest intensity of commercial and residential land use. CBD and Inner Urban Ring cover around 8 % of the total city area. In northern and new town areas, commercial and residential areas are utilized with lower population density. In CBD, residential areas with the highest density are to be located. The next higher level is found in the Inner Urban Ring in townships such as Tamwe, Sanchaung, Mingalartaungnyunt, Ahlon and Kyeemyintaing. Moreover, residential areas take 30 % of the total township area in Hlaing Township of the Outer Ring. The intensity of commercial areas is highest in Pabedan, Kyaukdata, Lanmadaw and Latha CBDs and the second highest in Northern Suburbs such as Mayangone, and Insein townships. The CBD has in general a low percentage of industrial usage. The township with the highest rate of industrial function is Hlaing. Here you will find 35 % of the city's industrial employment. Small scale industrial zones can be found in Halingtharyar, Shwepyithat, Haling, Insein and Mingaladon townships. Thus, the Outer Ring has the highest concentration of industrial areas.¹⁷

¹⁷ Swe Swe Aye, Formulation of guidelines for urban design in Yangon city residential areas, p. 8-9.

2.3. Kinds of housing projects in Yangon

According to Htay Htay Myint,¹⁸ there are 5 main types of housing projects in Yangon:

- (1) Walk-up apartment housing
- (2) Condominium housing
- (3) Aerial development housing
- (4) Single family housing
- (5) Garden city housing

(1) Walk-up apartment housing

Walk-up apartment housing buildings are a compound of apartments without elevator. Buildings of walk-up apartment housing in Yangon have typically 4, but also, as a maximum, 8 storeys. This kind of housing can be found in government projects belonging to housing strategies like “low cost housing” and “hut to apartment projects” after 1988. Nowadays, since 2004, walk-up apartment housing is found in the projects of private companies working together with the government. This housing model can be found in the CBD, Inner Urban Ring and Outer Urban Ring, New Suburbs and Outer Suburbs in most of Yangon’s areas (Figure 1).



Figure 1: Walk up apartment housing

Source: DHSHD, Report on construction activities, Yangon, 2000, p. 17.

(2) Condominium Housing

Typically, a condominium or ‘condo’ consists of multi-unit dwellings, where each unit is individually owned and the common areas, such as hallways and recreational facilities, are owned by all the unit owners in the building.

¹⁸ Htay Htay Myint, Analysis on recently built housing estates in Yangon, (Yangon, 2002), p. 2.

Mostly at the ground floor, commercial functions such as fancy shops, hair salons and supermarkets are situated. The residential units are in the upper floors of the condominium (Figure 2).

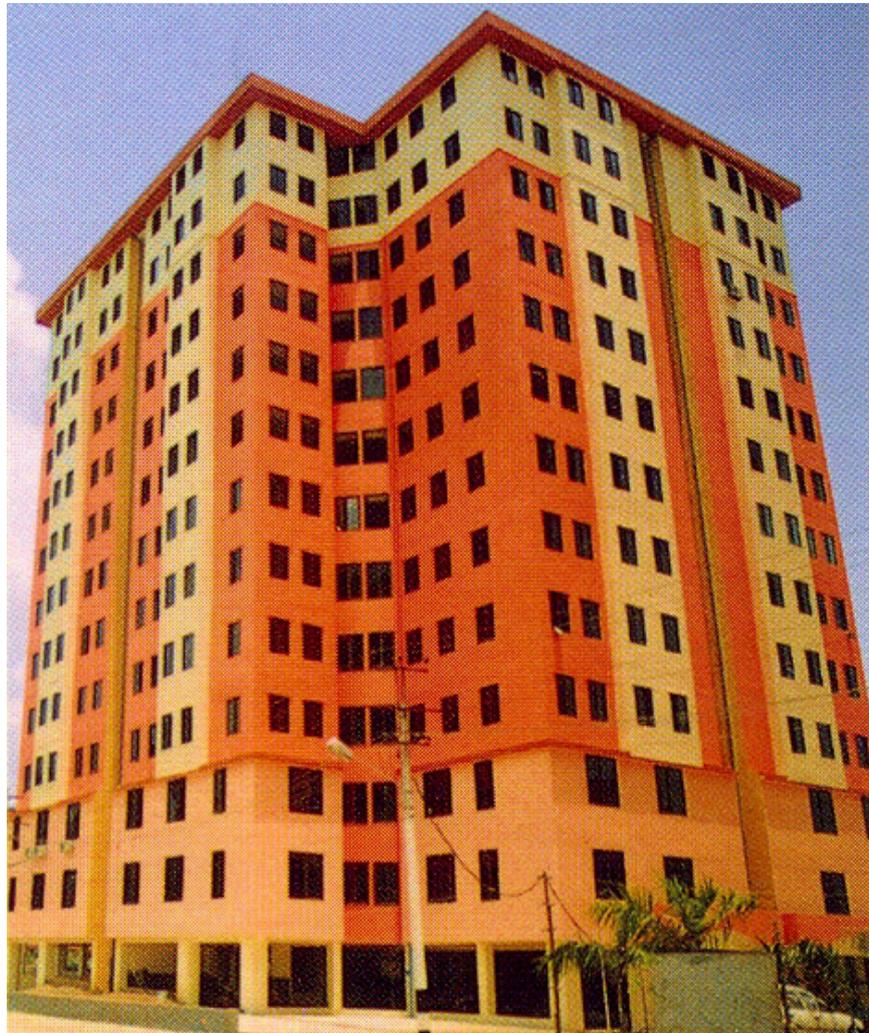


Figure 2: Condominium Housing

Source: DHSHD, Report on construction activities, Yangon, 2000, p. 58.

(3) Aerial Development Housing

“Aerial development housing” is a type of housing projects, where a mix is planned of single family housing, duplex housing and apartment housing. Firstly, the government implemented only apartments. Later on, they added also single family houses, walk up apartments, parks, schools and other social facilities. These kinds of housing projects are found mostly in the Inner and Older Urban Ring (Figure 3).

(4) Single Family Housing

This type of housing is mostly situated far away from the city center. Most of these projects are situated in the New Suburbs, in the Outer Urban Ring and the Older Suburbs. Even though these housing projects are far from the city centre, they represent a good place to live since there is



Figure 3: Aerial Development Housing

Source: DHSHD, Report on construction activities, 1998.



Figure 4: Single Family Housing

Source: DHSHD, Report on construction activities, 1998. Development (Footnote. 15)

fresh air and a natural atmosphere (Figure 4).

(5) Garden City Housing

Most of the garden city housing estate is located far away from the city centre. They can be considered to be upper middle and upper class housing. Families can live in single houses which have their own garden. Playing fields are also in the vicinity. Garden city housing can provide a natural environment, a well formed landscape and social facilities. Super markets, schools, health centers, playing fields are bound in numbers in proportion to the population of the housing estate (Figure 5).



Figure 5: Garden City Housing

Source: DHSHD, Report on construction activities, 1998.

2.4. Housing types according to access system

After the colonization of Myanmar, the British replanned Yangon city with the “Frazer plan” in the year 1852.¹⁹ Based on this plan, the present Central Business District (CBD) areas had a chess board pattern layout with 100 ft (30.5 m) wide East / West main roads, 50ft (15.2 m) wide North/ South main roads and 30 ft (9.14 m) wide secondary roads (Map 8).



Map 8: The present day CBD map of Yangon

Source: By author
Drawing based on Su Su and Swe Swe Aye, Conflicts between Development and Conservation in Yangon Central Business District, Proceedings of the Gulf First Urban Planning and Development Conference and Exhibition, Kuwait, 2006.

19 It is modeled and reconstructed by Lieutenant Fraser, a British Officer of the Engineering Corps.

The space between the roads was either 115 ft (35 m) or 135 ft (41 m) with 15 ft (4.6 m) wide back lanes in the middle. That results in 50 ft (15.2 m) or 60 ft (18.3 m) space for the row type houses. The minimum plot sizes were 25 ft (7.6 m) for the front, which resulted in 12½ ft (3.8 m) × 50 ft (15.2 m) or 60 ft (18.3 m).

However, the CBD area was occupied by the Indian or Chinese people at the beginning of the colonial period. The native Myanmar people lived in the suburban areas such as Kyeemyindine and Sanchaung, which still have the traditional forms of housing. These developments show that the walk-up apartments have been introduced artificially by the early planners. The development has not been an evolutionary change.²⁰

After the beginning of 20th century, more and more Myanmar people started to live in the apartments in central business district, and especially after the Second World War, CBD apartments became favored and expensive dwelling places in Yangon. The apartments of 12½ ft × 50 ft (3.8 m × 15.2 m) can only contain the living room at the front, the kitchen, bath and water closet at the back and the sleeping area in the middle.

Before 1980, apartments were constructed in Yangon CBD areas according to the urban requirements. In the design of apartments, straight flight stairs were used from the ground floor to the top floor. At the beginning, there have been only maisonette apartments with straight flight stairs. Then later the design was developed to the present types of apartment, which consist of duplex apartments with dogleg stairs and four unit apartments with central stairs.

With regarding to the types of apartments, there are two main basic types of apartments: the point type and the flat type. The housing types in Yangon can be categorized into these main categories.

2.4.1. Point type

Point block type apartments can be divided into two sub-categories, namely “duplex” and “central stair” type (Figure 6).

2.4.1.1. Duplex types

The duplex type can be categorized again into the following sub-divisions:

- a) Hall type apartment with one flight of stairs
- b) Maisonatte apartment with one flight of stairs
- c) Maisonatte apartment with dogleg stairs
- d) Hall type apartment with dogleg stairs.

²⁰ Swe Swe Aye, Proposal for Improvement in Walk-up Apartments in Yangon City, (Yangon, 1997), p. 15.

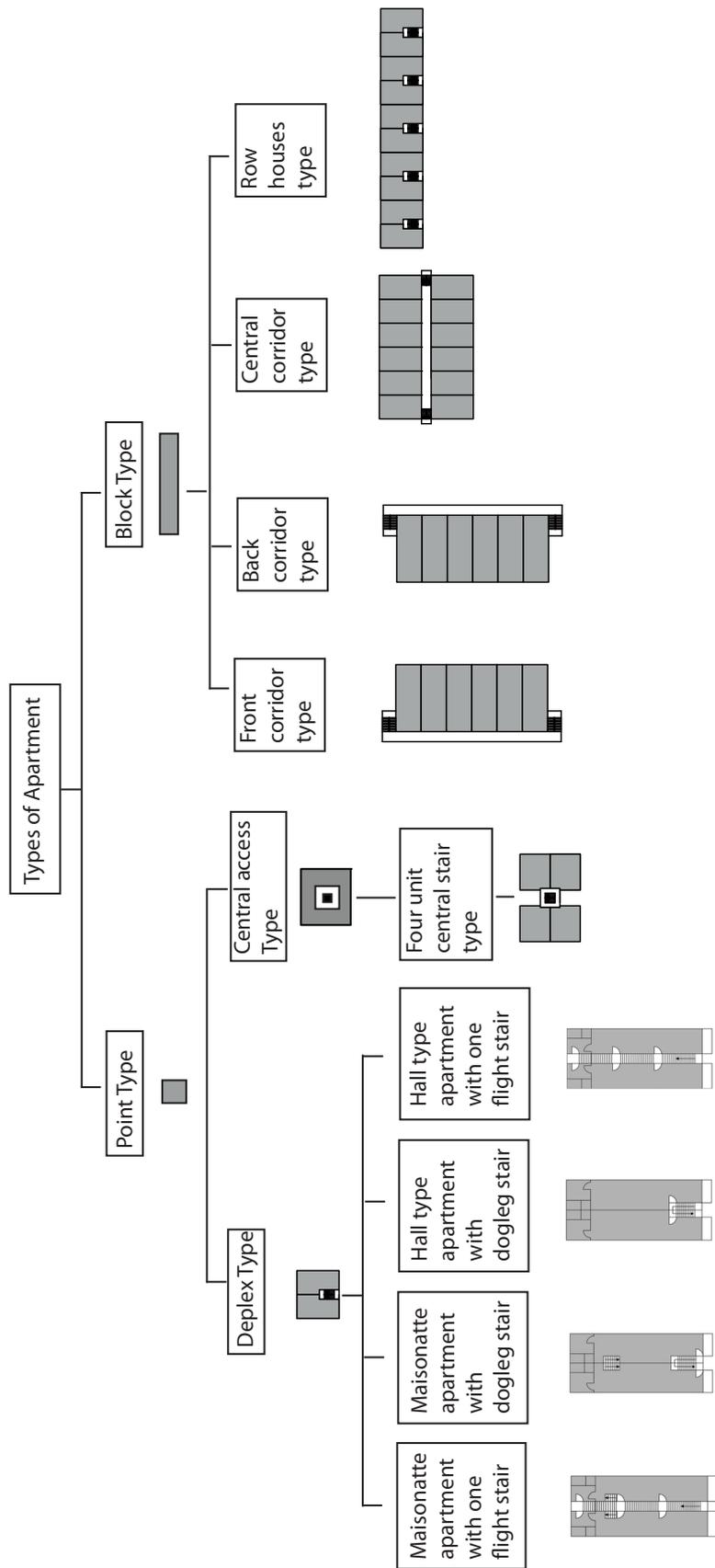


Figure 6: Types of apartment
Source: By author.

(a) Hall type apartment with one flight of stair

This type of apartment was developed before 1988 in Yangon CBD areas according to the requirement of urban living. In the design of the apartment, straight flight stairs were used from the ground floor to the top floor. The entrance of the top floor is at the back part in the kitchen. Not only the usage of straight flight stair is careless for the health of people but also the back entrance at the top floor is not relevant to the Myanmar custom. Also the spatial arrangement is not the same at each floor due to the different entrance of the straight flight stair. Consequently, the design was developed to the type at which the stair for the fourth floor was turned 90 degree from the straight flight not to enter the flat from the kitchen (Figure 7 and 8).

Figure 7: Hall type apartment with one flight of stair (Type-1)

Source: By author.

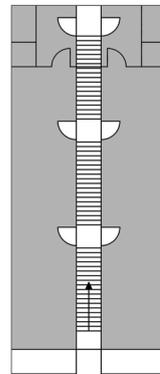
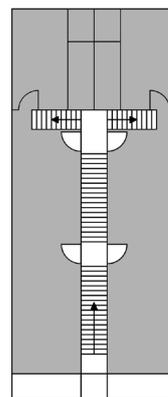


Figure 8: Hall type apartment with one flight of stair (Type-2)

Source: By author.



b) Maisonette apartment with one flight stair

After 1980, a maisonette type with a ceiling height of 7 feet 6 inches was developed. Between 1990 and 1995, another maisonette type was designed (Figure 9). Two flights of stairs were used for public access and inside of the maisonettes a private straight stair was used to gain access to the upper floor. The design was developed further by which the straight stairs were used for access to the first floor and dogleg stairs were used for another floor.

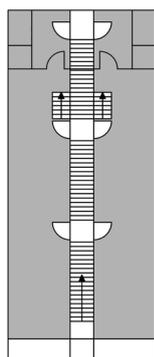


Figure 9: Maisonette apartment with one flight of stairs

Source: By author.

c) Maisonette apartment with dogleg stairs

This kind of apartment was developed between 1990 and 1995. The dogleg stair was used to access two apartments. It is also a maisonette type apartment; the dogleg stairs were used by the public. In every maisonette floor, there are small straight stairs to access the second maisonette floor (Figure 10).

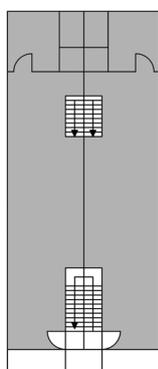


Figure 10: Maisonette apartment with dogleg stairs

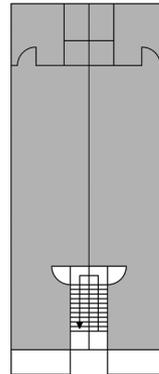
Source: By author.

d) Hall type apartment with dogleg stairs

This type of apartment is the one which has been constructed since 1996 by the private sector as well as by public private partnerships. Access proceeds both to apartments by dogleg stairs. At the front, there is a verandah, then follows the hall. Kitchen, bath and toilet are at the back of the house (Figure 11).

Figure 11: Hall type apartment with dogleg stair

Source: By author.

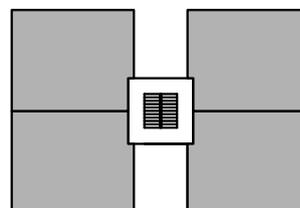


2.4.1.2 Central stair type

This type of apartment building has a central stair case with access to four apartments. It is found in Inner Urban Ring, in the Outer Suburbs and in the New Suburbs area of Yangon. Between each apartment, there is space of about 5 m². This in turn means that each family can get more contact to the exterior and larger window area. By providing a central stair case and landing area, there can be some social area for each family (Figure 12).

Figure 12: Typical four unit central stair type

Source: By author.



2.4.2 Flat type

Flat type apartments have been improved gradually since 1988. These can be differentiated according to whether they have:

- a) Front corridor
- b) Back corridor
- c) Central corridor, and
- d) Row houses type

2.4.2.1. Front corridor type

This type of housing can be found before the revolution of 1988. The government planned this type of housing for low income groups. They are found in several places, for example, in the Yankin Township of the Older Suburb or in the Anawrahta Road, near to the city centre. This apartment is arranged into a row of 6 to 8 family units. Two flight stair cases are provided, reached by the corridor at the front. Generally, the total length of a building with 6 families in one row is 26.5 m and the depth is 15.2 m, excluding the corridor. The floor area of each unit is 58 m². The corridor width ranges between 1.2-1.8 m (Figure 13).

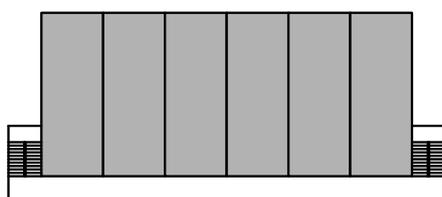


Figure 13: Typical front corridor type

Source: By author

2.4.2.2. Central corridor type

Main feature here is the long corridor along the centre. It is 6 ft (1.8 m) wide and connects 12 apartments on each floor. Stair cases are found at the each end, as is ambident lighting (Figure 14).

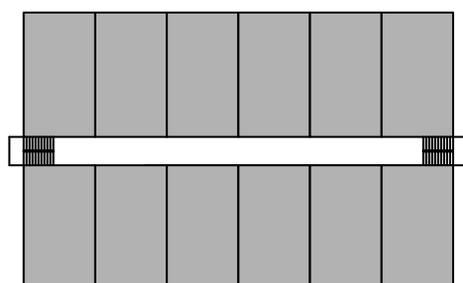


Figure 14: Central corridor type

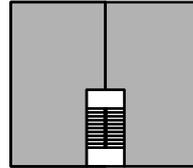
Source: By author

2.4.2.3. Duplex type

This arrangement refers to two apartments having rooms on two adjoining floors accessible by a dogleg staircase and is classed as a hall type apartment, where the two units are arranged in series. The CBD and suburban area of Yangon are common areas where this type can be found. Government planned housing and the private sector have built such arrangements (Figure 15).

Figure 15: Duplex type

Source: By author

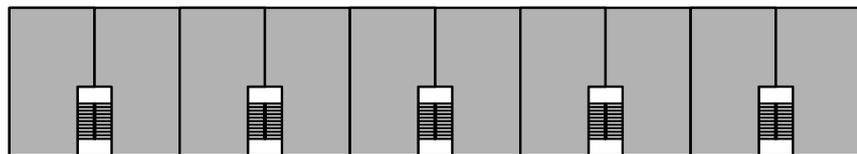


2.4.2.4. Row houses type

Essentially this is simply the combination of several duplex apartments arranged in a row. It is found in both private and public sector housing. The Inner Urban Rings and the Older Suburbs are typical areas where this housing type can be found (Figure 16).

Figure 16: Row houses type

Source: By author



2.5. Basic types of apartments

Basically, there are two types of apartments. They are constructed mainly in walk-up situations. They can be differentiated into 'hall type' and 'room type'.

2.5.1. Hall type apartment

Hall type apartments are apartments in which kitchen, bath and toilet are arranged at the back part of the apartment. The functions for living, working, hosting guests, entertaining, reading, studying and sleeping are planned to happen in the hall. Owners can arrange the location of the functions in the hall according to their desire after buying the apartment. In the original status after construction, it has only a wide hall space at the front part of the apartment, while kitchen, bath and toilets are at the back

of the apartment. These types of apartment have been constructed since the British replanned Yangon city according to the Frazer plan from 1852. Nowadays, hall type apartments are developed according to the design and planning of the private sector as well as of joint venture between public and private sector. Due to the special situations like for example, the road composition, the form of the hall can vary; it can be rectangular, square, or irregular. Figure 17 gives a description of a typical hall type apartment.

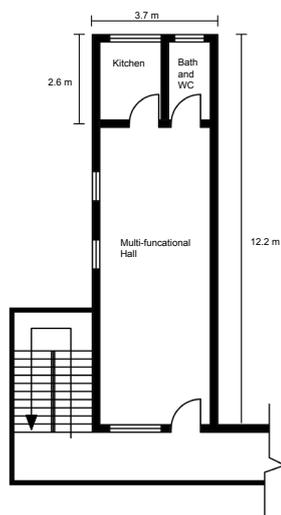


Figure 17: Typical hall type apartment

Source: By author.

2.5.2. Room type apartment

The room type apartment is planned with extra rooms for functions such as sleeping, living, cooking, and dining. In relation to the requirements of inhabitants, room type apartments are planned according to the available floor area and number of rooms. In some apartments, the dining area is found in combination with living area. In some cases, the dining area can even be found within the kitchen. Most of the kitchens are at the back of the apartment. The typical room type apartment is shown in the figure 18.

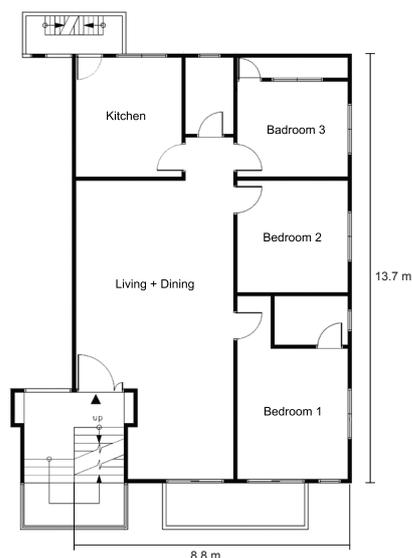


Figure 18: Typical room type apartment

Source: By author.

2.6. Conditions of Yangon Housing

In order to understand the design of housing facilities of Yangon and also to identify the facilities of housing in Yangon, this sub-chapter explores the conditions of Yangon housing. Regarding the conditions of Yangon, it is necessary to study mainly the functional aspects, social aspects within a family and with neighbours, indoor environmental aspects, cultural aspects and economic aspects.

2.6.1. Functional conditions

The following section concentrates on the functional conditions of urban apartments. In order to understand the zoning in urban apartments, it is necessary to know the zoning of rural area houses. The reason is that the people who are living in middle and low class housing in Yangon migrated from rural areas to urban areas after 1988 and are still in the continuity of their rural habits.

2.6.1.1. Myanmar domestic space and its transformation

The arrangement of zones deals with attitudes and kinds of behavior which are typical for traditional housing and has still a strong influence on the present way to deal with the functions in modern urban apartments. A classical traditional Myanmar house is orientated to a courtyard.

The floor plan shows the relative sizes of functional areas and its site. In traditional housing which has developed in the rural areas, one can differentiate four main functional zones: 1) living / sleeping, 2) cooking / dining, 3) working, 4) outdoor activities (Figure 19).

The first one is the main space. Here the family gathers together. To the second one belongs the preparation of food, storage, etc. Bathing and the washing of clothes can be done in the courtyard. One can see that in such a central courtyard house a lot of inward looking open spaces exist. Also it can be said that most of the activity spaces except for private use such as sleeping space and dressing space have semi-interior spatial quality. Living activity and guest receiving activities can be done in each zone. Therefore, it can be found that traditional living spaces are flexible for different activities and comfortable.

Spatial zones of rural area compound house

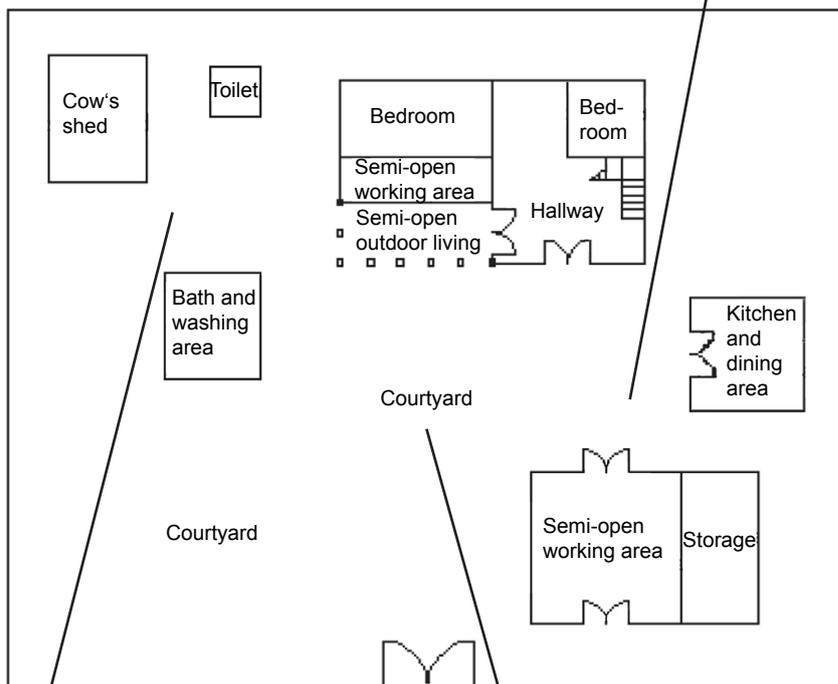
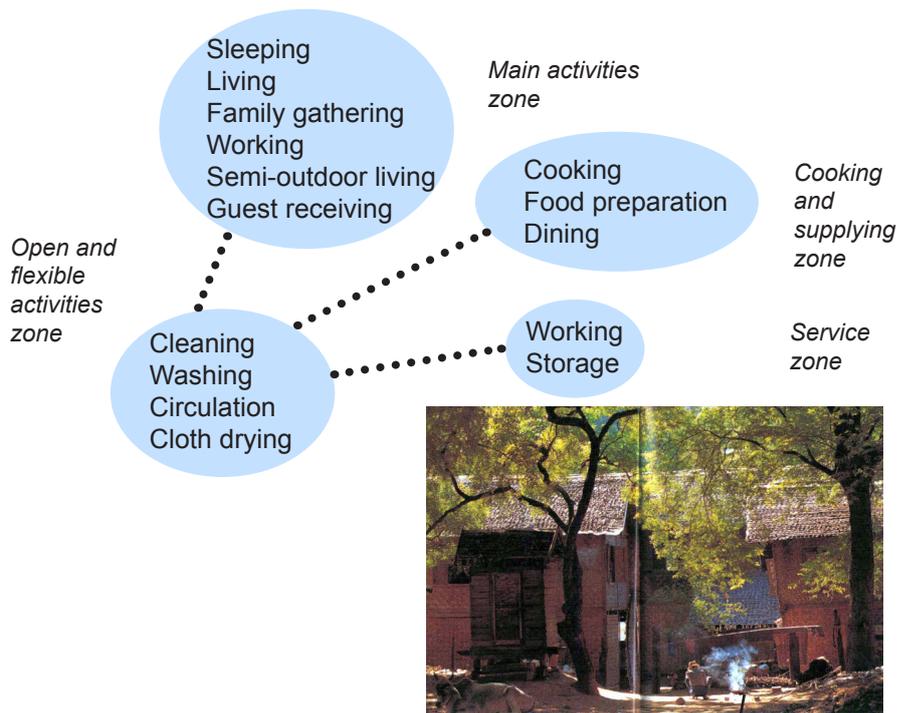


Figure 19: Spatial zones in rural area compound houses

Source: By author

In recent years a transformation process in the organization of domestic spaces has taken place (Table 1).²¹ It can be found that the sleeping space is transformed to the bedroom. The central courtyard is transformed into a multi-functional hall, which is now inside the building. The multi-functional hall can now accommodate more movements and activities such as traditional floor sitting style of living, sometimes dining and sleeping. It is different from the inward-looking open space in the traditional house, because it is outward-looking to see open spaces. Some spatial changes have been made in modern single houses. Bathrooms are now built within the houses or attached to the main building. Therefore, the activity of body washing and cleaning has moved away from the yard to indoors.

Living activities	Changes in space		Changes in use
	Previous	Present	
Sleeping	Multi-functional hall	Bedroom	From floor sleeping to bed
Cooking	Separated kitchen	Separated kitchen: sometimes attached to main building	Floor cooking to modern standing stove
Eating	Kitchen, semi-open space	Dining room	Floor sitting to dining table
Family gathering	Outdoor, semi-open space	Living room	A mixture of floor and chair sitting
Laundry	Bath space in yard	Bath room	-
Bathing	Outdoor bathing	Bath room	Water tank

Table 1: Changes of spaces in rural area houses due to the life pattern and facilities

Source: By author.
Table based on Than Htay Oo, 2009, p. 350.

When the old central courtyard disappeared in some rural areas, its role as a central space to link all the low-level activities together was also lost and attached to the main activity spaces. It is suggested that the old and the new houses can not be compared on a room-to-room basis; instead, these transformation processes can be seen at the hand of the space-activities interaction. It can be found that the rooms in the old traditional house are not equivalent to those in the new ones. Each room, as a spatial unit, was intentionally decomposed to serve the daily activities which characterized the function of the room (Figure 20).

²¹ Than Htay Oo, Modern Trend in Traditional Houses within the Myanmar Context in Central Myanmar, Proceeding of first international conference on science and engineering, (Yangon, 2009), p. 349.

Spatial zones of rural area single house

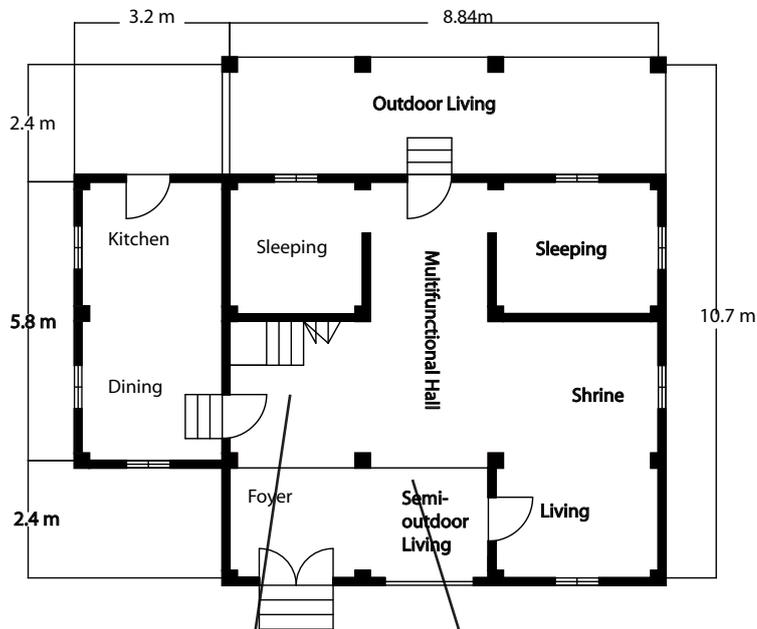
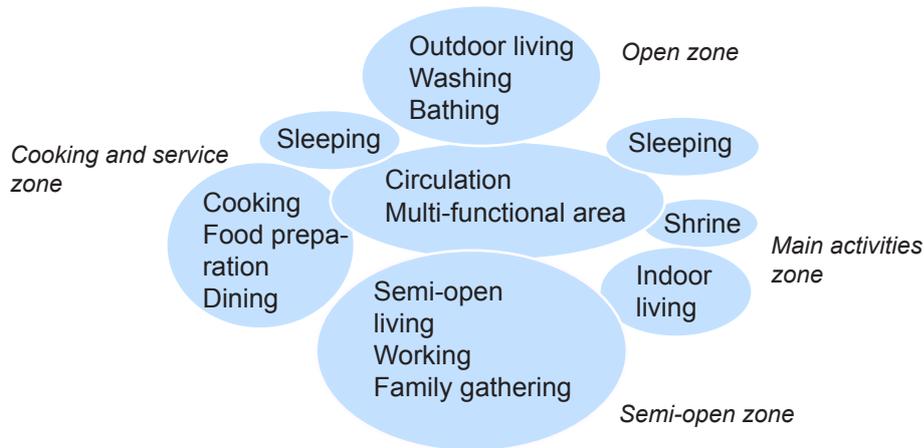


Figure 20: Spatial zones in rural area single houses

Source: By author



In urban housing, a transformation of the multi-functional hall to the indoor circulation area has happened (Figures 21 and 22). This was usually used for living and dining function. Now it is only used for circulation area. Outdoor washing and cleaning activities have been transferred to the bathroom with the installation of a WC. It is evident, that in urban apartments the sleeping space became changed into the bedrooms. This congested inward-looking plan is gradually transformed from the traditional inward space organization to external urban orientation. Therefore, it can be seen now that the people used to look around into the surroundings from the verandah or stair case in the evening and night time, because they wanted to look out of the building to get natural fresh air and ventilation.

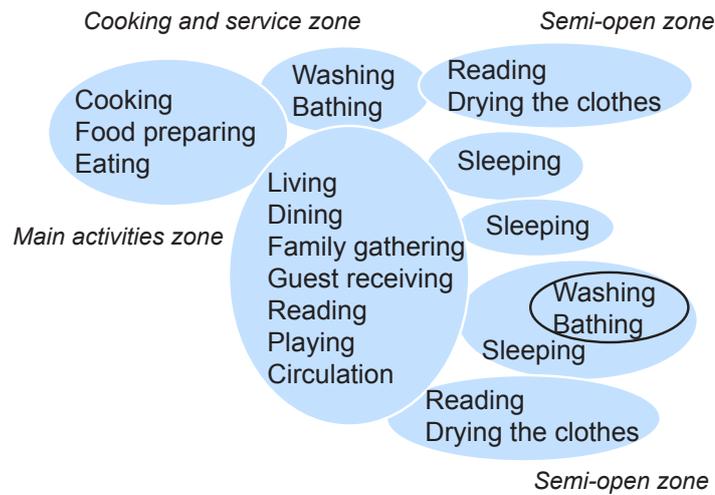
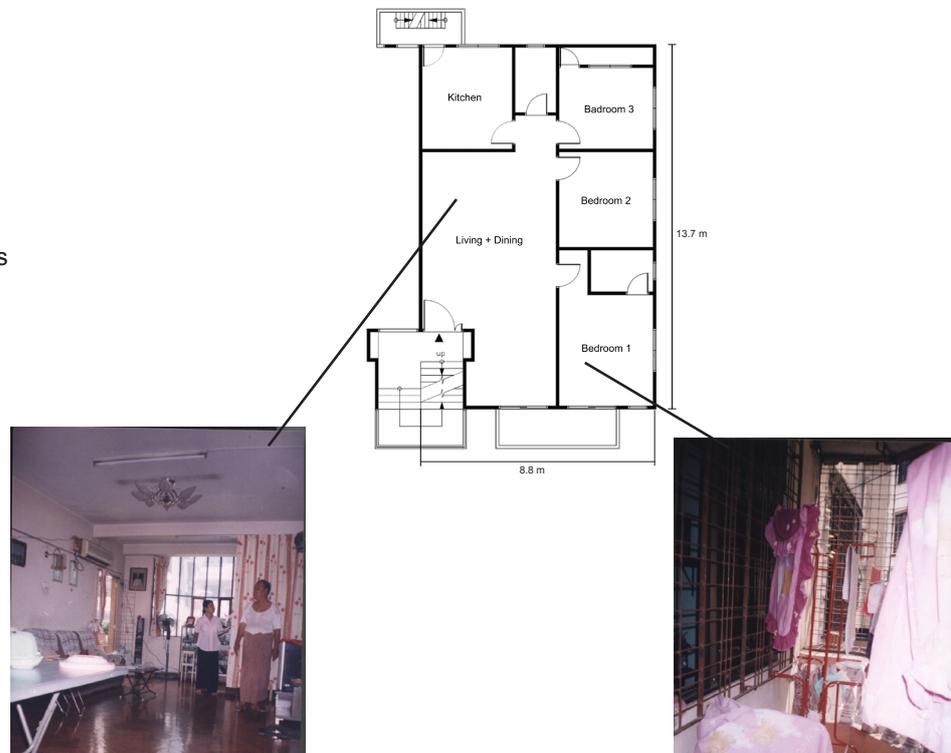
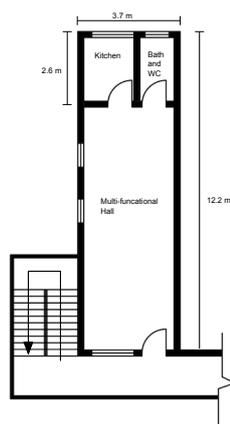


Figure 21: Spatial zones of Yangon room type apartments

Source: By author





Cooking and service zone

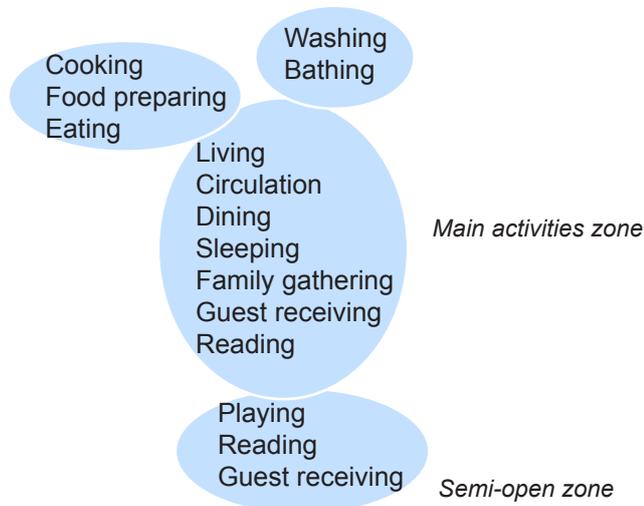


Figure 22: Spacial zones of Yangon hall type apartments

Source: By author

2.6.1.2. Spatial arrangement of Yangon apartments

In the study of the functional aspects of Yangon housing, we need to know the habits of residents and how this relates with the spatial arrangement of housing. The spatial arrangement of apartments is investigated.

Two types of apartment plans are found. They are the 'hall type' and the 'room type' (Section 2.5). In general, looking at the zoning of apartments, there is an access zone, a public activities zone, a private activities zone, a cooking and supplies zone and a circulation zone. The access zone is not always present in some housing projects, but it can be created by the user in some part of the living area by dividing the living area to get an entrance area. The cooking and cleaning zone are found mostly at the back of the apartment.

The arrangement of functional space in apartments can be classified by several different conditions. These are: living + dining + kitchen (Figure 23), living + dining (Figure 24), living + shrine + dining (Figures 25 and 26), and dining + kitchen (Figure 27). Dining in low cost housing can sometimes be found in the living space. Low income people use foldable dining

Figure 23: Living + dining + kitchen

Source: By author



Figure 24: Living + dining

Source: By author



Figure 25: Living + shrine + dining in two bed room apartment

Source: By author





Figure 26: Living + shrine + dining in three bedroom apartment

Source: By author



Figure 27: Dining + kitchen

Source: By author

tables in the living area or they use the living room table as a dining table. In most of the cases, the kitchen is at the back of the house and from there, people can access the fire escape stairs. The inhabitants use the fire escape stairs not only for escaping fire but also for social contact with neighbors. Sometimes housewives use this area for outdoor cooking as well. In some apartments, housewives cook outside and use the area for drying clothes (Figure 28).



Figure 28: Fire escape area

Source: By author

Verandahs are the open air and relaxation spaces of the urban apartments. Usually, they are found at the front. Residents use this area for drying clothes and occasionally as a place for the shrine area (Figure 29).



Figure 29: Verandah area

source: By author

By over viewing the whole process, some important points can be formulated:

(1) The traditional configuration of the four essential spaces, i.e. main activities space, working space, open courtyard space and cooking and dining space, have been gradually transformed into space more commonly found in the modern apartments.

(2) The open outdoor space, the courtyard, has been gradually transformed from a multi-functional hall into a circulation area in urban apartments.

(3) Changes to people's life style have led to a direct change in the function of domestic spaces.

(4) *"The traditional spatial pattern cannot directly be adapted to the urban context. It can be transformed to spaces which are similar to traditional ones. For example, the open space cannot form part of the urban apartments but flexible spaces such as a wide verandah can be provided. This results in exterior relations and enables flexible living for urban people."*²²

(5) In urban apartments, the multi-functional hall or living-dining hall has become centrally important for many activities. There is a mixture of functions in the multi-functional hall of urban apartments.

2.6.2. Social conditions (especially according to family, neighborhood)

*"Fundamental to understanding design issues for housing is the idea that the physical form of the urban environment is a central aspect of the social world itself."*²³

*"The concepts 'public' and 'private' can be interpreted as the translation into spatial terms of 'collective' and 'individual'. 'Public area' is an area that is accessible to everyone at all times. 'Private area' is an area whose accessibility is determined by a small group or one person. The concepts 'public' and 'private' may be seen and understood in relative terms as a series of spatial qualities which, differing gradually, refer to accessibility, responsibility, the relation between private property and supervision of specific spatial units."*²⁴

22 Khin Lin Nwe, To the development of flexible spaces in housing concepts for Yangon regarding the flexible spaces of Myanmar rural houses. Paper presented at 25 years of Trialog journal conference, (Darmstadt, January, 2010).

23 Sally Lewis, Front to back; a design agenda for urban housing, (Oxford OX2 8DP, 2005), p. 38.

24 Herman Hertzberger, Lessons for students in architecture, (Netherland, 1991), p. 12-13.

There are many different kinds of social conditions related to housing. There are mainly two parts of information needed to describe the social activities and spatial needs of Myanmar people. The first part is to know the current social data related to housing. The second part concentrated social behavior of the Myanmar people with the two most important phenomena, social behavior inside of families and the relationship with their neighbours.

2.6.2.1. Social data in relation to housing in Yangon

Social conditions are studied using the following variables:

- Average household size
- Population
- Township ranking and migration
- Age distribution
- In and out migrants in states and divisions
- Age pattern of migrants

Average household size

Resulting from the Household Income and Expenditure Survey (HIES), based on 25470 sample households, the estimated average size of households for the Union of Myanmar is 5.25 persons. This is similar to 5.2 which is the average size of households obtained in the 1983 census of Myanmar.²⁵

“The average household size for the urban areas of Myanmar is 5.2; it is 5.3 for the rural areas of Myanmar.”²⁶

According to the HIES report, overall average household size is 5.1 in Yangon, while average household size in urban areas is 5.12, while in rural areas of Yangon it is 5.09. In addition, the statistical yearbook (2003) indicated that the size of households in Yangon in 2001 was 5.01 persons.²⁷

The household size in urban and rural area in Yangon can be differentiated into 4 groups (see page 44). The percentage distribution of households by household size class in Yangon is shown in Table 2. The largest percentage comes from households with 3 to 7 persons (78 %). Thereby, this constitutes the largest households type in urban as well as in rural areas.

25 Central Statistical Organization (CSO), Household income and expenditure survey, (Yangon, 1997).

26 IDEA International Institute, IHLCA project technical unit, Integrated household living condition survey in Myanmar, Poverty profile, (Yangon, June 2007), p. 40.

27 Statistical department, Household income and expenditure survey (HIES), (Yangon, 2001).

Person	Urban	Rural	Average
1 to 2 person	8.93	10.38	9.37
3 to 7 person	77.20	79.41	77.86
8 to 10 person	11.08	9.23	10.53
11 and above	2.78	0.97	2.24

Table 2: Percentage distribution of households by household size class in Yangon (2003)

Source: CSO, Household income and expenditure survey, Yangon, 1997.

Population

Yangon has a population of 5.5 million (2000). The Inner City Area (ICA) of Yangon amount to 321,922 inhabitants (2003). The ICA includes seven townships which are located in the downtown area and have high development intensity. The townships such as Botahtaung, Kyauktada, Lanmadaw, Latha, Pabedan, Pazundong and Seikkan encompass as land area of about 8 km².

The population of the ICA was 245,530 in 1983, increasing to 321,922 in 2003. This could be partly attributed to the resettlement programme of relocating squatters to the suburban areas and new town developed by the government.

The projected population of the ICA is expected to decrease slightly to 311,751 in 2010, although it should increase to 357,709 in 2020. The future population of ICA will shift to the suburban areas as a result of the ICA being developed for commercial and offices uses.

Township ranking by size and migration

The township ranking by size changed from 1993 to 2003. The population rank position of the ICA actually dropped to 3rd position in 2003 from 1st position in 1993. The old suburbs of North Okkalapa, Tharketa and South Okkalapa continue to attract new residents. All the townships showed positive population growth. The new towns of Dagon Myothit (North, South, East, Seikkan), Shwepyitha and Hlaingtharyar showed a remarkable improvement in rank aligned with increased population growth. It can be observed that the ranking of townships changed according to the pattern of migration arising from their business, income and lifestyle wishes.²⁸ (Table 3)

28 Institute Sultan Iskandar of urban habitat and highrise (ISI) and Malaysian Industry Government Group for High Technology, Interim Report (Executive Summary), Yangon Strategic Development Plan, (Yangon, 2005), p. 7-9.

		1993			2003	
1	INNERCITY (BOTAHTAUNG, KYAUKTADA, LANMADAW, LATHA, PABEDAN, PAZUNDAUNG, SEIKKAN (PORT))	248.687		1	NORTH OKKALAPA	321.922
2	NORTH OKKALAPA	233.599		2	THARKETA	311.599
3	THARKETA	225.683		3	INNERCITY (BOTAHTAUNG, KYAUKTADA, LANMADAW, LATHA, PABEDAN, PAZUNDAUNG, SEIKKAN (PORT))	284.275
4	THINGANGYUN	220.480		4	INSEIN	268.061
5	INSEIN	213.435		5	THINGANGYUN	267.743
6	SOUTH OKKALAPA	198.398		6	SOUTH OKKALAPA	245.241
7	HLAING	174.494		7	HLAINGTHARYAR	221.827
8	MAYANGON	163.660		8	MAYANGON	203.825
9	HLAINGTHARYAR	148.878		9	SHWEPYITHAR	191.967
10	MINGALARDON	145.092		10	MINGALARDON	190.378
11	TARMWE	134.819		11	HLAING	186.962
12	MINGALAR-TAUNG-NYUNT	118.077		12	DAGON MYOTHIT (SOUTH)	156.340
13	SHWEPYITHAR	96.154		13	TARMWE	143.054
14	BAHAN	89.450		14	MINGALAR-TAUNG-NYUNT	122.274
15	YANKIN	83.530		15	YANKIN	119.377
16	DAGON MYOTHIT (SOUTH)	81.523		16	DAGON MYOTHIT (NORTH)	113.228
17	KYEEMYINDAING	80.823		17	BAHAN	105.922
18	DAGON MYOTHIT (NORTH)	75.035		18	KYEEMYINDAING	97.434
19	KAMARYUT	71.969		19	KAMARYUT	92.369
20	SANCHAUNG	69.972		20	DAWBON	88.627
21	DALA	65.769		21	SANCHAUNG	87.741
22	DAWBON	61.592		22	DALA	86.015
23	AHLONE	41.292		23	DAGON MYOTHIT (EAST)	61.465
24	DAGON	35.360		24	AHLONE	48.520
25	SEIKKYI-KANAUNGTO	18.974		25	DAGON	44.509
26	DAGON MYOTHIT (EAST)	0		26	SEIKKYI-KANAUNGTO	28.493
27	DAGON MYOTHIT (SEIKKAN)	0		27	DAGON MYOTHIT (SEIKKAN)	20.356
	Sub Total	3.096.745			Sub Total	4.109.524

Table 3: Township ranking

Source: ISI and Malaysian Industry Government Group for High Technology, Interim Report, Yangon Strategic Development Plan, Yangon, 2005, p. 9.

Age distribution

*"The composition of a population is firstly determined by the proportion of males and females in each age group. The age and gender structure of a population is the cumulative result of past trends in fertility, mortality, migration and influences the future development of the population."*²⁹

Population pyramids (Figure 30) show the composition of a population according to age and gender. The bars represent the percentage of males and females in a particular age group. Five years interval age groups are represented in each bar.

Due to the data collection of Immigration and Manpower Department, United Nations Population Fund (UNFPA) and Labour Department, Myanmar from 1973 to 2000, it is evident that young people outnumber older people during 1973 to 1983 (Figure 31). However, from the data during 1993 to 2000, the number of children and younger people declined in comparison to the period 1973 to 1983. By 2000, the proportion of older people in the age group 65+ is clearly more than in the other time frames.

²⁹ Than Than Thwe, Regionalized population forecast for the Union of Myanmar, (Stuttgart, 2004), p. 39.

From this evidence, one can see that population pyramid of 1993 and 2000 shows a relative decline in younger age groups which means that fertility rates have decreased resulting in the larger proportion of people over 65+, as seen from the population pyramid in 2000.

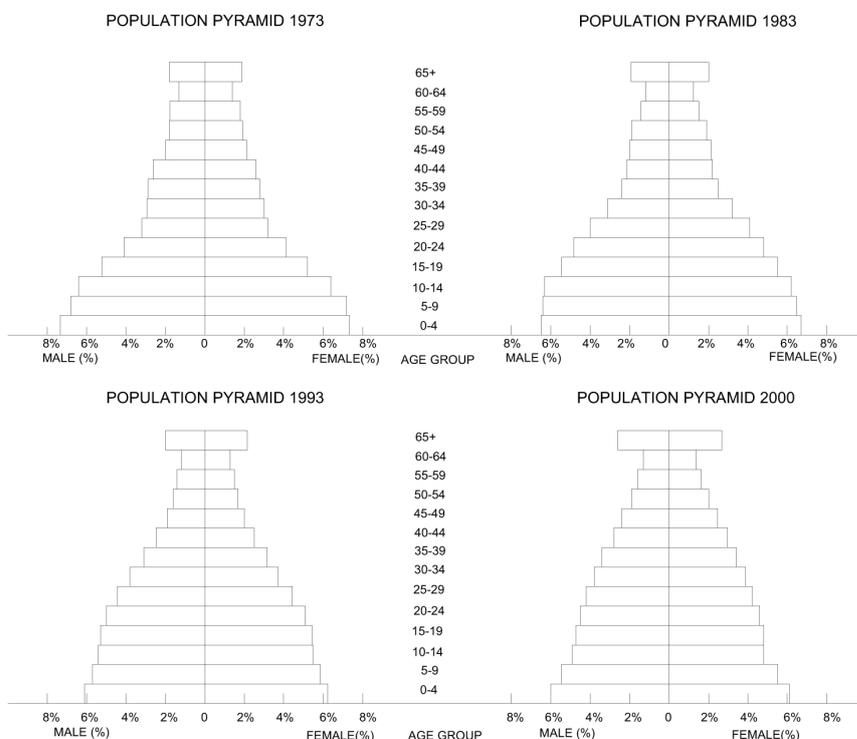


Figure 30: Population pyramid of Myanmar (1973- 2000)

Source: Than Than Thwe, Regionalized population forecast for the Union of Myanmar, Stuttgart, 2004, p. 40.

In and out migrants in states and divisions

Migration is an important component of population change. A report prepared by United Nations Population Fund (UNFPA), Population Department (PD) and Health Department (HD) shows in and out migration in 1991 in states and divisions in Myanmar (Figure 31).

According to Than Than Thwe,³⁰ regarding migration in states and divisions, it can be assumed that people who are ready to migrate will have a tendency to migrate to the nearest most developed states or divisions. For example: people who were born in Ayeyarwaddy division migrate mostly to Yangon even though Ayeyarwaddy is a fertile area. In Yangon, the number of in migrants in 1991 is higher than that of out migrants and also higher than in other states and divisions. The main reason is that Yangon is the most developed region in the country and offers many opportunities to have better jobs, better living standards, and also better social services.

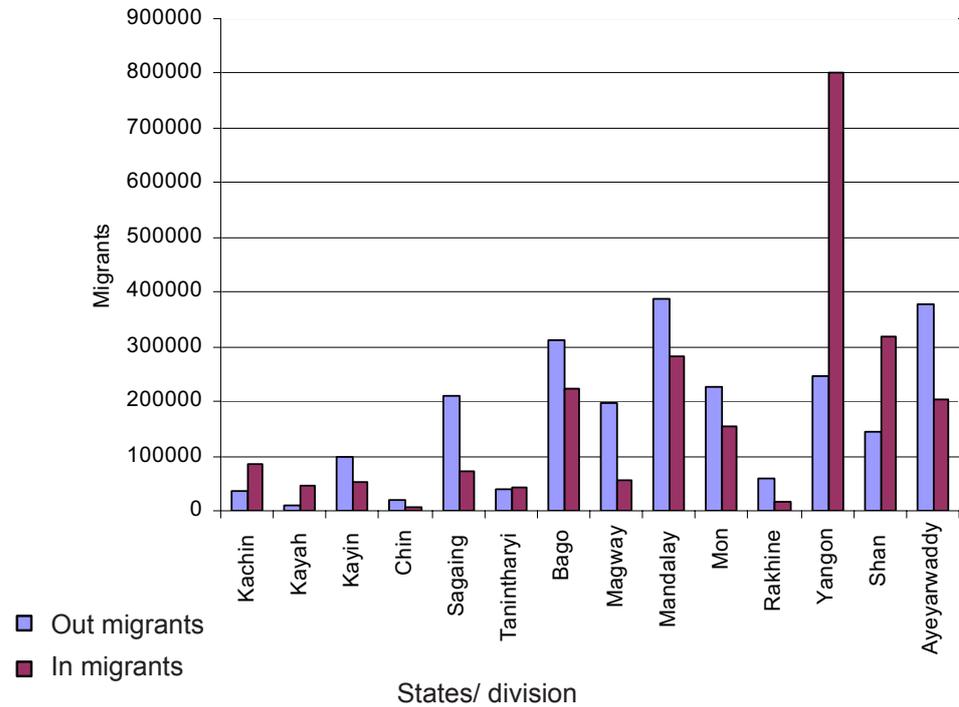
Regarding to the in migration rates in Yangon, one can see that Yangon is attractive as a major business city and social sector in country. On the

³⁰ Than Than Thwe, Regionalized population forecast for the Union of Myanmar, p. 47-48.

other hand, a housing supply system is important for the people migrating to Yangon as well as for the people who are living in Yangon before 1988.

Figure 31: In and out migrants in states and divisions (1991)

Source: Than Than Thwe, Regionalized population forecast for the Union of Myanmar, Stuttgart, 2004, p. 48.

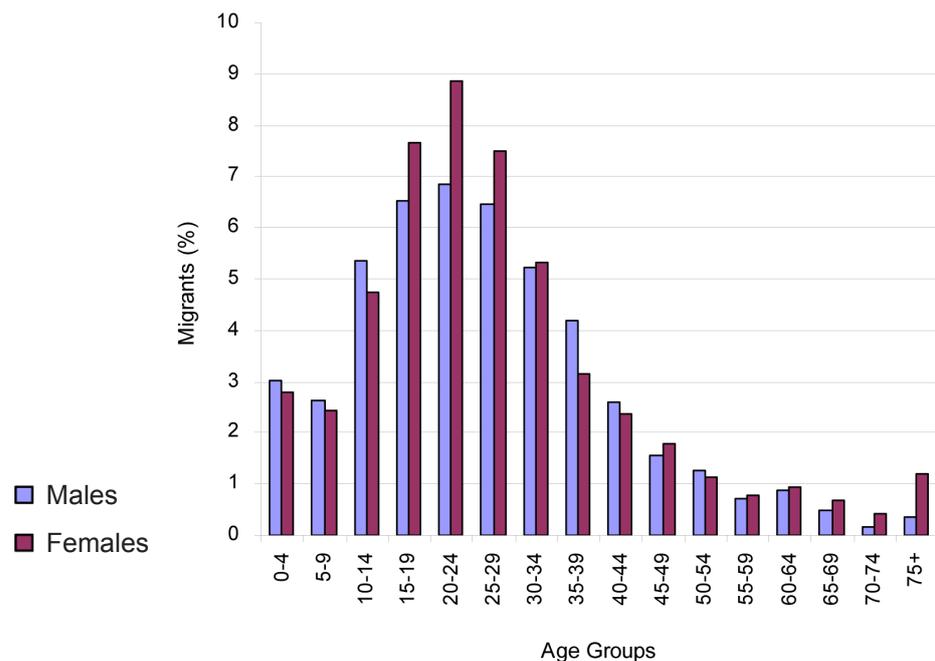


Age pattern of migrants

According to the data collection of UNFPA, PD and HD, the age groups of 15-19, 20-24, 25-29 and 30-34 are the major groups of migrants in the country (Figure 32). Young ages migrate more freely than other ages. The reasons for a migration movement in there age groups can be attributed to opportunities for better jobs, education and business.³¹

Figure 32: Age pattern of migrants

Source: Than Than Thwe, Regionalized population forecast for the Union of Myanmar, Stuttgart, 2004, p. 49.



31 Than Than Thwe, Regionalized population forecast for the Union of Myanmar, p. 49-50.

2.6.2.2 The habits and social relationships inside families and with neighbours

After studying the social data in relation to housing in Yangon, the second part will show the family habits and the relationships between residents and neighbours.

In a physical setting, the residential environment is critical for human well-being. We spend most of our time in buildings, and most of our leisure time at home or close by in our neighbourhood. The home is clearly a crucial aspect when studying housing. The concept of home represents the essence of the housing experience. It may express the personality, culture and lifestyle of the homeowners and will depend upon whether the individual lives alone or together with family or friends.³²

This study aims to contribute to the knowledge about the social relationships inside families and with neighbours based on Myanmar peoples' lifestyle, behaviors and customs. First of all, the lifestyle and domestic spaces of the Myanmar people is described.

Lifestyle of Myanmar people

To discuss about behavior of the Myanmar people and their social activities, firstly the social relationship inside the family and then secondly the social relationship with neighbours are studied.

Social relationship inside the family

Family life is strong in Myanmar and families tend to be extended rather than shrink to a nucleus. Each member of the family is expected to contribute in some way towards either the expenses or the running of the household. It is essentially a relationship based on specific duties and responsibilities on the part of the husband, wife, and parents. These rights and duties are taken seriously and adhered to closely. Love and respect, rights and responsibilities are the foundations of a Myanmar family irrespective of religious creed. This holds true today as it did in ancient times.

In the family, it is the mother who is usually closest to the children, together with aunts. The day-to-day running of the household, including expenses, is mostly done by the mother. The whole month's salary is handed over by the father to the mother who will divide the sum according to various expenses.

32 Ricardo Garcia Mira et al., *Housing, Space and Quality of life*, (Great Britain, 2005), p. 1-3.

These often include giving parents-in-law a monthly allowance, making charity donations to important causes and handling children's expenses. Women are expected to help with the household chores and take care of their aged parents more than men.

In Myanmar society, males have priority in everything, much the same as in other Asian cultures. This appears to derive from the belief that to be a Buddha one must first be reborn as a man. Girls as well as boys are regarded as "jewels", a treasured object. Nevertheless, girls are expected to look after parents more than boys.³³

When boys are born, the parents pleasure that they will someday gain great merit from entering the boys into novice hood. To be parents of novices and monks is held in great esteem and is capable of bringing good karma. Women are traditionally expected to have a self-effacing demure and unobtrusive. Girls are usually brought up to be gentle, quiet and to move with silent steps.

The following section discusses the habits and behaviours of Myanmar families in their domestic spaces. There are three main domestic spaces for social interaction in the family, that is:

- Living area
- Dining area
- Cooking area

Living area

In the long history of Myanmar, the Myanmar people are very kind and hospitable. When relatives or guests come to visit, they usually are received in the living area. If one person is drinking tea in the living area which is a semi-outdoor or outdoor area in rural houses, he will welcome others into come and drink tea at his home. There is no separated living room in Myanmar housing. The living space is semi-open, such as a multi-functional hall. Living area may have long benches at the front of the house and sometimes a wide bench under a shady tree beside the house.

However, in the urban apartment, receiving guests as well as the activities of daily charity (Figure 33) and doing homework or studying (Figure 34) are usually done in the living area. The living area is also used sometimes for dining. Most of the family's social time is taken after dinner while they are watching television in the living room (Figure 35).

One of the Myanmar habits is the usage of collapsible easy chairs in the living area. Moreover, in rural areas people use wide benches under the trees for their relaxation. In urban areas, grand sofas, TV, computer, "air cons", and refrigerators belong to the functional things gained from their

33 Saw Myat Yin, Cultural shock (Burma), (Singapore, 1996), p. 111.

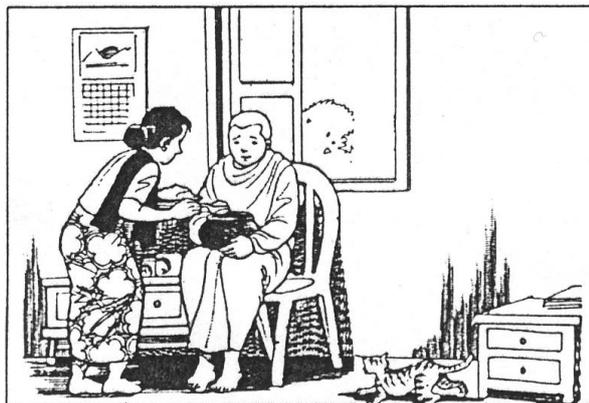


Figure 33: Daily charity area

Source: Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, Yangon, 2005, p. 69.

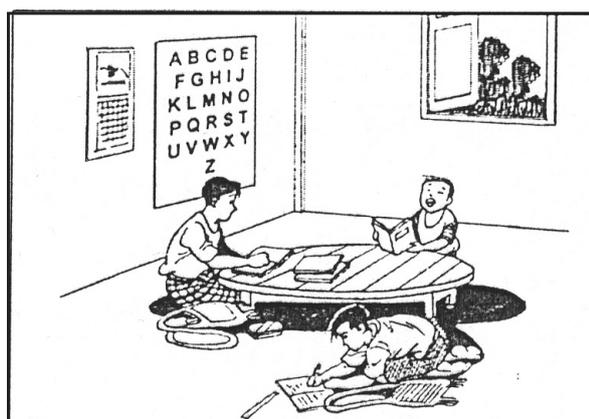


Figure 34: children study area at living

Source: Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, Yangon, 2005, p. 68.

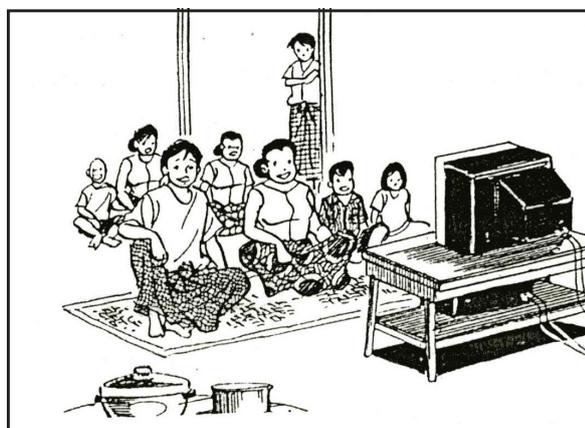


Figure 35: Family social time

Source: Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, Yangon, 2005, p. 91.

wealth and relaxation. Instead of wide benches and easy chairs, “dream beds” are used in the living room.

Traditional floor sitting style in Myanmar residential areas – seen typically in rural areas and villages – is replaced by modern conventional sitting style, with settees and sofas in the urban apartments.³⁴

While most of the rural Myanmar customs in the living rooms involve sitting on the floor in the multi-functional hall (or) under a shady tree, the urban residents prefer to use chairs, sofas and settees. The reason is that

³⁴ San San Moe, Norms and space standard for multi-storeyed residential buildings in Yangon city, (Yangon, 1998), p. 79.

they have been influenced by the western culture and that this is more comfortable for living. Moreover, new equipment and facilities have been developed for the urban residents within in domestic lifestyle.

Although this development is good for the urban lifestyle, the circulation space between furniture on the other hand is less than the rural area. As social activities within the family and guests take place in this area, it should be flexible enough in order to avoid the multi-functional hall becoming to be congested (Chapter 6, recommendations).

Dining area

Myanmar people in the rural tradition use a round table and small mats for their dining. The Myanmar table is circular and only ten or twelve inches off the floor. People sit on small mats round the table (Figure 36).



Figure 36: Dining area

Source: Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, Yangon, 2005, p. 68.

Younger members of the family put a little token morsel of rice and curry in the dish of the senior members as a sign of respect. At the round table, the leader of the family or the most senior member sits at the head of the table. The mother sits beside the father and serves him food first. If there are older people, such as grand father or mother, they must be served first. If the oldest or most senior person is not present, a small portion of food is spooned up and then put back in the dish as a gesture that the person has been remembered. Younger people are not supposed to take their first bite or taste until the elders have been served. From the functional point of view, round table and small mats are able to be moved and used in a multi-functional space, semi-open verandah or front portion of the house and at 'kut-pyit' under shady trees.^{35,36}

There is no fixed space for dining activity in rural Myanmar custom. From the social point of view, it is important that all members of the family eat at the same time. In this case, father and mother can meet and chat about the economic and social matters and about their work, and they can train their children. The dining time is one of the important social times for com-

35 "kut pyit" is usually made by bamboo. It can be used as a long bench. In summer, people sometimes use it as a sleeping bed.

36 Saw Myat Yin, Cultural shock (Burma), p. 116-118.

munication between inhabitants.

In urban housing, the dining space is fixed which is adapted to the congested urban living. The space is less and people use dining table and chairs, refrigerator, and other dining facilities in the dining area according to the changes of lifestyle. As the style of furniture has changed to match the lifestyle, congestive problems develop because there is no flexible space. As dining area in urban apartments is used not only for personal life but also for social and family life, a greater flexibility needs to be created.

Cooking area

Myanmar food is generally bought and cooked fresh. The older generation particularly prefers shopping to be done every morning. Storage in a “meat safe” is the usual method of preserving food and keeping it away from insects and flies. The meat safe is a small cupboard with doors and sides made of mesh. It is the traditional storage method and most of the Myanmar families possess at least one meat safe. Nowadays, housewives use refrigerators and wall cupboards to keep cooked foods in them according to the lifestyle.

Cooking methods don't differ much between the villages and towns, although the kitchen, utensils and fuels might vary. In the rural areas, wood fires are most common and pots are mostly earthenware. The cooking area can be found outside the house, or besides the house. Also this area is one of those for social contact with guests or neighbours. The guests are invited sometimes into the kitchen.

The change from the traditional cooking style to modern cooking style had a good effect on urban housewives from the health point of view. As the technology has rapidly advanced, more and more new materials and equipment have been produced for the improvement of people's lifestyles. San San Moe suggested the required space for modern kitchen for two persons in Yangon (Figure 37).³⁷

For two person dining table = 0.9 m x 0.9 m

O = oven

C = chair

T = Table for preparation

& dining

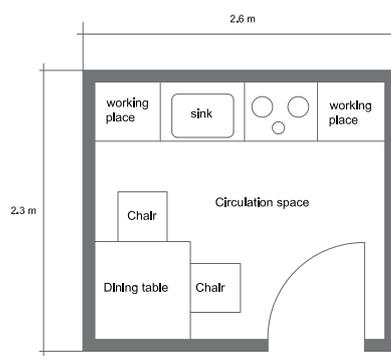


Figure 37: Modern kitchen for two persons in Yangon

Source: By author
Drawing based on San San Moe, Norms and space standard for multi- storeyed residential buildings in Yangon city, Yangon, p. 81.

37 San San Moe, Norms and space standard for multi- storeyed residential buildings in Yangon city, p. 80.

However, there is no standardized equipment: for example, exhaust fans are used in some apartments while some housewives cook at the fire escape space or on the back verandah as their semi-open kitchen, if they can't afford an exhaust fan. This space is also one of the social meeting points with neighbors (Figure 27). Therefore, enough space should be provided because it is essential not only for their original function but also for cooking.

Communication with neighbours

In rural area houses, guests are normally welcomed in the living area or shaded area under trees with tea or snacks. Relatives who come to visit are welcome as long as they want to stay. Indeed, they are expected to stay with the family.³⁸

Most of the space in Myanmar housing units is accessible to the neighbors except the private space. In rural area, guests are allowed to enter the kitchen directly and can chat in the kitchen area. In urban areas, the living area is an essential space for receiving guests. To relate to neighbours people living in urban areas use the verandah, the fire escape and the landing area. They try to be contented with the available limited space. Therefore, it is necessary for these space like verandah, fire escape, landing area to have semi-open quality and social relations. The quality of urban life depends heavily on the quality of social interaction in neighbourhoods. For the people living in the city, their evaluation of urban life seems to be affected more by their social relations than by the physical environment. The satisfaction of the housing conditions and urban settings very much depends on the quality of social interactions. The physical environment, as a part of the material setting people live in, is a condition which allows social contacts and which create social interaction.³⁹

“The quality of urban life is always concerned with whether people live well or poorly: is life easy or hard? Are people satisfied or dissatisfied? Does the city help them realize their needs and desires or does it thwart them?”⁴⁰

Besides many other aspects like the fulfillment of basic needs and some standards of living according to the economic situation, the facilities for social relations and communication are of important weight and a condition without which for living in urban housing is not acceptable. Housing and neighbourhoods are ideal units to study and assess the quality of life because they combine physical and social settings. In the housing in Yangon, semi-outdoor areas such as the verandah, corridor and stair area are the social areas for communication with neighbours (Figure 38).

38 Saw Myat Yin, Cultural shock (Burma), p. 111-112.

39 Dieter Frick, The quality of urban life, social, psychological, and physical conditions, (Berlin, Germany, 1986), p. 49.

40 Ibid., p. 20.

In the daily life, people use those semi-outdoor areas for their daily activities such as: watching the children going to school with their friends, asking the neighbour to buy small things on the way to the market, buying a snack sold on the road, asking the neighbor to baby sit, being able to help each other when they are getting old, or chatting and doing chores. There is strong evidence from the above facts that semi-outdoor areas are the main spaces in the apartments in urban areas for relaxation and social communication with others.

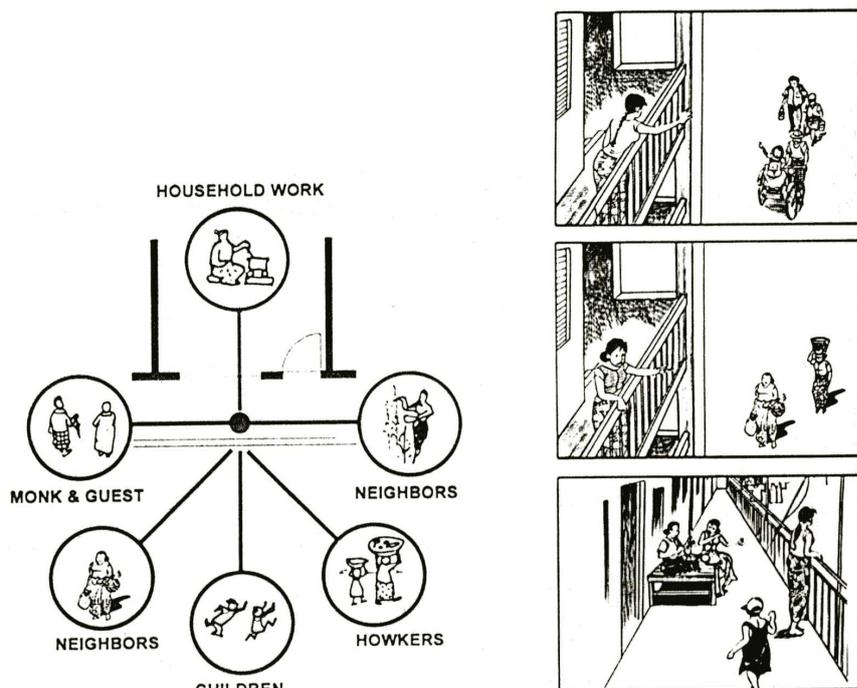


Figure 38: Social communication area with neighbours

Source: Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, Yangon, 2005, p. 92.

2.6.3. Cultural conditions

The following sections concentrate on the cultural aspects which are mainly relevant for the modern forms of housing prevalent in Yangon city. They relate to attitudes and kinds of behavior which are typical for traditional housing, but they have still a strong influence on the present condition of housing in modern urban apartments.

There are five main aspects concerning culture which are relevant to Myanmar housing. They are:

- The ceremony and ritual concerning the construction of the house
- Location of building and alignment of houses
- Orientation of floor plan
- Location of the shrine room and the altar
- Entrance space

2.6.3.1. The ceremony and ritual concerning the construction of the house

Traditions are observed in the construction of all types of buildings of differing sizes and dimensions, for the smallest structure, such as a temporary field hut, but also for a large, modern multi-storey office complex or shopping centre. A simple check on a Burmese calendar will tell the good days and bad days. Even so, people who have stronger beliefs may go to specialists to consult them about the best times and days to ground the foundation.

“Most commonly ‘Pane’ is used to refer to the ground-breaking ceremony that initiates the building process. When choosing the day and time for the ‘Pane’ ceremony, priority is given first to avoiding the ‘pya dha da’ or ill-fated days, which are considered to bring bad omens. Next, a ‘je ja za’, or auspicious day is selected and finally an appropriate day is chosen for breaking the ground. The Pane ceremony involves driving wooden pegs into the ground, making the ground plan of the house. A bowl containing the offerings - a whole coconut, hands of banana, betel, incense sticks and candles are offered to spirit beings. In making the offering, the owner, one of the builders or a male practitioner of astrology will say words to this effect: ‘We make offerings to the spirits may be more stubborn than others’ and monks may have to be brought in, and a firmer line taken to remove them. Sometimes monks are invited to the Pane ceremony to say appropriate prayers, but this is not always the case. After the ‘Pane’ ceremony, when the main post is erected, a similar offering of coconut and bananas is made at the time of the final placing of the stairs.”^{41,42}

(Figure 39)

Finally, when the house is completed and the family moves in the house, a house warming ceremony, so called, an ‘*ein de’ min gala*’ takes place. Monks, relatives and neighbours are invited to the ceremony.



Figure 39: Pane ceremony

Source: Ronald G.Knapp, *Asia's old dwelling, tradition, resilience, and chance*, Oxford, 2003, p. 224.

41 'Pane' means to drive in the stake or stakes that make the ground plan of a building.

42 Ronald G.Knapp, *Asia's old dwelling, tradition, resilience, and chance*, (Oxford, 2003), p. 224-225.

2.6.3.2. Location of building and alignment of houses

In rural areas of Myanmar, houses are built in such a way that the roofs are aligned with the sun. In urban areas, the practical considerations of building according to the layout of the plot of land and the road makes it often impossible to follow the traditional belief. However, in the rural areas of Myanmar, this tradition is followed when constructing new houses.

If a tree has to be cut down to make space for a building, the spirit or spirits who reside in the tree must be requested to move somewhere else. A plot located directly against where a road ends is considered bad luck.

If such a plot cannot be avoided, a small mirror is placed in an appropriate position to reflect back the same fate to whoever wishes ill-will on the occupants of the house.

2.6.3.3. Orientation of floor plan

As mentioned before, orientation is very important in Myanmar traditional houses. This manifests in their belief that there is a head part (*khaung-yin*) and a foot part (*chay-yin*) in the house. The orientation of space is shown in Figure 39. The shrine or Buddha image as well as the living area are placed at the head part of the house if it is a one storey building. If it is a two storey house, the shrine is placed on the upper floor in the head part.

Single male members of the family sleep in the hall - like main part of the house. Some space is partitioned for privacy using bamboo, wood, or a curtain, when to be used as a room for female members of the household or for a member of the family who marries. Known as the 'chei jin khan' or the foot end room, a private space occupies a corner on the side of the house in the opposite direction to the shrine room. It can be used also as a room for childbirth. The 'gaung jin khan' or head end room, is located where the shrine room or a similar facility is located. According to tradition, it is in the eastern or southern part of the house. In some houses, the floor of the shrine room is raised not to be at the same level with the rest of the house. Sometimes the shrine room is actually a small alcove which is specially constructed and can clearly be seen from outside the house. It is generally accepted that the elder members of the family sleep in the part of the house that contains the shrine room or alter. It is usual to build the kitchen and toilets separate from the main house in order to minimize the amount of smoke and the smell from cooking entering the main house.⁴³

Outdoor living or semi-outdoor living and the kitchen are placed at the front part of Myanmar traditional house. Altogether it can be stated that the spatial composition and orientation is very important aspect in Myanmar house planning and construction (Figure 40).

43 Knapp, Asia's old dwelling, tradition, resilience, and chance, p. 226-230.

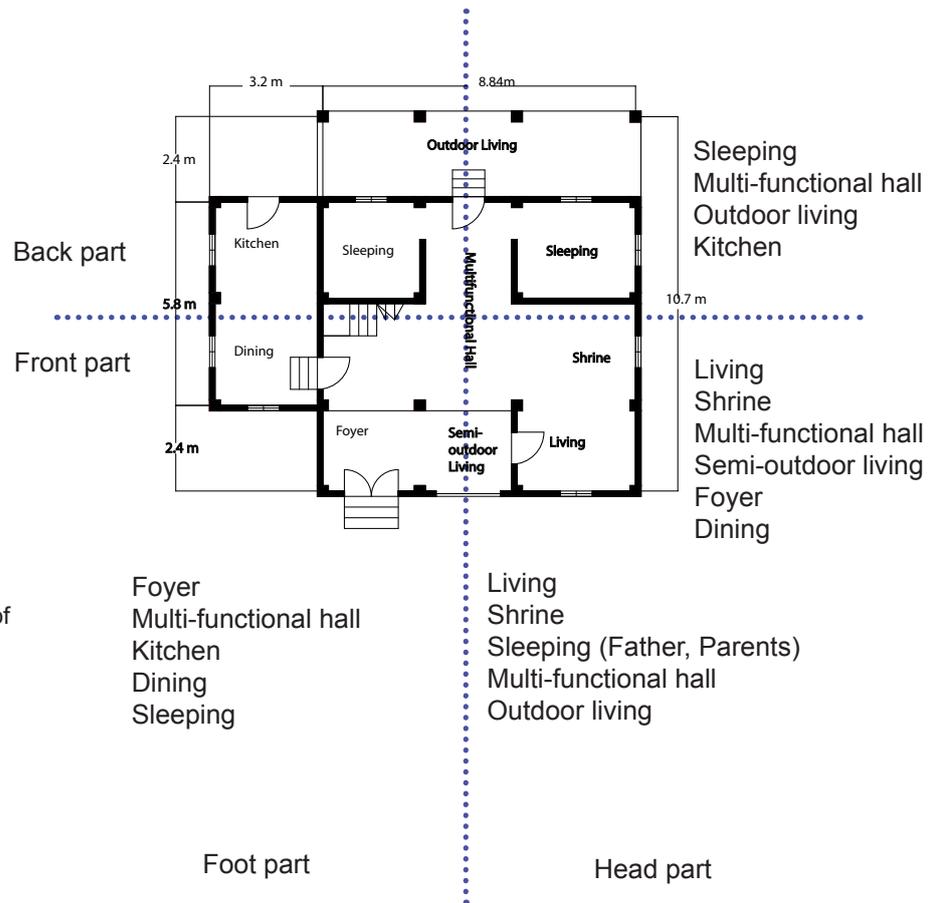


Figure 40: Orientation of floor plan

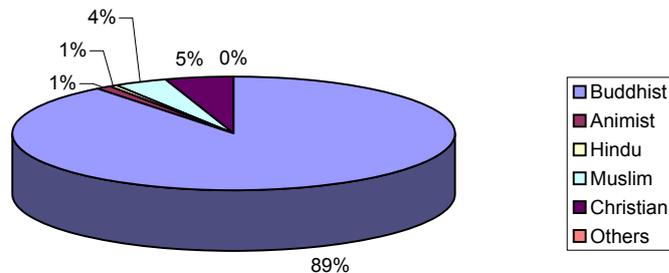
Source: By author

2.6.3.4. Location of shrine room and altar

In Myanmar the majority of the population is Buddhist. Theravada Buddhism is widely practiced. Religious intolerance or discrimination on grounds of religion is not existent in Myanmar throughout its long history. The main religions of present day Myanmar are Buddhism (89.2 %), Christianity (5.1 %), Islam (3.8 %), Hinduism (0.6 %), and Animism (1.3 %). Other faiths such as Bahai Sikhs, Lipian fujianhal, Chinese Animism⁴⁴ make up approx. 1 % (Figure 41).⁴⁵

Figure 41: Religions in Myanmar

Source: Asiarecipe.com, Myanmar religion, online available at < <http://asiarecipe.com/burreligion.html>>, accessed on 03.11.2010.



⁴⁴ Animism is one of the oldest belief systems in the world, and people on nearly every continent practiced it. Animism was prevalent in East Asia, mostly in folk religions.

⁴⁵ Asiarecipe.com, Myanmar religion, online available at < <http://asiarecipe.com/burreligion.html>>, accessed on 03.11.2010.

Evidently, the Buddhist religion is the most important one in Myanmar as well as in the regions and townships. In the majority of housings the respective religious shrine/facility is usual.

Shrine (or) altar

The altar known as the shrine room or space is an essential part of a Myanmar Buddhist house. The room or the space for altar is generally located in either the southern or eastern part of the house, but depending on the layout of the land in relation to the road, this can vary. It is placed in the upper storey at the head part of the house if the house is two storey building (Figure 42). If the house is one storey building, the shrine is placed at the head of the house (Figure 43). The occupants of the house sleep towards the altar with their feet pointing in the direction away from the shrine room.⁴⁶

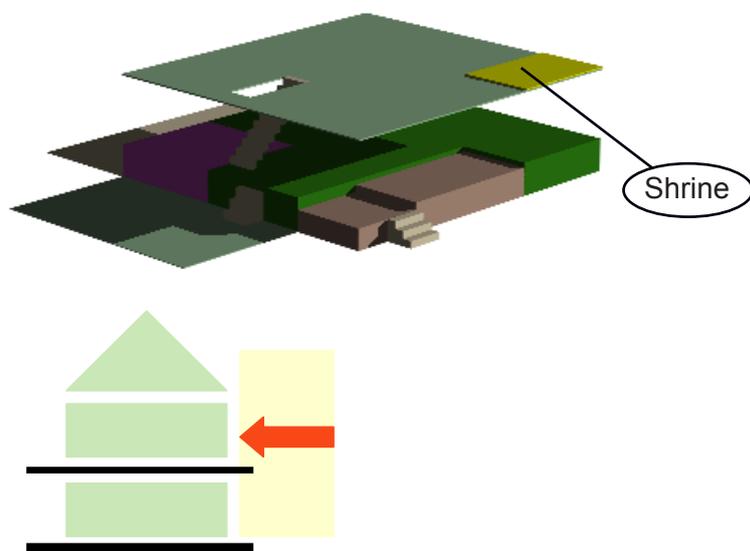


Figure 42: Shrine placement in a two storey house

Source: By author



46 Knapp, Asia old dwelling, p. 230.

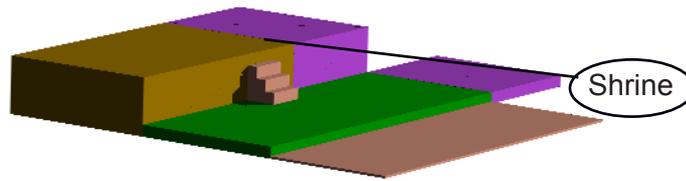


Figure 43: Shrine placement in a one storey house

Source: By author



2.6.3.5. Entrance space

Myanmar houses have a special entrance space in order to give the people the possibility to take off their slippers before entering the main lobby (Figure 44). This is part of typical cultural behavior. Myanmar people have the belief that they are thereby paying respect to Buddha and that to the elders who are living in the house.



Figure 44: Entrance area of a rural area house

Source: By author

Summary

Myanmar culture is influencing greatly by the organization of the residential space. The space is divided into head and foot and front and back portions. Spatial arrangement depends upon the cultural tradition. For example, it is a consequence that the woman's bed is not placed at the head portion.

Some important points can be summarized.

- The orientation of houses and the interior spatial composition are dependent on the cultural tradition, behavior and religion.

- Due to the changes of lifestyle, domestic spaces have been transformed in urban areas. Nevertheless, tradition is still strong – there is evidence that in urban environments certain traditions are still in place.

- Urban apartments cannot offer the same area like those found in rural apartments. However, they both have fundamentally similar structures. For example, the missing open spaces in rural houses can be compensated by flexible spaces like wide verandahs.

2.6.4. Economic condition

Regarding the economic condition with respect to housing in Yangon, the following section concentrates on four factors:

2.6.4.1. General situation of economic development in Myanmar since 1948

2.6.4.2. Percentage distribution of average household expenditures

2.6.4.3. PAE⁴⁷ rates from the Department of Housing Settlement and Housing Development from 10/2007 to 11/2008, and

2.6.4.4. Cost factors affecting housing

2.6.4.1. General situation of economic development of Myanmar since 1948

If we look back before the economic development of the period of parliamentary democracy (1948-61), the economy of Myanmar was seriously damaged by the Second World War. The military government dissolved not only the democratic form of government but also ended the phase of a growing market-based economy, replacing them with '*The Burmese Way to Socialism*' after 1948. International trade, businesses, banks, and even schools were nationalized.

47 PAE means Plint Area Estimate. The term '*Plinth Area*' refers to the entire usable area along with the thickness of the external walls of the apartment. It obviously includes the thickness of the internal walls and the columns.

Burma / Myanmar had a relatively high level of economic growth in the early 1990s, but this declined in the years after 1994 / 95, leveling off at a level of around 5 % per year until 1998/99 and increased until 2003/04 to more than 10 % per year. After assuming power in 1988, the military government continued to pursue the aim of opening up Myanmar's economy to foreign investors.⁴⁸

Myanmar is an agricultural country. Since independence in 1948 and until 1962, the national government has practiced a mixed economy by allowing for favorable market forces. In 1962, a centrally planned economy was adopted. After 1988, the government introduced market-oriented economic policy.⁴⁹

The national currency is 'Kyaat'. The major agricultural product is rice which covers about 60 % of the country's total cultivated land area. Precious stones such as sapphires, pearls and jade are also valuable exports. Rubies are the biggest earner; 90 % of the world's rubies come from Myanmar.

Even so, the country is one of the poorest nations in Southeast Asia, suffering from decades of stagnation, mismanagement and isolation. Burma's GDP (Gross Domestic Product) grows at present at an average rate of 2.9 % annually.⁵⁰

2.6.4.2. Percentage distribution of average household expenditure

The Central Statistical Organization (CSO) surveyed household income and expenditure in 2006 (Table 4). Based on the findings of the survey of CSO, the following indicators can be found:

- Expenditure on house rent and repair is less than for traveling, fuel and lighting.
- The expenditure on food and beverages is more than the expenditure for non-food articles.
- As part of the non-food expenditures, travel costs are a large contributor followed by fuel and lighting costs.

48 Michael von Hauff, *Economic and social development in Burma/ Myanmar*, (Marburg, 2007), p. 8-23.

49 Nyunt Shein, Hla Hla Myint, *The poverty ratio in Myanmar*, UNSD workshop on development indicators, Manila, Philippines, 2001, p. 5. Available online at, <http://www.nscb.gov.ph/events/ASEAN/papers/country/Myanmar%20.pdf>, accessed on 20.09.2009.

50 Central intelligence agency, "The world factbook: Burma", online available at <<https://www.cia.gov/library/publications/the-world-factbook/geos/bm.html>> accessed on 13.01.2007.

2. Housing in Yangon - history, types and conditions

No	Particulars	Yangon Division			
		Urban		Rural	
		Value	%	Value	%
1	Size of Household		5,13		4,37
2	Household Expenditure Total	132327,93	100%	89712,31	100%
	1. Food and beverages total	86425,58	65,31	63264,14	70,52
	Rice	18817,36	14,22	17328,29	19,32
	Pulses	2410	1,82	1423,17	1,59
	Meat	10302,01	7,79	6755,57	7,53
	Eggs	3495,06	2,64	2642,54	2,95
	Fresh fish	7907,1	5,98	5535,07	6,17
	Dried fish	3541,29	2,68	3190,51	3,56
	Ngapi and nganpyae	2184,34	1,65	1972,09	2,2
	Cooking oil and fats	5963,37	4,51	5193,06	5,79
	Fruits and vegetables	10088,21	7,62	6809,68	7,59
	Spices and condiments	5886,45	4,45	5460,17	6,09
	Beverages	2284,95	1,73	1132,34	1,26
	Suger and other food	705,47	0,53	1091,41	1,22
	Milk and milk products	628,96	0,48	114,75	0,13
	Other miscellaneous food	12211,02	9,23	4615,5	5,15
	2. Non food total	45902,35	34,69	26448,16	29,48
	Tabacco	442,65	0,33	449,25	0,5
	Fuel and light	9623,92	7,27	7491,48	8,35
	Clothing and apparel	2827,2	2,14	2314,36	2,58
	Personal use goods	2453,93	1,85	1615,75	1,8
	Cleansing and toilet	3250,56	2,46	2348,56	2,62
	Stationery and school supplies	451,57	0,34	53,97	0,06
	Crockery	104,38	0,08	61,06	0,07
	Furniture	126,59	0,1	194,04	0,22
	Medical care	2093,66	1,58	1197,08	1,33
	House rent and repairs	4127,03	3,12	479,24	0,53
	Recreation	217,18	0,16	73,22	0,08
	Charity and ceremonials	4746,03	3,59	4873,51	5,43
	Travelling expenses	9963,24	7,53	3120,66	3,47
	Education	3139,53	2,37	1374,21	1,53
	Other household goods	71,58	0,05	205,6	0,23
	Other expenses	2263,31	1,71	596,18	0,66

Table 4: Household expenditure survey in Yangon

Source: CSO, Statistical Year Book (2008). Yangon, 2009, p. 155.

2.6.4.3. Cost factors created by project development

The Department of Housing Settlement and Housing Development (DH-SHD) cooperates with developers to develop the housing projects. The department provides the land to develop housings together with private sector. The ratio of government and private sector contribution is 40:60. Of particular importance to housing developers are, for example, the interior materials including floor types (concrete or parquet floor, floor tiles, etc.), type of WC (European versus Indian-style, etc.). Different target groups need specific requirements. Initial housing development costs depend on the following main factors:

- Location
- Quality
- Apartment type
- Size of floor area,
- Car parking area.

Maintenance costs are proportional to the quality of the house or the apartment. Rental rates depend on the location, i.e. main road or secondary road, township, room sizes and payment system.⁵¹ Tax is free for housing built by the DHSHD. On the other hand, tax is set at 15 % of the value of the house if it is built by the private sector.⁵²

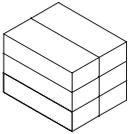
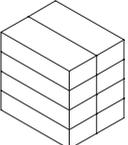
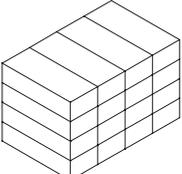
2.6.4.4. Cost factors affecting housing

The costs of a project depend on many factors. Size and shape of the unit, number of units per floor and number of storeys are the main factors with respect to architecture. They mostly affect the costs per square area of the buildings.

PAE (Plinth Area Estimate) rates developed by the DHSHD

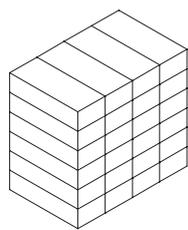
The DHSHD is implementing many different housing projects for the benefit of the people in Yangon. Based on the PAE rates from 10/2007 to 11/2008, the spread of area costs from the different unit types, apartment types and storey levels are reproduced in Figures 45 and 46.

According to housing categorization system of the DHSHD one can see that less budget allocation is given to units as more storeys are attached to them. Another interesting example is that units which bear more external walls induce higher costs. As do room types with interior partitions, which are typically more expensive than hall types.

Housing type	PAE rate (Kyat / ft ²) (€ / ft ²)	
	10/2007 to 6/2008	From 11/2008
Room types		
	13500 Kyat (10.38€)	14500 Kyat (11.15€)
	12000 Kyat (10.15€)	13000 Kyat (11€)
	11400 Kyat (8.78€)	12700 Kyat (9.77€)

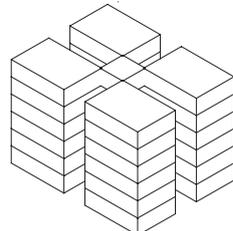
51 Payment system has two different methods. Some residents pay a deposit to the house owner. In this case the rent rate is low. Other residents do not pay a deposit to the house owner leading to a higher rate.

52 (Than Than Thwe), "(Thesis)", e-mail message to (Khin Lin Nwe), (13.06.2009).



11400 Kyat (8.78€)

12600 K (9.7€)



14000 Kyat (10.76€)

15000 Kyat (11.53€)

Figure 45: For standardized PAE rate of different room type apartments in DHSHD from 10/2007 to 11/2008.

Source: By author, Data based on: (Than Than Thwe), "(Thesis)", e-mail message to (Khin Lin Nwe), (13.06.2009).

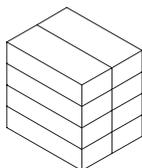
Housing Type

PAE rate (Kyat/ sqft) (€ / sq ft)

10/2007 to 6/2008

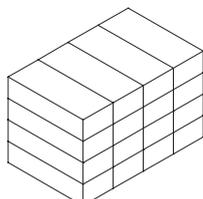
After 11/2008

Hall Type



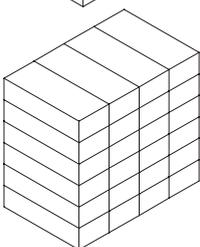
10600K (8.14€)

12500 K (9.6€)



11400 K (8.76€)

12200 K (9.38€)



11200 K (8.61€)

12000 K (9.23€)

Figure 46: For standardized PAE rate of different hall type apartments in DHSHD from 10/2007 to 11/2008.

Source: By author. Data based on: (Than Than Thwe), "(Thesis)", e-mail message to (Khin Lin Nwe), (13.06.2009).

Building costs

The factors for low cost are mainly important for the low and middle class housing. The budget of the project with the low costs is dependent on the distance between the buildings, the room dimensions, number of storeys, number of units attached, and the form of the building.

Moe Thae Phyu has stated that costs per square feet area of the building is affected by the size of the columns and the span between columns (Figures 47 and 48).⁵³ In other words, the room dimension including the numbers of columns and their sizes is a central cost factor. Furthermore, the room shape with the same floor area can lead to several different cost levels. In this case, the number of columns is considered. The facade area will also have a bearing on costs.

Figure 47: Different area in square unit affect cost per square feet

Source: By author, Table based on Moe Thae Phyu, 2005, p. 107.

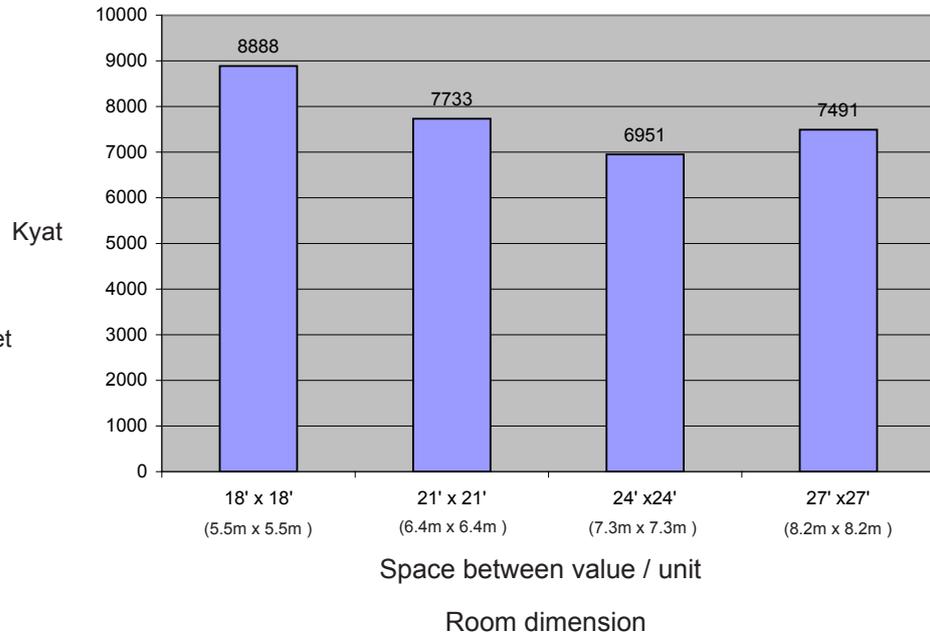
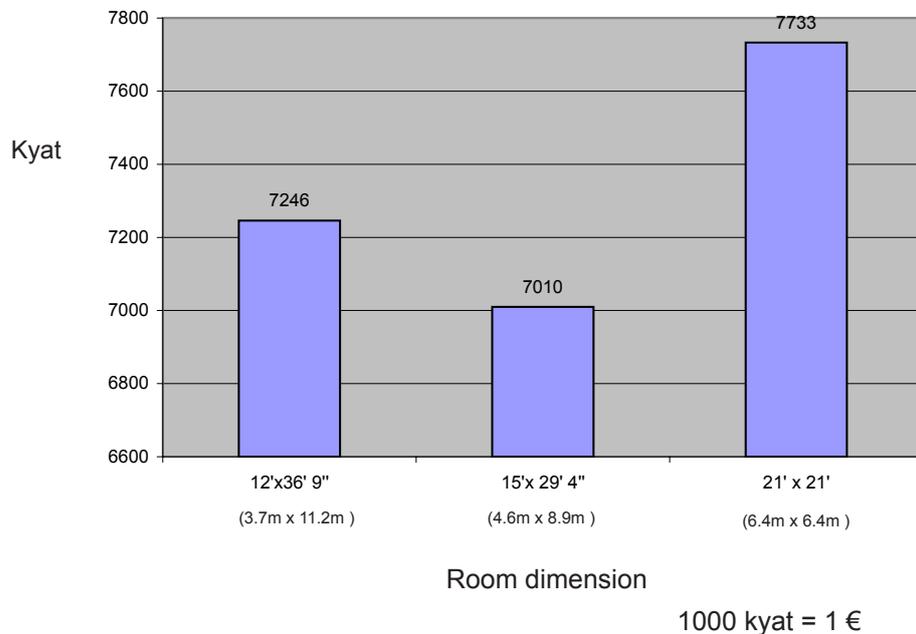


Figure 48: Different dimension with the same area and the affect costs per square feet

Source: By author, Table based on Moe Thae Phyu, 2005, p. 107.



⁵³ Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, (Yangon, 2005), p. 107-108.

Moreover, Moe Thae Phyu simulated the building costs for several storey and unit configurations. A unit area of 270 ft² (25 m²) for a hall type apartment was used as a basis for the calculations (Figure 49). From that simulation one can see lower costs are incurred as the storey number increases. Other simulations concerning one and two bedroom apartments in different systems are given in Figures 50 and 51. From these additional simulations it is evident that costs are affected by the location of the stairs, the access system, room dimension and the numbers of columns.

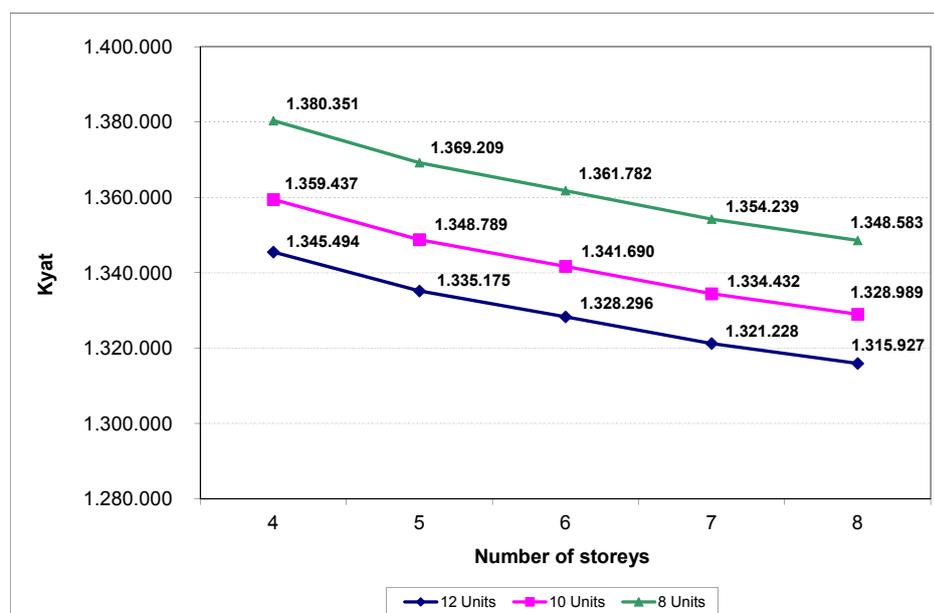


Figure 49: Relationship between unit design and number of storeys for hall type apartments

Source: By author
Data based on Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, 2005, p. 138.

Number of storeys

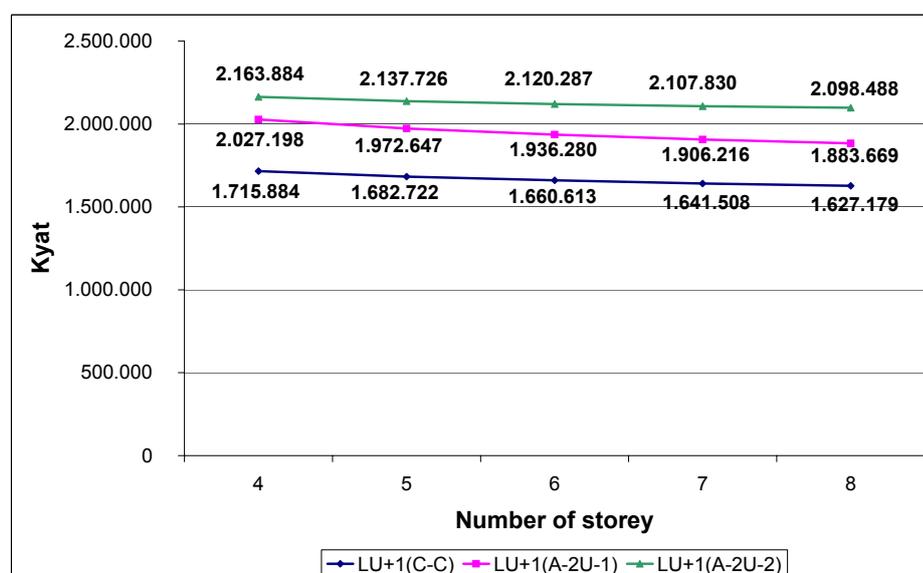


Figure 50: Relationship between cost, number of stories and design type for a one bedroom apartment

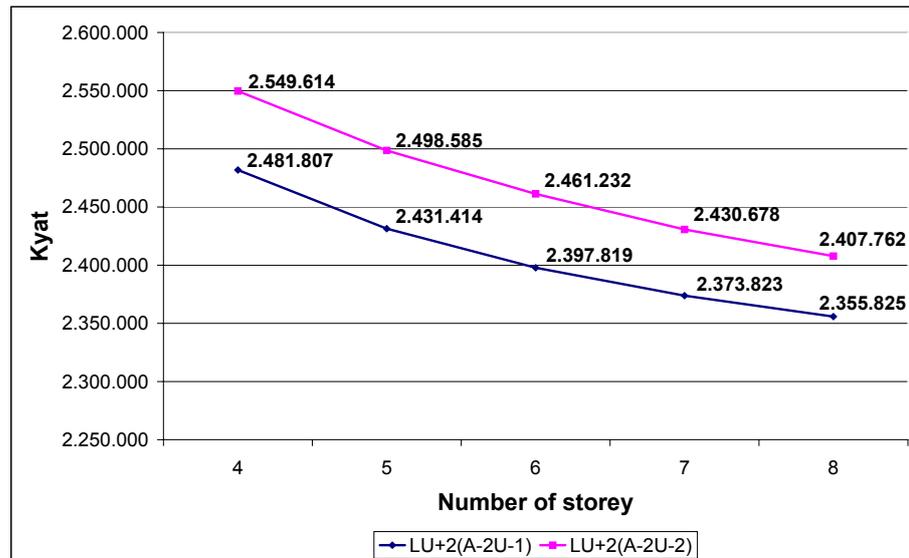
Source: By author
Data based on Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, 2005, p. 138.

Number of storey

1000 kyat = 1 €

Figure 51: Relationship between cost, number of stories and design type for a two bedroom apartment

Source: By author
Data based on Moe Thae Phyu, Analysis on Housing for Low Income Community in Yangon, 2005, p. 138.



1000 kyat = 1 €

Summary

Taking the above information together we can summarize as follows:

- The hall type apartment is the most cost effective room type apartment.
- The corridor access system design saves money.
- The higher the number of units attached, the lower the costs.
- Room dimension influences the cost because of columns' sizes and span.

Furthermore, to conclude the analysis on the economic considerations, the following points are worth worthy of summary:

- Costs for housing rent and maintenance are cheap compared with other costs.
- According to the percentage distribution in the average household expenditure, the outcome rate can't cover the whole family's expenditure if there is only one person who works in the family. For example, in a 5 person family which depends on only the father's income, the family has some problem with income and expenditure. There is no exact income ratio shown in the literature. However, we can see and assume the family income by seeing the "government servant's salary rate"⁵⁴.
- With respect to the types of apartments and numbers of units, it can be seen that the cost per ft² of the building slightly decreases if there are more than four storeys. In general, therefore, there is proportionality between the number of storeys and the cost per square feet.

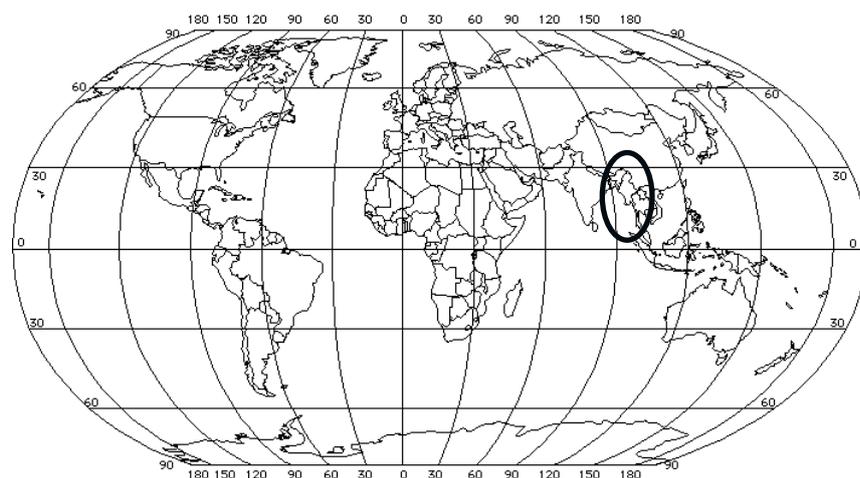
⁵⁴ Yayintnge, Government salary rate, available online at: <http://www.yeyintnge.com/2010/01/blog-post_6830.html>, accessed on 20.02.2010.

2.6.5. Climatic conditions

The form of architecture is influenced by the factors of climate. It is important to know the climatic data before thinking about the design of housing. The following section shows the general information about climatic conditions in Myanmar before the climatic conditions in Yangon are presented.

2.6.5.1. General climatic conditions in Myanmar

Myanmar is geographically located between 9°32' and 28°31' north latitudes and 92°10' and 96°10' east longitudes (Map 9). It is characterized by mountain ranges in the north, east and west and a long coastal strip to the south. It stretches about 2061 km north to south and approximates 945 km east to west, and has an area of approx. 67.65 million hectares. It has a common borders with China in the north, Thailand and Laos in the east, India and Bangladesh in the west and again with Thailand in the south.⁵⁵ (Map 10)

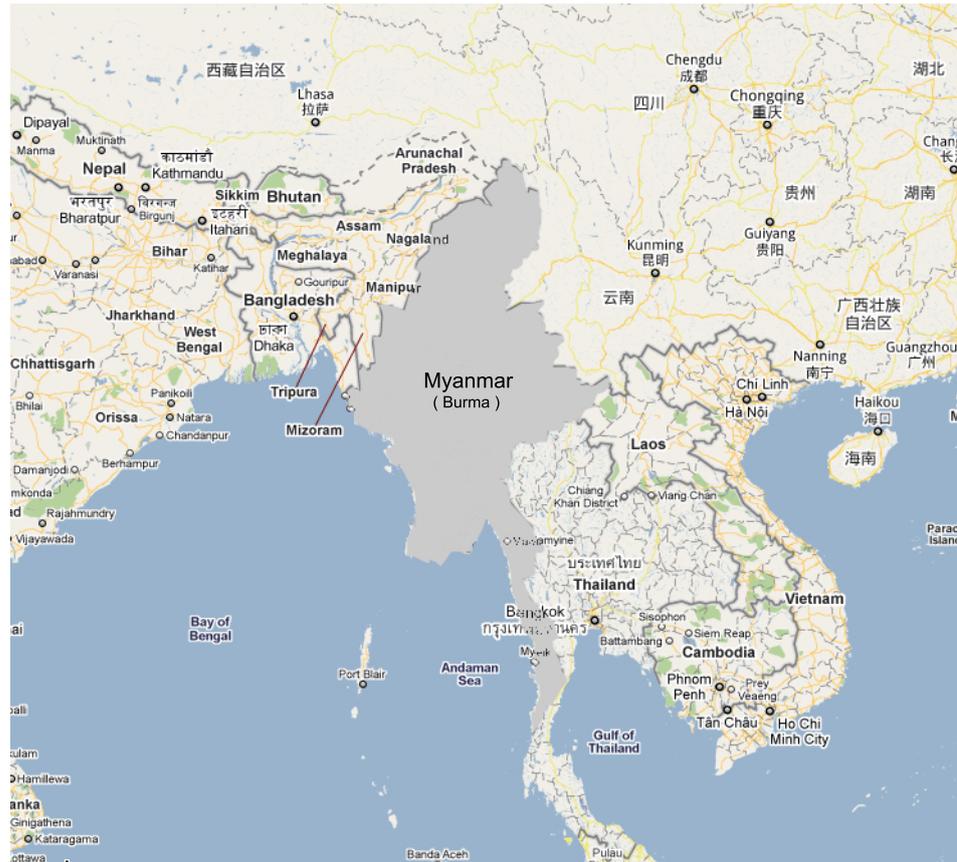


Map 9: Location of Myanmar with Latitude and Longitude

Source: Myanmar location with latitude and longitude, online available at <http://cse.ssl.berkeley.edu/SEGwayEd/lessons/search_ice_snow/world-mapL.gif>, accessed on 08.09.2010.

Myanmar is influenced climatically from the south by the warm temperatures caused by the proximity to the equator and by the monsoon which originates from the Indian Ocean and approaches Myanmar across the Bay of Bengal (Map 10).

55 Shan Yoma, Myanmar travel agency, Geography and climate in Myanmar, available online at <<http://www.myanmartraveltour.net/geography-climate-in-myanmar>> accessed on 08.09.2010.



Map 10: Myanmar map

Source: By author
 Map based on:
 Myanmar map, online
 available at <<http://maps.google.de/>>, accessed on 04.04.2011.

The Union of Myanmar is a tropical country in South East Asia with a total land area of 676,577 km². The topography is generally low in the coastal and deltaic regions, but rising to about 6,000 m in the north of the country. As mountain ranges generally run in the north to south direction, the major river systems also flow from north to south. Most of Myanmar belongs to the tropical region. It is characterized by a tropical monsoon climate with three well-defined seasons, namely summer, rainy and cool seasons.

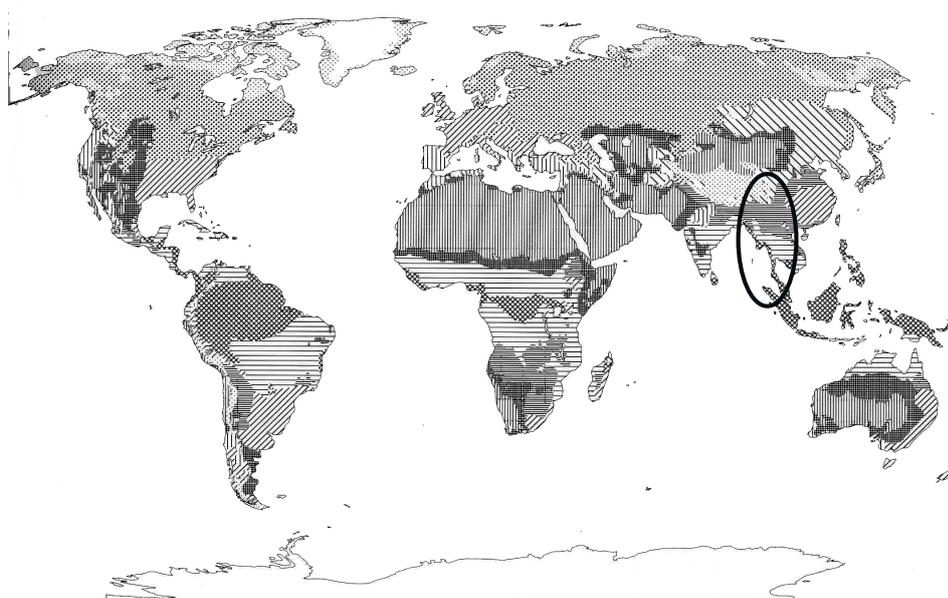
Annual rainfall in the coastal and deltaic region is as high as 5,000 mm whereas it is only about 600 mm in the Dry Zone of Central Myanmar. During the summer months, i.e. March and April, the highest temperature in the Central Myanmar is above 43° C while it is about 36° C in Northern Myanmar and 29° C on Shan Plateau in the east.

The rainy season, from mid May to the end of October, has an annual rain fall of less than 40 inches in central Myanmar while the coastal regions of *Rakhine*⁵⁶ and *Tanintharyi*⁵⁷ get about 200 inches. Winter starts from November and lasts to the end of February with temperature in hilly areas

56 Rakhine is a state in Burma which is situated on the western coast, it is bordered by Chin State to the north, Magway Division, Bago Division and Ayeyarwady Division to the east, the Bay of Bengal to the west, and the Chittagong Division of Bangladesh to the northwest.

57 Tanintharyi Region is an administrative region of Myanmar, covering the long narrow southern part of the country on the Kra Isthmus. It borders the Andaman Sea to the west and Thailand to the east. To the north is the Mon State.

of over 3000 feet dropping below 32 F (0 C) (Map 11).⁵⁸



Map 11: Climate zones

 Climate of perpetual ice and snow	 Warm winter-dry climate
 Tundra climate	 Desert climate
 Cold-humid winter climate	 Steppe climate
 Cold winter-dry climate	 Savannah climate
 Temperate-humid climate	 Tropical rainforest climate
 Warm summer-dry climate	

Source: Dirk U. Hindrichs, Klaus Daniels, Plusminus 20°/40° latitude, (Bielefeld, 2007), p. 111.

2.6.5.2. Climatic conditions in Yangon

In order to give an insight into the climatic conditions in Yangon, the following facts are presented:

- Amount of sunshine
- Rainfall
- Temperature
- Relative humidity,
- Wind velocity

Amount of sunshine

The sunshine hours in Myanmar vary depending upon the season. In June 21, the sun rises at 6:51 and sets at 19:00. In August 21, the sun rises at 5:51 and sets at 18:40. In December 21, the sun rises 6:51 and sets at 17:35 (Figure 52).

⁵⁸ Ministry of forestry, Yangon, National action programme of Myanmar to combat desertification in the context of United Nations convention to combat desertification (UNC-CD), (Yangon, 2005), p. 9.

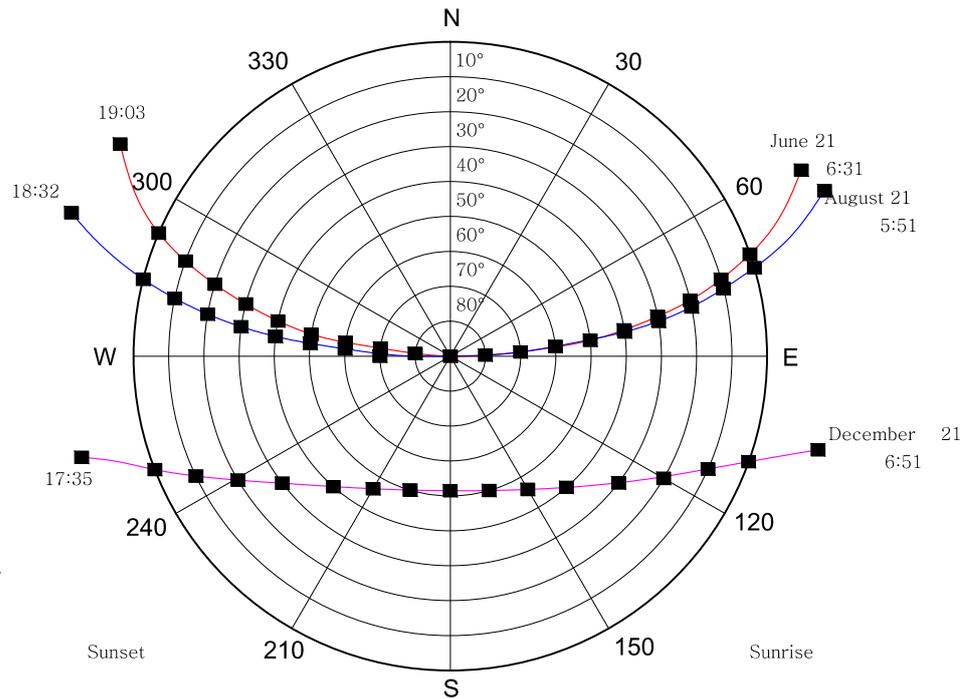


Figure 52: Sun path diagram in Myanmar

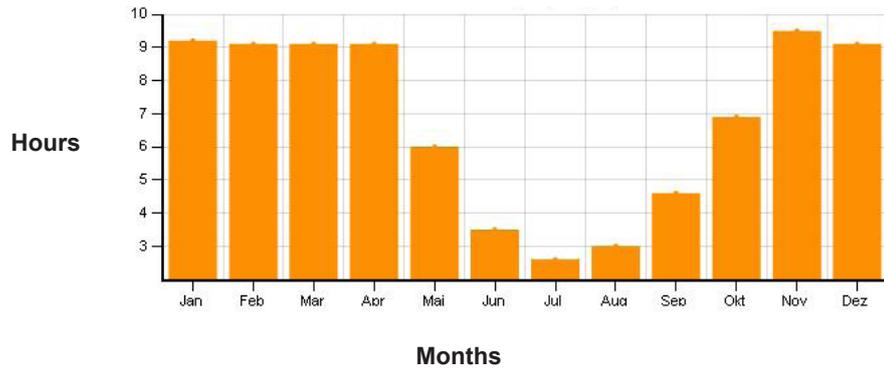
Source: By author
 Data based on: Falam, Solar diagram of Myanmar, available online at < <http://www.gaisma.com/en/location/falam.html>>, accessed on 03.09.2010.

■ Annual variation

The amount of sunshine hours in Yangon is approx. 9 hours from November to April (Figure 53). In May at the beginning of the rainy season, the sunshine hours are 6 hours per day. In the rainy season from June to October the minimum sun shine hours are about 2 hours a day, and with a maximum of about 7 hours a day.

Figure 53: Amount of sunshine in Yangon

Source: Climatic condition in Yangon, available online at <<http://www.wetter.com/reise/klimadatenbank?type=humid&continent=AS&country=MM&station=480970>>, accessed on 12.12.2009.



Rainfall

90 % of the rainfall in different regions of Myanmar is monsoonal (Figure 54). Eventhough the rainy season extends from June to September, it usually starts to rain in May with a rainfall of 300 mm. The maximum rainfall in the rainy season is 500 mm for July and 600 mm for August.

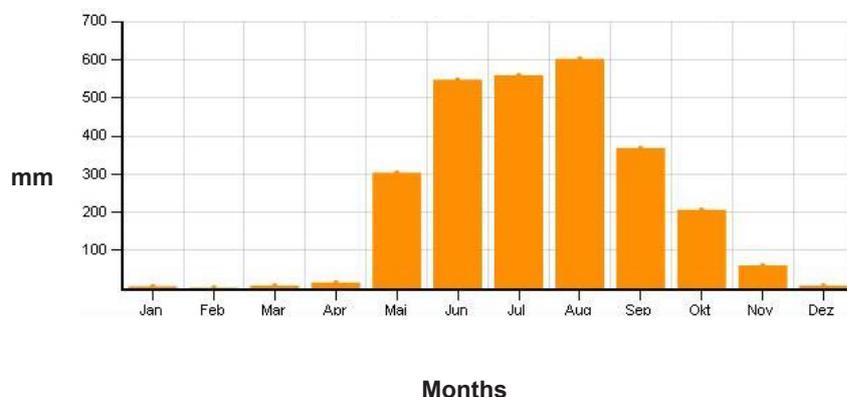


Figure 54: Rainfall in Yangon

Source: Climatic condition in Yangon, available online at: <<http://www.wetter.com/reise/klimadatenbank?type=temp&continent=AS&country=MM&station=480970>>, accessed on 12.12.2009.

Temperature

In Yangon, the hot and dry summer season is from March to May, the rainy season is from June to October and the winter season is from November to February. The temperature varies from 12° C to 42° C. Figure 54 shows the minimum and maximum temperature in Yangon. The yellow columns represent absolute maximum temperature in degree centigrade. The blue columns represent absolute minimum temperature. The yellow line shows maximum degrees centigrade and blue line shows minimum degrees centigrade. According to this graph, the average temperature of summer season is a minimum of 17° C and a maximum of 42° C. In the rainy season, the average temperature is a minimum of 20° C and maximum 38° C. In winter, the minimum average temperature is 7° C and maximum 38° C.

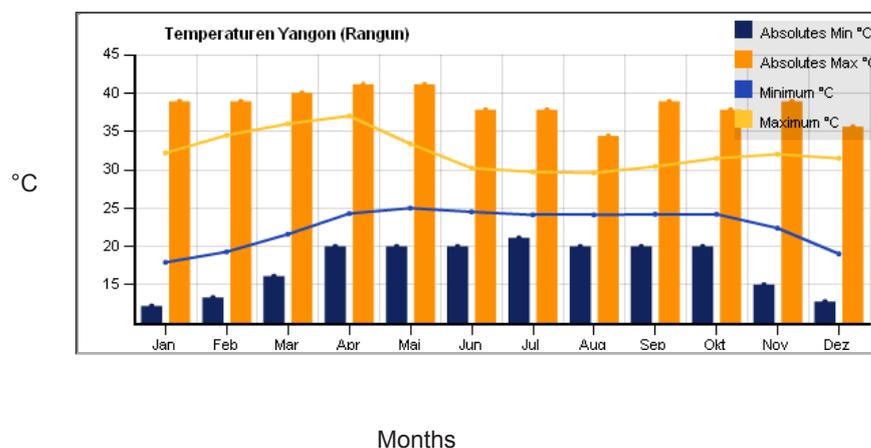


Figure 55: Temperature in Yangon

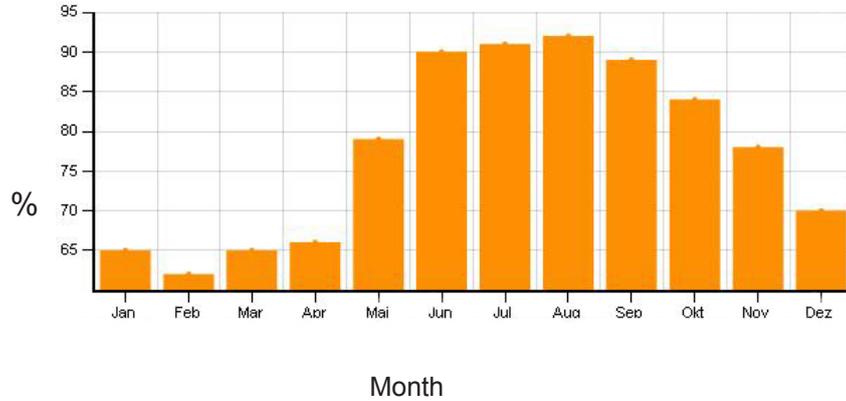
Source: Climatic condition in Yangon, available online at: <<http://www.wetter.com/reise/klimadatenbank?type=temp&continent=AS&country=MM&station=480970>>, accessed on 12.12.2009.

Relative Humidity

The average relative humidity of Yangon is shown in Figure 56. According to the data, the highest humidity occurs between June to October. The highest percentage of humidity at 93 % in August.

Figure 56: Relative humidity in Yangon

Source: Climatic condition in Yangon, online available at < <http://www.wetter.com/reise/klimadatenbank?type=humid&continent=AS&country=MM&station=480970>>, accessed on 12.12.2009.



Wind Velocity

Wind velocity in Yangon is shown in Table 5. It shows the maximum velocity, the minimum velocity and the average velocity based on miles per hour and kilometers per hour in each month. The maximum average wind velocity occurs in rainy season from June to August with 6 mph, 9 km / h. In October, November, December and January, there is a lower wind velocity of 3 to 4 mph, 5 to 6 km / h.

There are generally two wind direction in Yangon. In May to October, the wind direction is from the south-east, and from November to February, the wind direction is from the north direction.⁵⁹

Table 5: Wind velocity in Yangon

Source: Yuzana Lwin, Correlation between health and housing for walk-up apartments in Yangon, Yangon, 2004, p. 46.

		2004											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max	Mph	5	10	17	22	23	21	17	17	12	17	14	12
	Km/h	8	16	27	35	37	34	27	27	19	27	23	19
Avg	Mph	3	4	5	6	5	6	6	6	5	4	4	4
	Km/h	5	7	7	9	8	9	9	9	7	6	6	6
Min	Mph	0	0	0	0	0	0	0	1	0	0	0	0
	Km/h	0	0	0	0	0	0	0	2	0	0	0	0

59 Moe The Phyu, Analysis on housing for low income community, p. 118.

Bio climatic chart in Yangon

According to the bio climatic data in Yangon, the “comfort zone” lies from December to February with the comfort temperature, 25° C to 29° C and the relative humidity of about 50-70 % (Figure 57).

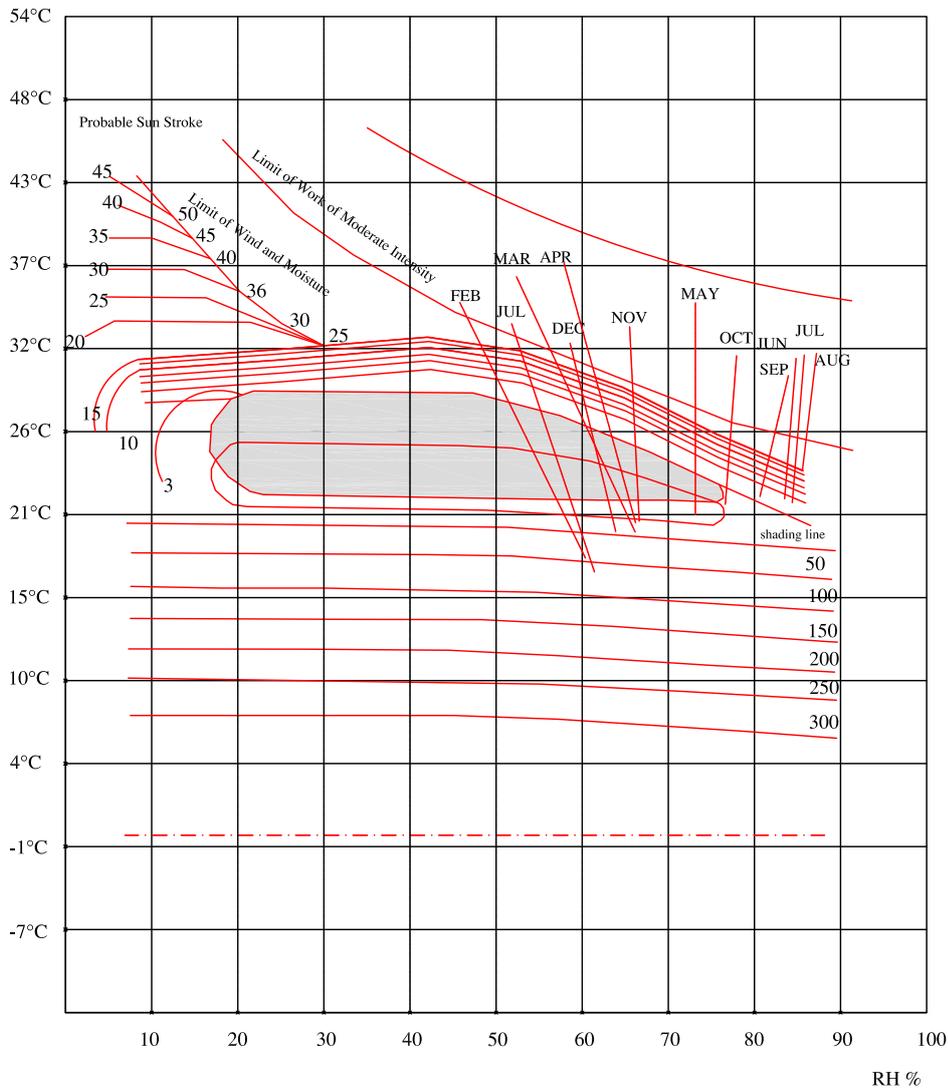


Figure 57: Bio climatic chart in Yangon

Source: By author
Data based on Moe Thae Phyu, 2005, p. 118.

Sun angles in Yangon

The sun direction and angles in three different months (March in summer, June in raining season, and December in winter) are represented in Figure 58.

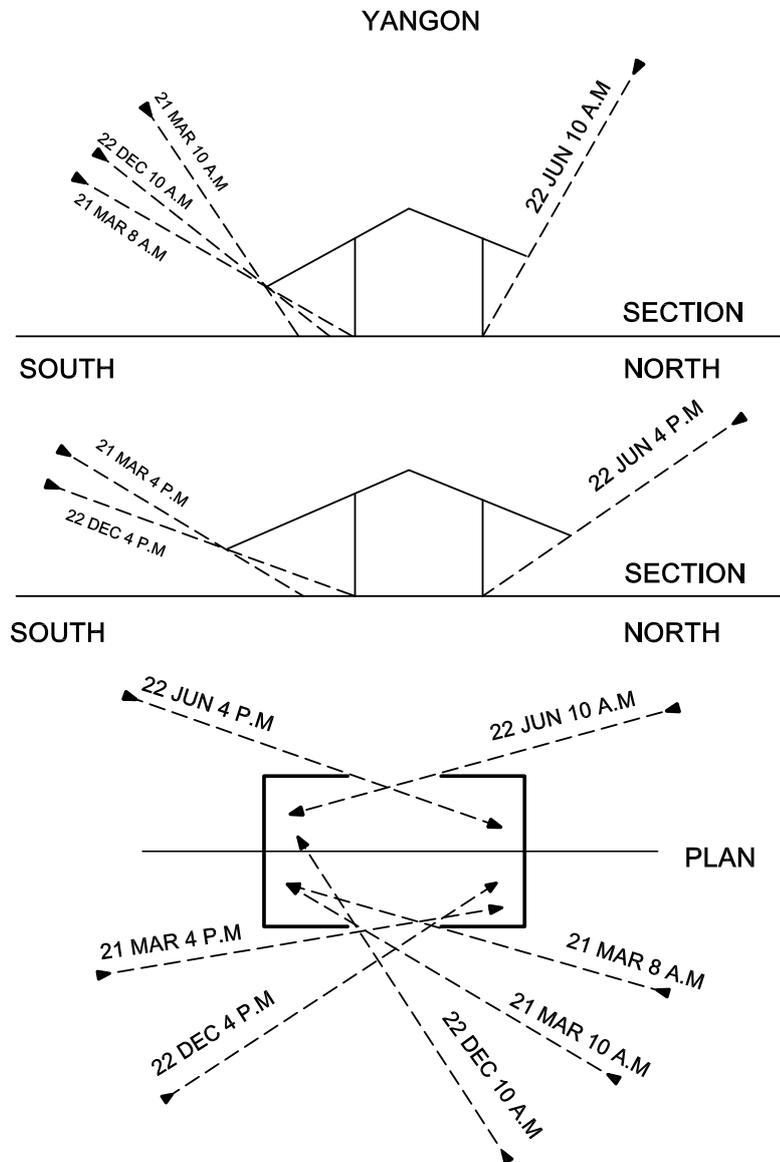


Figure 58: Extreme Sun Angles in Yangon

Source: By author.
Data based on Moe Thae Phyu, 2005, p. 119.

Excursus 1 : Architectural features affecting natural ventilation

Natural ventilation is the process of supplying and removing air through an indoor space by natural means. There are two types of natural ventilation occurring in buildings: wind driven ventilation and stack ventilation. In the tropics, the ventilation by the stack effect normally is not significant due to the following reasons. Firstly, the temperature difference between interior and exterior is relatively small. Therefore thermal stratification required for stack effect is difficult to occur.

Secondly, natural ventilated buildings usually have more porous external walls, which greatly enhance cross ventilation. Openings in building forms are connected horizontally rather than vertically.⁶⁰

The goodness or weakness of a natural ventilation system in the case studies can be stated on hand of the specification of the following features.

- (a) Air flow through system
- (b) Optimal condition and comfort
- (c) Natural ventilation and windows
- (d) Types of building
- (e) Architectural standard in the relation of opening area per floor area

(a) Air flow through system

Quality of housing depends on a large extent to the quality of the indoor environment. The quality of housing in Yangon largely depends on the quality of ventilation, the air flow system. There are four basic types of air flows: laminar, separated, turbulent and eddy (Figure 59).⁶¹

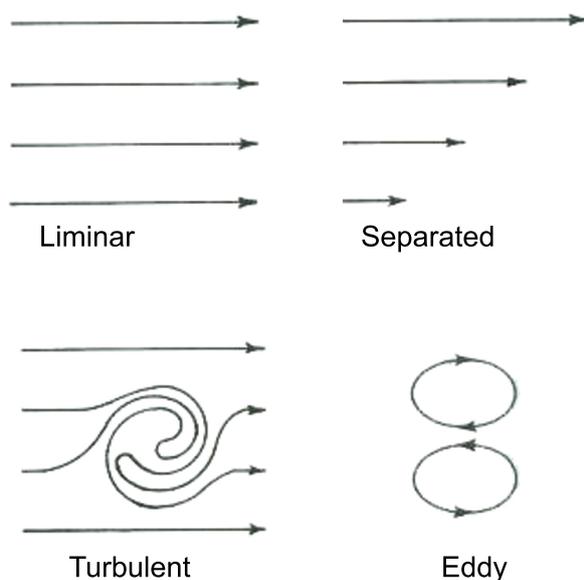


Figure 59: Air flow through system

Source: Norbert Lechner, Heating, cooling, lighting, design method for architects, New York, 2001, p. 256.

60 Henry Feriadi, Thermal comfort for naturally ventilated residential buildings in the tropical climate, (Ph.D Diss., National University of Singapore, 2004), p. 9-10.

61 Norbert Lechner, Heating, cooling, lighting, design method for architects, (New York, 2001), p. 256.

(b) Optimal condition and comfort

Where there is only slight air movement with air velocities of up to 0.3 m/s, the optimal values for room temperature lie between 22 °C and 26 °C. Temperatures of up to 29 °C are still perceived as comfortable if air movement also increases – whereby air velocities above 0.8 m/s are, on the other hand, no longer perceived as comfortable. Humidity has only a slight influence, even though it can range between 20 and 90 % (Figure 60; cf. Figure 56).

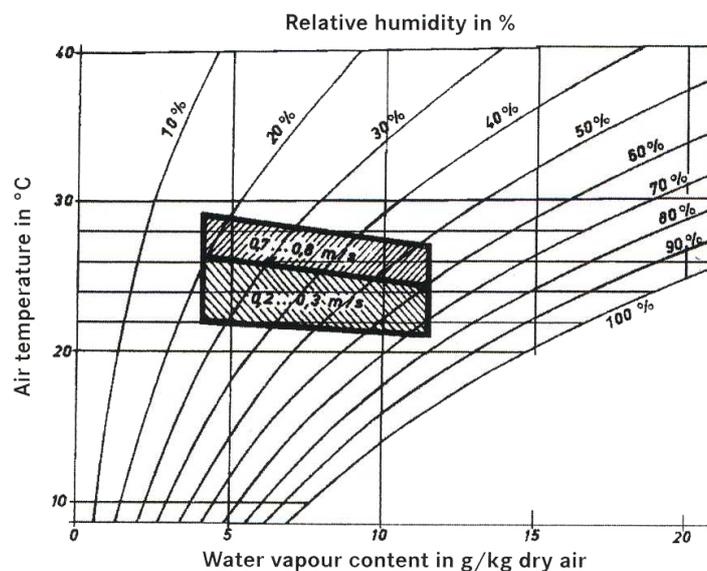


Figure 60: Optimal condition and comfort

Source: Wolfgang Lauber et al., *Tropical architecture, sustainable and humane building in Africa, Latin America and South-East Asia*, (Munich, 2005), p. 93.

(c) Natural ventilation and windows

“To provide a good potential for natural ventilation at least one of the walls of any dwelling unit should face the wind. It is not necessary to face the wind directly. Even with winds oblique to a wall by up to about 60 degrees from the perpendicular (normal) it is possible to use windows in the wall as inlets for the wind.”⁶²

In many situations rooms have only one external wall. If two windows are provided in that wall, the two openings are exposed to about the same pressure, and this configuration reduces the ventilation potential of the room. When the wind is oblique to the building, a pressure gradient is created along the windward walls and the upwind window is at a higher pressure than the downwind one. Thus, air enters the room through the downwind aperture, creating better ventilation even in rooms which have only one external wall.

⁶² Baruch Givoni, *Climate considerations in building and urban design*, (New York, 1998), p. 93.

To achieve natural ventilation, the clear width of the supply and exhaust openings in opposite exterior walls must be extremely large and should be at least 0.1 to 0.2 m² per floor area. Depending on the room height this amounts to between 40 and 80 % of the total wall surface area of the room. The buildings should therefore be designed in a way that is very open to the wind and the movement of air.⁶³

(c.1) Location of windows

“The effect of window location (orientation with respect to the wind) is relevant mainly to the placement of the inlet openings. The location of the outlet openings has no significant effect on the indoor airflow. The height of the inlet opening may determine the level of the main indoor airflow. In some cases, architectural, functional, or privacy requirements call for placing openings near the ceiling, with their sills high above the level of occupancy. In this case, poor ventilation conditions may exist in the occupied zone of the room unless the flow is directed downward.”⁶⁴

Adequate ventilation by the use of openable windows and doors

For optimum ventilation properties, windows should have the following properties: *“For a hinged or pivot window that opens 30° or more or for parallel sliding windows (e.g. vertical sliding sash windows), the height x width of the opening part should be at least 1/20th of the floor area of the room. For a hinged or pivot window that opens between 15° and 30°, the height x width of the opening part should be at least 1/10th of the floor area of the room. If the window opens less than 15°, it is not suitable for providing good ventilation and other arrangements should be made. If the room contains more than one openable window, the areas of all the opening parts may be added to achieve the required proportion of the floor area. The required proportion of the floor area is determined by the opening angle of the largest window in the room.”⁶⁵*

The directives for external doors should be in line with the following guidelines: For an external door, the height x width of the opening part should be at least 1/20th of the floor area of the room. If the room contains more than one external door, the areas of all the opening parts may be added to achieve at least 1/20th of the floor area of the room.

63 Wolfgang Lauber et al., Tropical architecture, sustainable and humane building in Africa, Latin America and South-East Asia, (Munich, 2005), p. 103.

64 Givoni, Climate considerations in building and urban design, p.94.

65 HM Government, The building regulation 2000-2010, Ventilation, available online at < http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADF_2010.pdf>, October 2010, p. 47, accessed on 12.09.2010.

If the room contains a combination of at least one external door and at least one openable window, the areas of all the opening parts may be added to achieve at least 1/20th of the floor area of the room.⁶⁶

(d) Building and ventilation forms

With respect to the form of the building, there are three common ventilation strategies. They are single-sided, two-sided, and courtyard ventilation. Single sided ventilation relies on opening(s) on only one side of the enclosure. Its ventilation effectiveness depends on the numbers of the openings and their position in relation to the other. There is a limit of effective depth of fresh air distribution in rooms with single-sided natural ventilation. Cross ventilation occurs where there are openings on both horizontal sides of a space. As the air driven by wind moves across space, it picks up heat and pollutants. Courtyard ventilation is used to describe those ventilation strategies where driving forces promote an outflow at the top level of the building, thereby drawing in fresh cool air via openings at low level.⁶⁷

Multi-storey apartment buildings can be divided in terms of their climatic performance into two basic types.

“The two main types are:

A. Buildings with long corridors providing access to the units along them. Vertical access to the corridors is provided by either staircases or elevators.

These can be subdivided again into two categories:

A1: Building with an internal corridor, providing access to units on both sides (Double loaded corridors).

A2: Buildings with an external corridor located along one wall of the building (Single- loaded corridor).

B. Buildings with staircases or elevators providing direct access to two, three, or four apartments.

Which again can be differentiated into two subdivisions:

B1: Multiple staircase or elevators serving two apartments on each floor.

B2: Staircase or elevators serving more than two units at each floor.⁶⁸

66 Givoni, Climate consideration in building and urban design, p. 224.

67 Henry Feriadi, Thermal comfort for natural ventilated buildings, (National University of Singapore, Singapore, 2004), available online at <<http://scholarbank.nus.edu.sg/bitstream/handle/10635/13922/Chapter%202%20-%20Literature%20Review.pdf?sequence=4>>, p. 10, accessed on 02.02.2011.

68 Givoni, Climate considerations in building and urban design, p. 219-221.

Double loaded corridor buildings

*In double loaded corridor buildings, the corridors are located at the centre of the block by providing access to the dwelling units on both sides. Thus the corridor separates the dwelling units of the building into two groups with completely different exposure conditions. Most units, except the end ones, have only one external wall. As a result almost all the units do not have even the potential for effective cross ventilation. From the viewpoint of direct sunlight and solar energy utilization for space heating, one-half of the units in buildings with double loaded corridors are always at a disadvantage, unless the building is orientated along the north-south axis. Then the east wall and windows get the sun in the morning and the west wall and windows get it in the afternoon (Figure 61)."*⁶⁹

Considering the climatic performance characteristics of double loaded corridor buildings, it can be said that they are not highly effective with regard to their natural ventilation, comfort, and solar energy properties. This is the case for hot climates and especially so for low income individuals who may not be able to afford air conditioning.

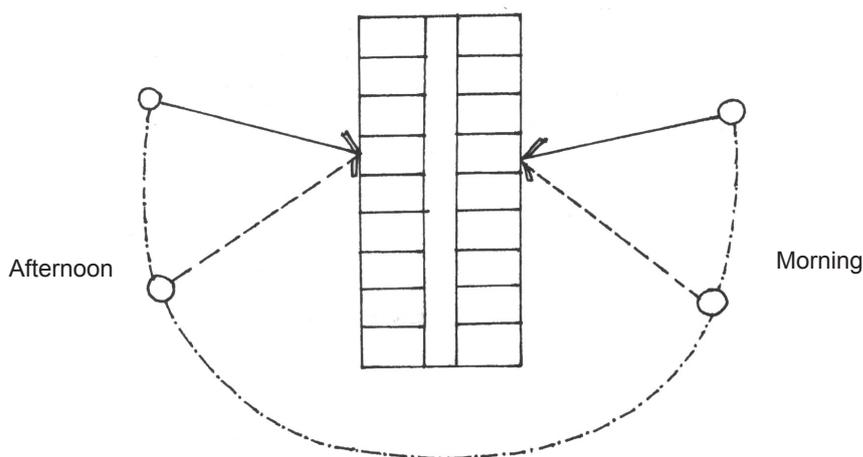


Figure 61: Double loaded corridor building

Source: Baruch Givoni, *Climate considerations in building and urban design*, (New York, 1998), p. 223.

Single loaded corridor buildings

In single loaded buildings, the corridors are located along one wall of the building. Each apartment is thus bound on one side by the corridor and on the other side by an external wall. Theoretically, cross-ventilation is possible in apartments along an open corridor by leaving windows open in the external as well as windows and doors in the wall facing the corridor. Practically, however, leaving doors open in the corridor wall reduces greatly the visual and acoustical protection of the occupants.

69 Givoni, *Climate considerations in building and urban design*, p. 222-224.

Direct access multi-storey apartments with two units per staircase

Up to four floors with staircases directly serving two apartments on each floor is a much better design scheme than corridor type buildings from the climatic point of view. With this building type, each apartment has two opposite external walls. In contrast to the single loaded corridor type, such buildings do not compromise the privacy of the inhabitants while the apartments are cross ventilated. The air flows from inlets in one wall to the other wall while the apartment is completely isolated from strangers (Figure 62).

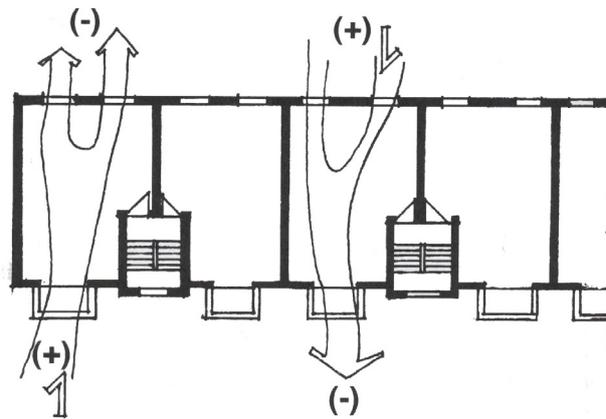


Figure 62: Direct access multi-storey apartments with two units per staircase

Source: Baruch Givoni, *Climate considerations in building and urban design*, (New York, 1998), p. 228.

Multi-story buildings with more than two units per staircase

If the apartments contain more than two apartments and are accessed directly at each floor from a staircase, the third or fourth apartment projected in a right angle to the overall building block gets wind shadow, when the wind is oblique to the building. While all apartments can still have reasonable ventilation, their conditions are less favorable than in the case of two units to a staircase, as their external walls are all exposed to zones of low pressure (Figure 63).⁷⁰

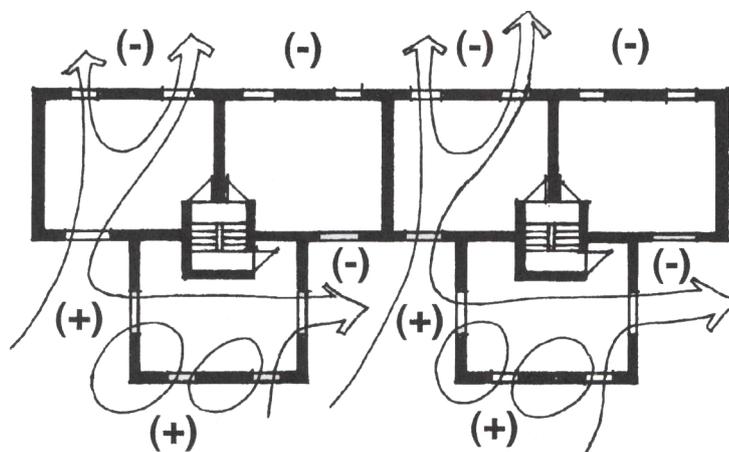


Figure 63: Ventilation potential in direct-access building with internal staircase (type-1)

Source: Baruch Givoni, *Climate considerations in building and urban design*, (New York, 1998), p. 229.

70 Givoni, *Climate considerations in building and urban design*, p. 224-228.

A partial solution for improving the ventilation potential of a unit in the wind shadow is when the staircase itself projects out of the main block and is open to air flow through it (Figure 64).⁷¹

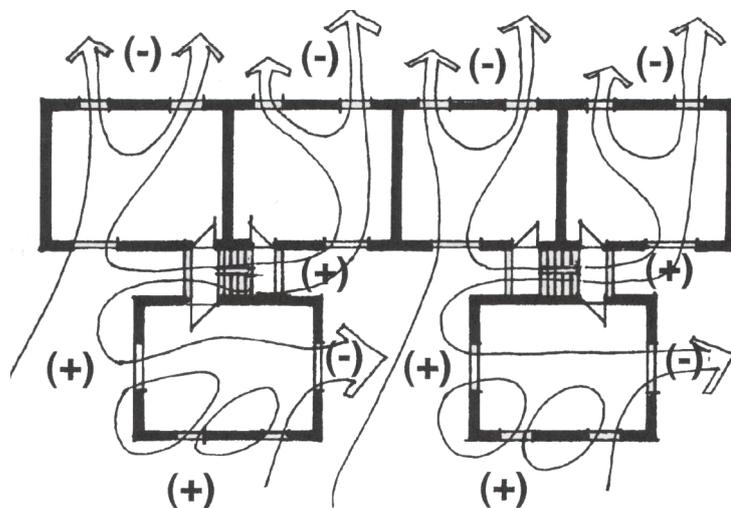


Figure 64: Ventilation potential in direct-access building with external staircase (type -2)

Source: Baruch Givoni, *Climate considerations in building and urban design*, New York, 1998, p. 229.

When the projection is on the leeward side of the building the third apartment itself is located in the wind shadow. As a result it will always suffer from poor ventilation in this position (Figure 65).

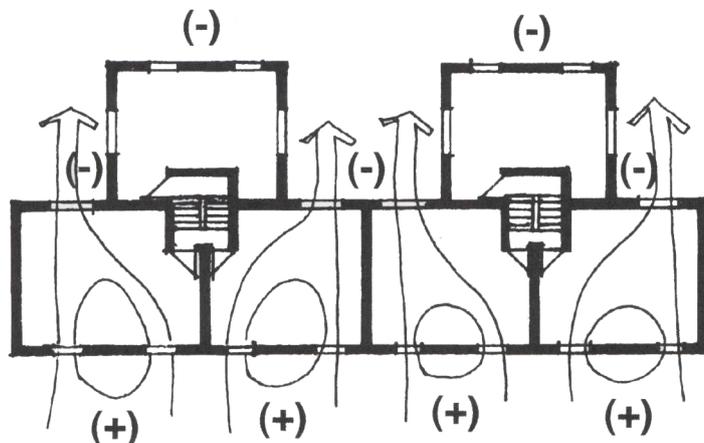


Figure 65: Ventilation potential in direct-access building with internal staircase (type-3)

Source: Baruch Givoni, *Climate considerations in building and urban design*, New York, 1998, p. 229.

(e) Architectural standards in relation to opening area per floor area

There are different regulations according to the relationship of opening area per floor area. The natural ventilation regulations in Hong Kong require a habitable room⁷² to provide effective natural lighting by one or more windows which shall not be less than 1/10 of floor area of the room

71 Givoni, *Climate considerations in building and urban design*, p. 229.

72 Habitable room means a room that is intended to be used for sleeping, living, cooking or eating purposes but does not include a lobby, hallway, closet, toilet room, bathroom, corridor, laundry or storage space.

or 1/16 of floor area of the room if the top of the window is 2 m (6.5 ft) above the floor. The same requirements are valid for kitchens also.⁷³

In comparison, building standards for natural ventilation in Japan require that the ratio of the effective area of ventilation to the floor area be not less than 1/20. Yuzana Lwin investigated the relationship between window area to floor area for natural ventilation in apartments in Yangon. According to her research, window area per floor area for natural ventilation should not be less than 8 % in living areas, 10% in the kitchen, 5 % for bathrooms, and 7 % for separate WCs.⁷⁴

Excursus 2 : Architectural features affecting natural lighting

Day lighting is the use of light from the sun and sky to provide illumination within buildings, which can enrich architecture with changes in character over time, seasons and climate conditions of respective countries and cities. It affects not only the nature of built form and space, but also affects the people to be living in a more comfortable, with less energy consumption.⁷⁵

Nature of daylight

The daylight that enters a window has several sources: Direct sunlight, clear or cloudy skies, or reflections from the ground and nearby buildings (Figure 66). There are various design considerations for day lighting, e.g. window type, clerestories and atria which bring the light into the interiors. The size of rooms and their corresponding windows is a crucial factor for adequate daylight design.⁷⁶

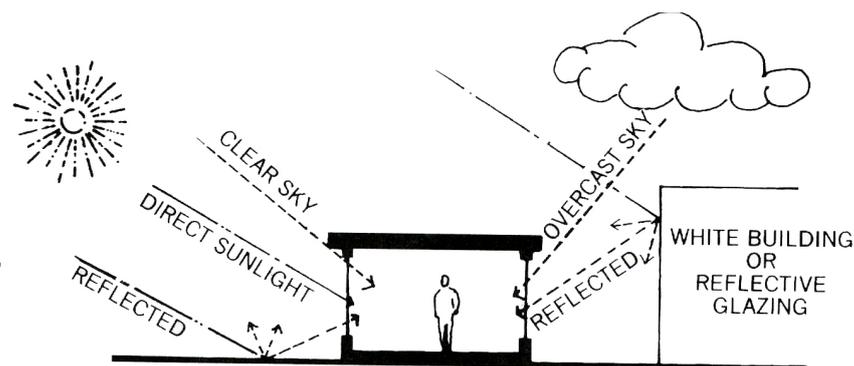


Figure 66: The various sources of daylight

Source: Nibert Lechner, Heating, cooling, lighting, design method for architects, New York, 2001, p. 365.

73 Hong Kong building regulation center, 1996.

74 Yuzana Lwin, Correlation between health and housing for walk-up apartments in Yangon, (Yangon, 2004), p. 127-129.

75 Swe Swe Aye and Maung Hlaing, Research on architectural fenestration for sustainable building designs, World housing congress, Terengganu, Malaysia, 2007, p. 1.

76 Lechner, Heating, cooling, lighting, design method for architects, p. 365-366.

Daylight and the influence on interior spaces in buildings are discussed below under the following headings:

1. Architectural components

Window height

Window size and height are obviously important factors. As windows become larger the amount of daylight admitted increases. Window height is here the most important factor: The higher the window, the deeper the daylight will penetrate into the room. Figure 66 shows the effects of changes in window height on a non-dimensional graph superimposed on a cross section of a rectangular room 28 feet deep.

If the ceiling is lowered from 14 to 12 feet, the illumination at the point near the back wall decreases about 19 percent. Similarly, when window height is reduced from 14 feet to 12 feet, there is a 19 percent drop in illumination in the back of the unilaterally lighted room, as indicated on the graph superimposed on a cross section (Figure 67).⁷⁷

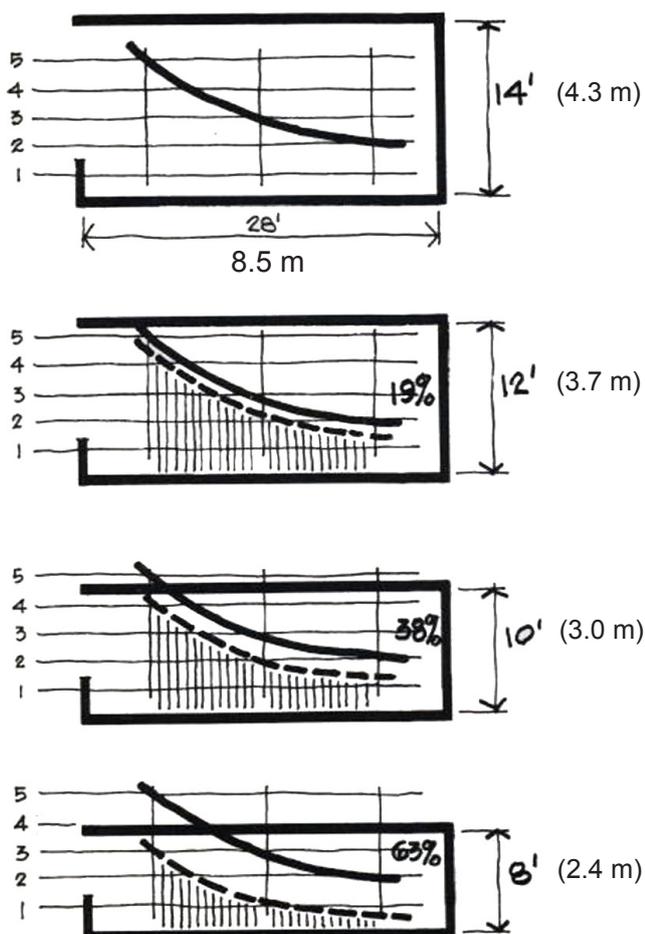


Figure 67: Study on the window height and illumination

Source: Benjamin H. Evans, AIA, *Daylight in architecture*, New York, 1981, p. 56.

77 Benjamin H. Evans, AIA, *Daylight in architecture*, (New York, 1981), p. 56.

In the bilaterally lighted room, there is an 8.5 percent drop at the center of the room. Further lowering of the window height results in reduced illumination levels; reductions are, however, not so pronounced as in the unilateral room (Figure 68).

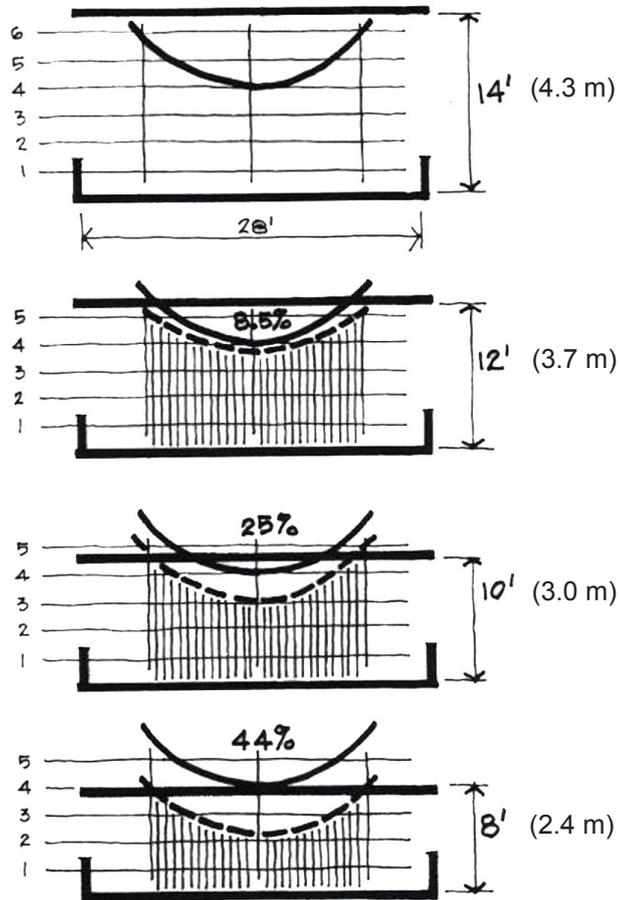


Figure 68: Study on the window height and illumination (bilateral)

Source: Benjamin H. Evans, AIA, *Daylight in architecture*, New York, 1981, p. 57.

Window width

Window width will also affect lighting provision. Wide windows provide higher illumination levels than narrow windows. The figures show that when a 36 feet wide window wall was shortened to 28 feet, there was a 7 percent drop in intensity at a point near the back wall. When the 36 foot window was reduced to 20 feet, the reduction was 25 percent (Figure 69).⁷⁸

⁷⁸ Evans, AIA, *Daylight in architecture*, p. 57-59.

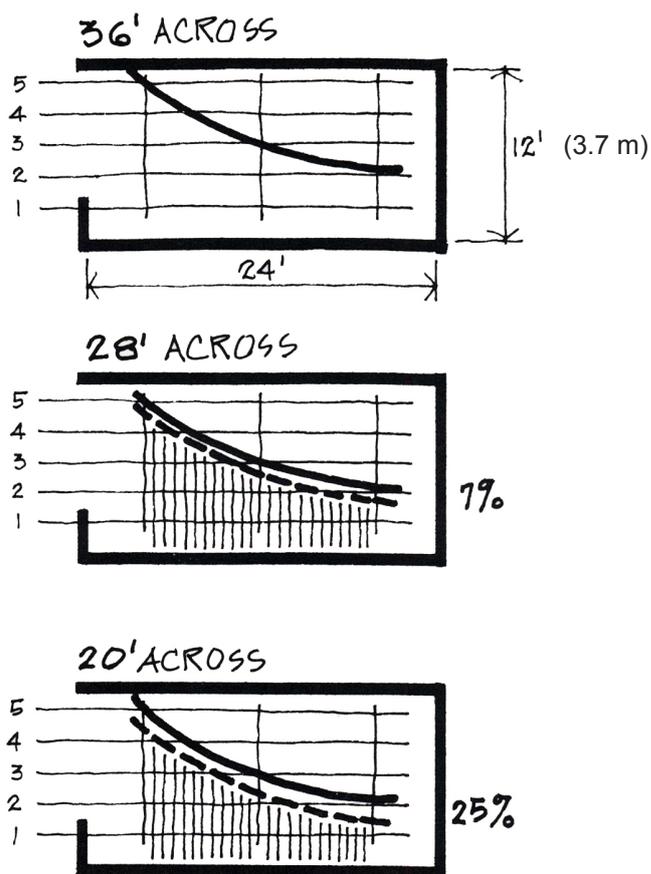


Figure 69: study on the window width and illumination (unilateral)

Source: Benjamin H. Evans, AIA, *Daylight in architecture*, New York, 1981, p. 56.

Room depth

How deep the light illuminates the room depends on ceiling and window height. Figure 70 shows a room with a 12 feet ceiling using room depths of 24, 28 and 32 feet. The figures show that light intensity drops off as the room becomes deeper. For example, 28 foot-deep room had 18 percent less light at a point near the back wall than at the same relative position in the 24 foot room. In going from 24 to 32 foot-deep room, a 28 percent reduction in illumination at a point in back of the room was observed.

Light shelves will not only improve the quality of the day lighting, but also increase the depth of the day lighting zone. A rule of thumb for daylight penetration is 1.5 times the height of a standard window and 2 times the height of a window with a light shelf for south-facing windows under direct sunlight (Figure 71).⁷⁹

79 Evans, AIA, *Daylight in architecture*, p. 59.

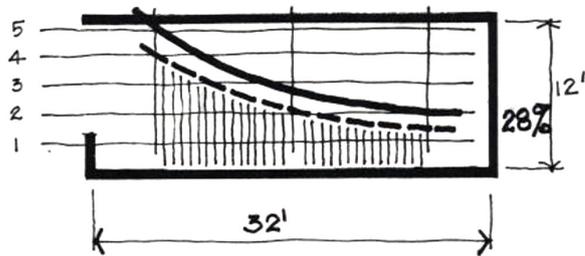
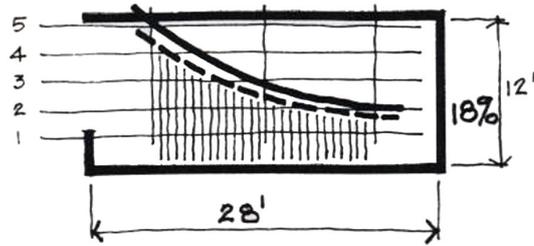
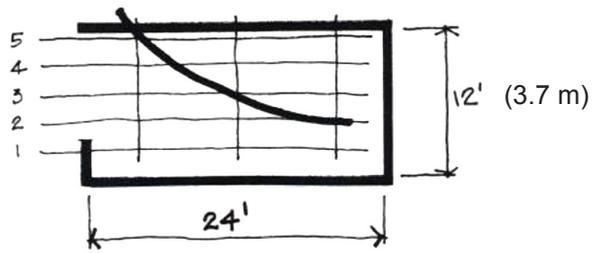


Figure 70: study on the room depth and illumination (unilateral)

Source: Benjamin H. Evans, AIA, Daylight in architecture, New York, 1981, p. 60.

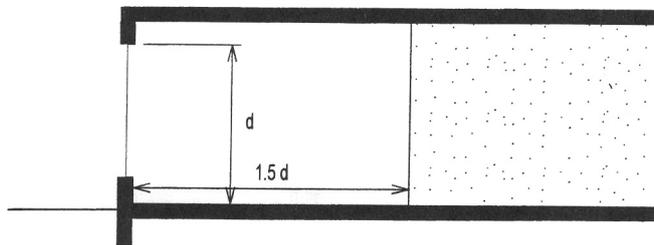
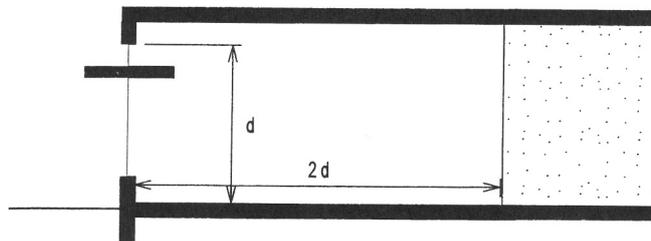


Figure 71: The depth of day lighting zone

Source: Norbert Lechner, Heating, cooling, lighting, design method for architects, New York, 2001, p. 379.



Overhangs

Building overhangs are useful in sun and rain control although they reduce the level of light intensity within buildings. Figures 72 and 73 show overhang length and the resulting reduction in illumination. With the addition of a 6 foot overhang, a 39 % reduction in illumination near the window of a unilaterally lighted room is obtained; only a 22 % drop near the interior wall is found. In a similar room with windows at opposite walls, the addition of a 6 foot overhang over both windows reduces illumination near the windows by 34 % and at the center of the room by 25 %.⁸⁰

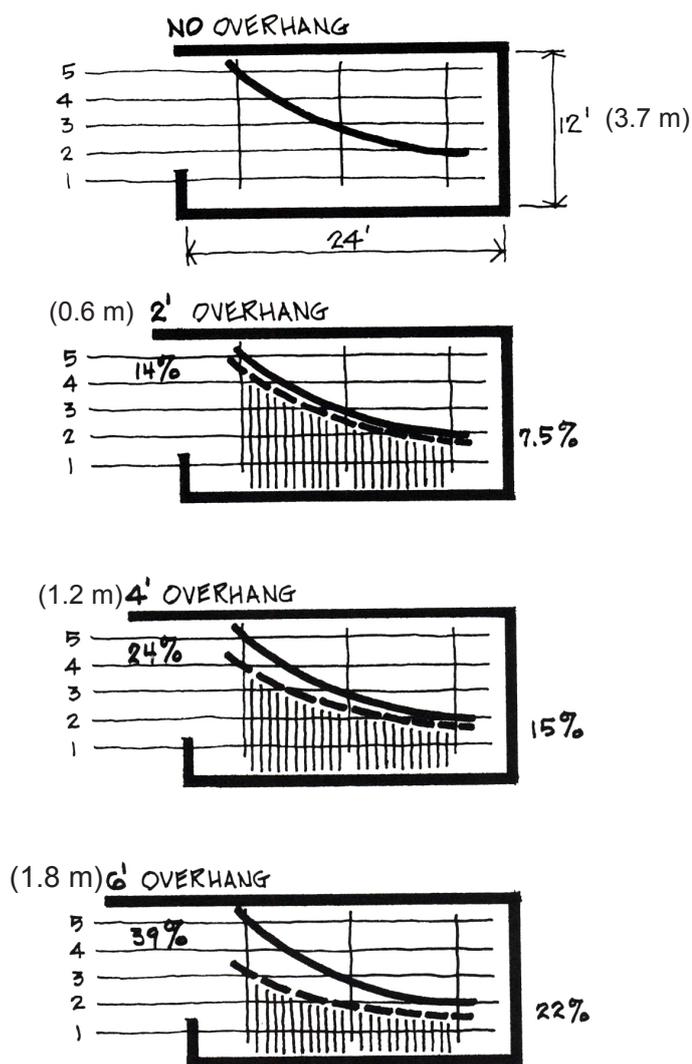


Figure 72: Unilateral overhangs

Source: Benjamin H. Evans, AIA, Daylight in architecture, New York, 1981, p. 56.

80 Evans, AIA, Daylight in architecture, p. 61.

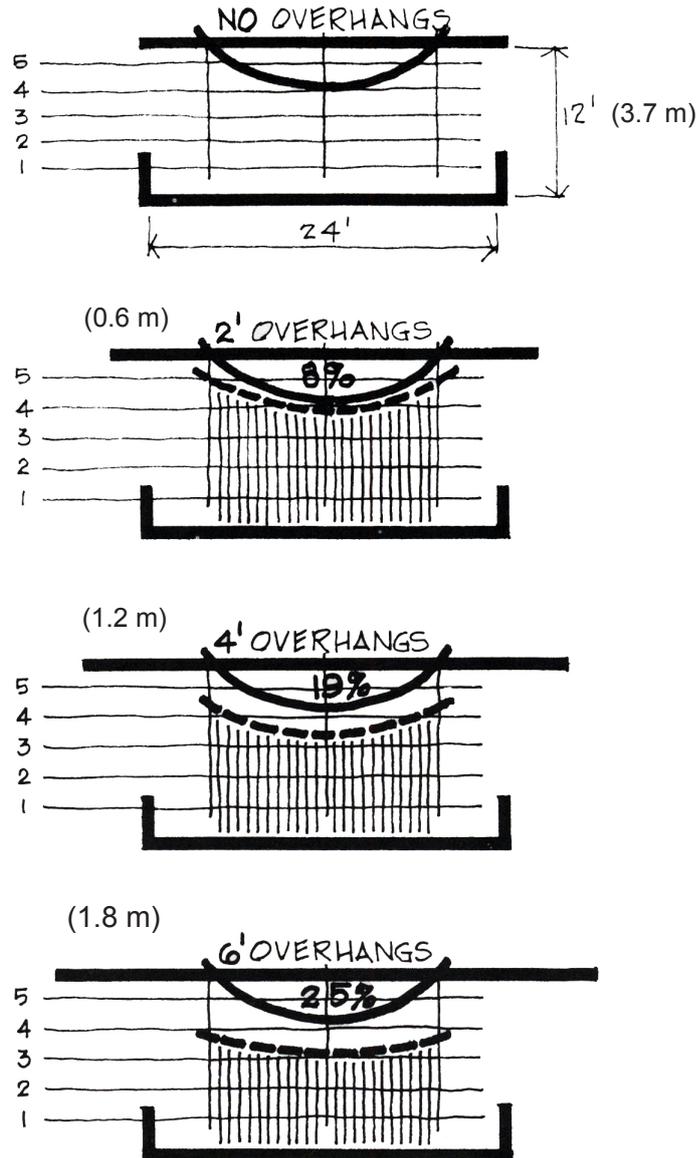


Figure 73: Bilateral overhangs

Source: Benjamin H. Evans, AIA, *Daylight in architecture*, New York, 1981, p. 63.

Blinds, Louvers and Shelves

Horizontal louvers and overhangs are the most effective type of controls when the sun is high in the sky. Venetian blinds are one of the most effective designs: They can be adjusted to exclude direct sunshine though will still reflect light to the ceiling where it will bounce into the interior area of the space. They can be raised or lowered and tilted at the same time (Figure 74).⁸¹

81 Evans, AIA, *Daylight in architecture*, p. 78.

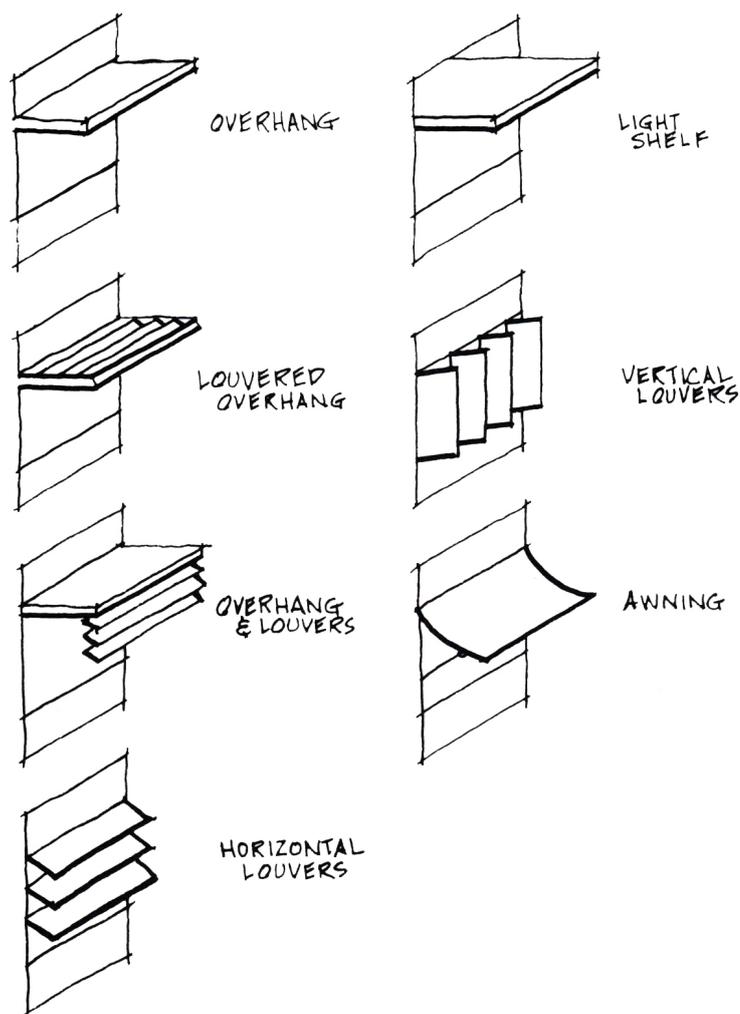


Figure 74: Types of reflectors and shades

Source: Benjamin H. Evans, AIA, *Daylight in architecture*, New York, 1981, p. 79.

2) Room Orientation

Bed rooms

West exposure should be avoided because of strong heat build in the room up in summer during the late afternoon and early evening. The living room should have a southerly exposure. An easterly dining room will allow sunlight to enter the room during the morning for breakfast. If, however, sunset or sunlight during the evening meal is desirable a westerly or south-westerly exposure should be used. A northern exposure is generally considered to be the best orientation for kitchen and laundry area because it provides an even, non-glare light (Figure 75).⁸²

82 Joseph De Chiara., et al., *Housing and residential development*, (Singapore, 1995), p. 83.



Figure 75: Room orientation

Source: Joseph De Chiara., et al., Housing and residential development, (Singapore, 1995), p. 83.

3) Form of building

There is a number of light controlling design considerations which may affect significantly the shape and form of a building. Probably the most significant design determinant in the use of daylight is the geometry of the building, that is, the way the walls, ceilings, floors, windows relate to each other.⁸³

The form of building will also determine how much floor area will have access to day lighting. An important design feature and the main public zone is the atrium. Generally, in multi-storey buildings, a 15 feet perimeter zone can be fully day-lit and another 15 feet beyond that can be partially day-lit (Figure 76).⁸⁴

⁸³ Evans., AIA, Daylight in architecture, p. 56.

⁸⁴ Lechner, Heating, cooling, lighting, p. 373.

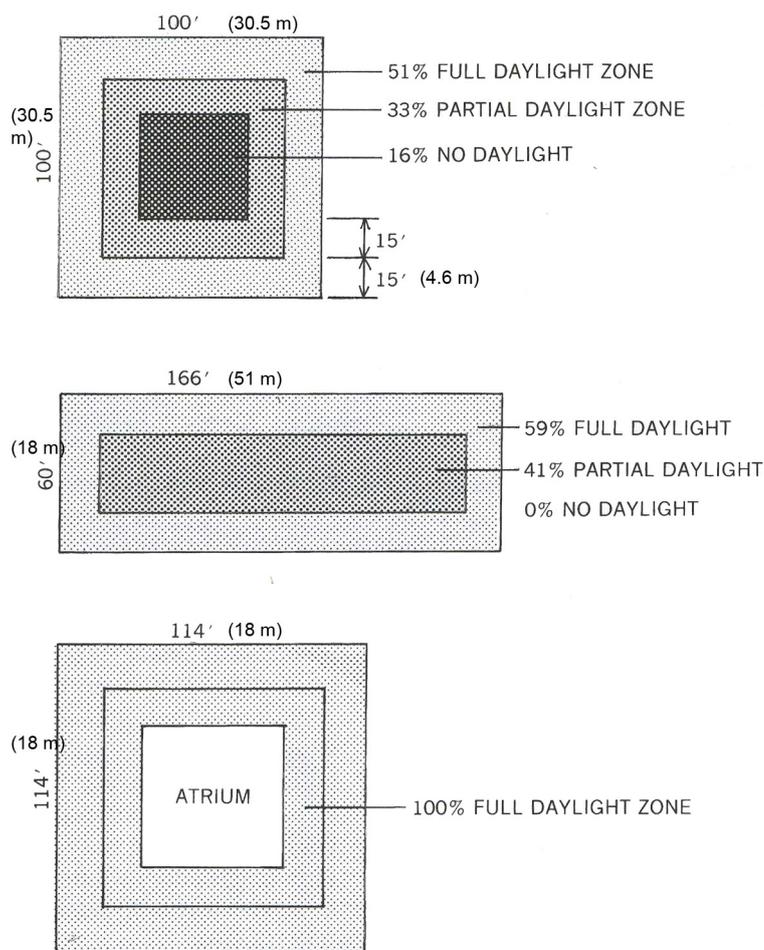


Figure 76: Different form of building and lighting access system

Source: Norbert Lechner, Heating, cooling, lighting, design method for architects, New York, 2001, p. 374.

4) Architectural standards

In relevance to the standards and recommendation in this study, the regulations per area are studied:

Natural lighting regulations in Hong Kong

A habitable room is required to provide effective natural lighting by one or more windows which shall not be less than 1/10 of floor area of the room or 1/16 of floor area of the room when the top of the window is 2 m (6.5 ft) above the floor. The same requirement applies to the kitchen as well.⁸⁵

Natural lighting regulations in Japan

All housing units in Japan must have windows and other openings for natural lighting, and the ratio of the effective area for natural lighting to the floor area shall not be less than 1/7.

85 Moe Thae Phyu, Analysis on housing for low income community in Yangon, Yangon, 2006), p. 123.

Daylight distribution data

According to Neufert, the illumination (%) and distance from the opening correlated as follows:⁸⁶

Distance from the opening	Illumination (%)
Near the window	75%
12 ft (3.7 m) from the window	55%
16-17ft (4.9- 5 m) from the window	53%
50-70ft (15- 21 m) from the window	27%

Window area / floor area (%) for natural lighting in rooms in walk-up apartments in Yangon

Yuzana Lwin calculated the relation between window area/ total surface area and the value with respect to the daylight factor (DF).

According to the calculation, the following data are recommended for the window area for the natural lighting in each room.⁸⁷

Table 6: The ratio between window area/ total surface area

Source: Yuzana Lwin, Correlation between health and housing for walk-up apartments, Yangon, 2005, p. 125.

Rooms	Window area for natural lighting
For living areas	Not less than 20% of floor area
For kitchen	Not less than 40% of floor area
For bathrooms (with and without W.C)	Not less than 17.5% of floor area
For separate W.Cs	Not less than 27% of floor area

⁸⁶ Ernst Neufert, Architect's data, London, 1988.

⁸⁷ Yuzana Lwin, Correlation between health and housing for walk-up apartments in Yangon, (Yangon, 2005), p. 128.

3.

DEVELOPING THE METHOD FOR THE DEFICIENCIES ANALYSIS OF HOUSING



CHAPTER 3: Developing the Method for Deficiencies Analysis

The main task is to identify weak points and deficiencies in order to begin to improve the status quo. An instrument is needed to help identify weak points. The instrument is taken to initiate an assessment which takes into consideration an ordered and defined set of aspects. In the following, the order takes the form of a tree, which we shall call the 'aspect tree'. Aspect, in this case, is interchangeable with the term criteria. The aspects are arranged in the hierarchical order of a tree. The tree consists of main aspects, sub-aspects, sub-sub aspects, and so on.

Each aspects can be judged with a statement, i.e. 'good' or 'bad', 'neither/nor' according to the discussion results of each aspect.

3.1. Criteria tree for deficiency analysis

The criteria tree is made in order to perform the analysis of apartments in Yangon. The following four aspects are considered to be the most important ones with which we can judge the quality of the apartments. They are: 1) functional performance, 2) social performance, 3) indoor environmental quality, and 4) cultural performance.

From each main aspect, the sub-aspect and sub-sub aspect are derived and arranged. More description is given in Figure 77.

3.1.1. Functional performance

Based on the factors such as: whether the residential spaces are adequate or not, and whether there is sufficient space in the apartment or not, two sub aspects are established. They are:

- Adequacy of zoning,
- Sufficiency of area

- Adequacy of zoning

To judge on the adequacy of zoning, this aspect is broken down into four sub-aspects. They are:

- Adequacy of communication and access zone,
- Adequacy of public activities zone,
- Adequacy of private activities zones,
- Adequacy of cooking and supplying zone.

With respect to these aspects, both hall and room type apartments are examined.

- Sufficiency of area

The sufficiency of area is analyzed for each area, i.e. living, dining, cooking, sleeping, washing, body cleaning, and entrance. The analysis refers to the standards which are referenced in DHSHD. Also furniture size, circulation area and the kinds of people's activities are taken into account.

3.1.2. Social performance

This examines social contact between all members of the family and with the neighbors. It is asked when and where they can come into contact with each other. Social performance is broken down into three sub-aspects further:

- Social activities and appropriateness of spaces
- Social contact between residents and appropriateness of spaces
- Social contact with visitors and appropriateness of spaces

3.1.3. Cultural performance

In order to tackle the cultural performance, it is necessary to concentrate on what the people may need for their cultural activities. Here we examine whether there is enough spaces for the cultural activities of the residents. The corresponding sub-aspects are:

- Space for praying
- Space for leaving the shoes
- Space for donating activities

Each aspect will be examined by the questions, whether space is provided for the residents' cultural activities and whether the inhabitants can do their cultural activities in the existing spaces.

3.1.4. Indoor environmental quality

Although there are many possible aspects, here we concentrate on the followed two sub-aspects, that is:

- Natural ventilation
- Natural lighting

- Natural ventilation

Some of the main questions in the context of natural ventilation are:

- What happens to the air flow system in the different spatial compositions of the apartments?
- How much opening area is provided in relation to the floor area?
- How does ventilation depend upon building type?
- What is the relationship between ventilation, building orientation and the wind direction?

Based on these four questions, four main points are necessary to discover a better organization of residential spaces. They are:

- Air flow through system
- Relation of floor area to opening area
- Quality of ventilation depending on type of building
- Quality of ventilation depending on orientation of building and wind direction

- Natural lighting

According to this aspect, three main factors are analyzed in particular to investigate whether there is sufficient or good or bad natural lighting in the public and private rooms. Moreover, different orientations of building are examined with respect to the sun directions and sun angles in each season. The three factors which probably affect the quality and natural lighting the most are:

- Relation of floor area to opening area
- Room depth
- Orientation of building

Each aspect is analyzed for the selected case of the hall and room type apartment. Evaluation takes the form of the judgment 'good' or 'bad', or 'neither nor' (Figure 77).

3.2. Aspect tree

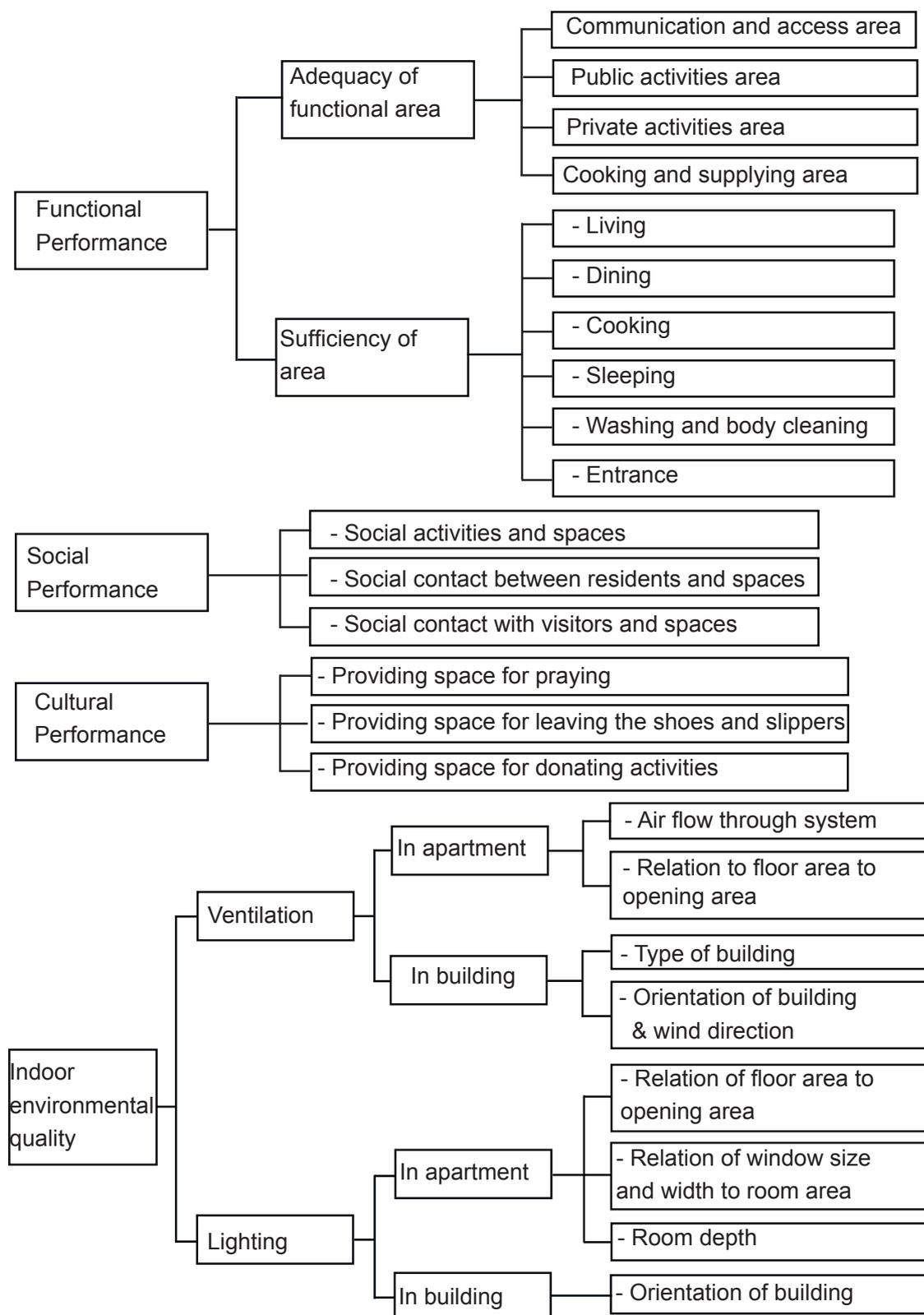


Figure 77: Criteria tree for the deficiencies analysis

Source: By author

4.

DEFICIENCY ANALYSIS: CASE STUDIES



CHAPTER 4: Case Studies

Case studies are important because they show at first hand typical examples of housing planning in Yangon and the advantages and disadvantages that can be found for the different types. The deficiencies in these types form the basis for deriving recommendations – to be presented in Chapter 6. A comprehensive account of all housing types is beyond the scope of this Thesis. Therefore, the research area and case selection has been limited to achieve a concise analysis.

4.1. Factors that define the research area

There are 5 aspects to define the research area, They are:

- 4.1.1. Location
- 4.1.2. Timeframe
- 4.1.3. Financing organization of housing supply
- 4.1.4. Type of housing compound
- 4.1.5. Type of building

4.1.1. Location

Yangon has 7 land use zones: Central Business District, Inner Urban Ring, Outer Urban Ring, Older Suburb, New Suburb, Northern Suburb, and south of CBD⁸⁸ (cf. Map 5, Chapter 2). Most of the housing is located in Inner Urban Ring and Outer Urban Ring. Therefore a decision was made to use case studies based on these locations. Indeed, the Department of Housing Settlement and Housing Development (DHSHD) recorded the number of housing projects in each zone. According to the data collection of DHSHD, the Inner Urban Ring and the Outer Urban Ring have more housing projects than any other land use area. The Inner Urban Ring has over 40 housing estates and the outer urban ring has over 35 housing estates (Figure 78).

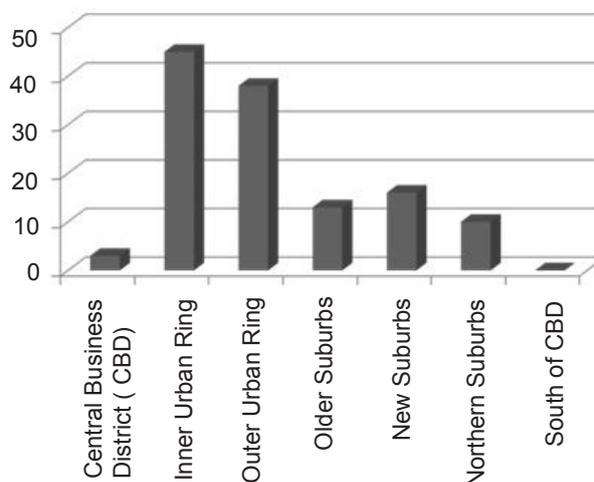


Figure 78: Number of housing in each land use zone

Source: By author.
Data based on DHSHD
and YCDC, 2005.

88 CBD = Central Business District

4.1.2. Timeframe

The case studies apply to the years 1988 to 2004. During this time most of the volume of the modern walk-up apartments was built, giving good reason for critical consideration.

4.1.3. Financing organization of housing supply

There are mainly two kinds of housing supplying groups (Figure 79): Private construction companies offer contract apartments. When the people are interested in buying, it is normal that they need to pay half or one third of the total price of apartment first before construction can begin, using the owner's budget. Government housing, on the other hand, is financed and planned by the state, usually on a large scale. The projects are diverse: Walk-up apartments, condominiums, aerial development housing, single family housing, garden city housing etc. The location of these housing projects is not confined to the Inner Urban Ring, but also to the Outer Suburb Areas because of the increasing population and the need for housing.

For this research, one joint venture between government and private sectors was selected because it concerns the common type of housing for poor and middle income families. This forms the main interest of this thesis.

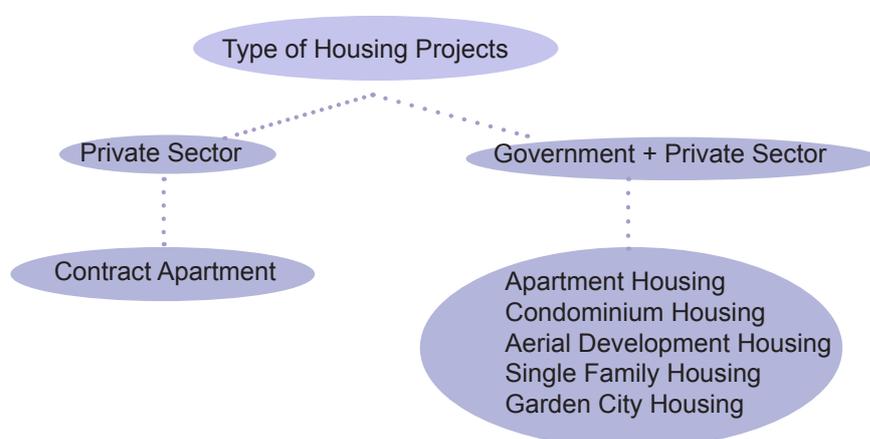


Figure 79: Financing organization of housing supply.

Source: By author.
Data based on:
- DHSHD and
- Htay Htay Myint, 2002,
p. 4.

4.1.4. Types of housing

The five types of housing in Yangon are: Walk-up apartment housing, condominium housing, aerial development housing, single family housing and garden city housing.⁸⁹ They have been described in detail in Section 2.3. For this research, walk up apartment and aerial development housing have been selected. There are two reasons why they have been chosen: One is that most housing of these types is located in the Inner Urban Ring and Outer Urban Ring. The other is that these types of housing are mostly low and middle class. Figures 80 and 81 show the housing types by percentage and walk up apartment and areal development housing in Yangon.

Figure 80: Percentage of walk-up apartments and aerial development housings

Source: Khin Lin Nwe, Architectural design criteria for middle class housing in Yangon, Mandalay, 2006, p. 13.

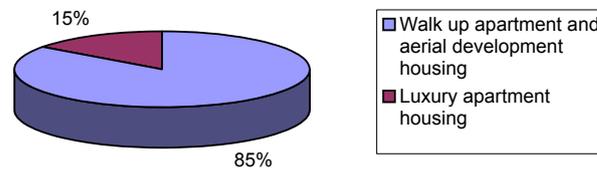
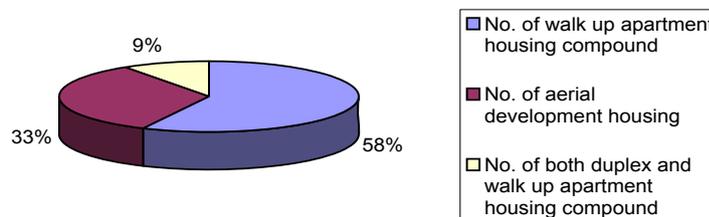


Figure 81: Percentage of the type of housing

Source: Khin Lin Nwe, Architectural design criteria for middle class housing in Yangon, Mandalay, 2006, p. 13.



⁸⁹ Htay Htay Myint, Analysis on recently built housing estates in Yangon, (Yangon, 2002), p. 2.

4.1.5. Types of building floor plans

Generally, there are 5 different types of floor plan units in use since 1988. The five types are: Front corridor (example: Yankin housing), central corridor (example: aungzaya Housing), duplex (example: Myakantha Housing), four unit (example: Malika housing), roll houses (example: Mahamyaing housing). The floor types have been described in more detail in Section 2.4.

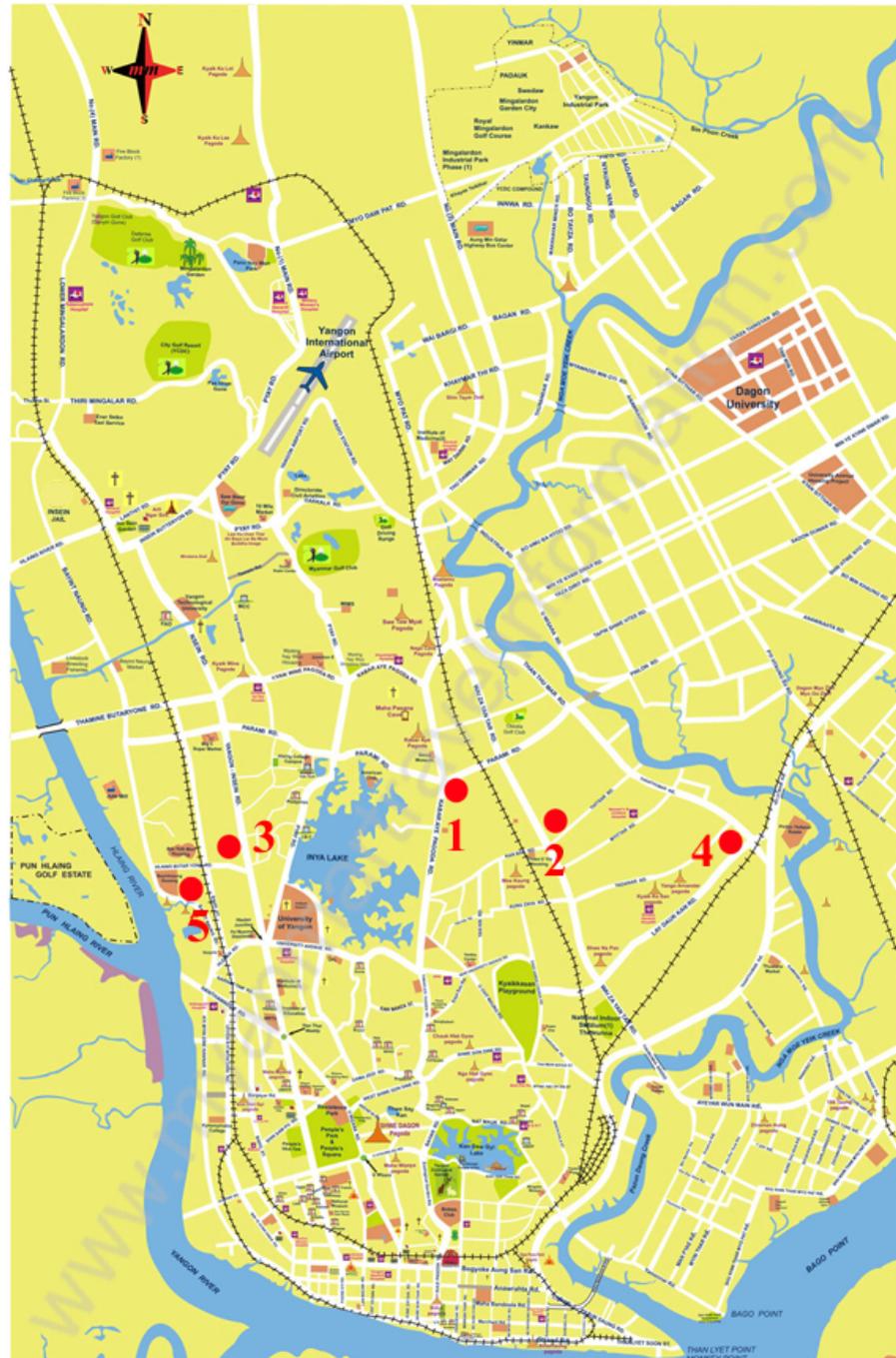
In order to get to know the advantages and disadvantages of the apartments in housing projects, these 5 types of housing are analyzed. The front corridor type can be found in Yankin Housing, which is located in Outer Urban Ring. Central corridor type can be found in Aungzaya Housing. It is in new Suburb Area of Yangon.

Row houses type is found in Mahamyaing Housing in Inner Urban Rings. Malika housing with the type of four unit combination type is selected. It is situated in outer suburbs of Yangon. Myakantha housing with duplex type is located in Inner Urban Ring of Yangon. All five types are taken for the deficiency analysis, since they represent a large part of the lower and middle class housing, but have different characteristics.

4.2. Location of the selected housing type cases

To summarize the reasons for selecting the cases:

- 1) The housings in Inner Urban Ring and Outer Urban Ring are focused because most of the low and middle class housings are constructed there.
- 2) It is concentrated on the time between 1988 to 2004.
- 3) The financing by government and private sectors is representative.
- 4) The walk up apartment for low and middle income represent 85 % of building activity.
- 5) Different building types have different features.



Map 12: Location of selected cases of housing

Source: By author.
Data based on < <http://www.rubyland.net/map/yangon-l.jpg>>, accessed on 10.05.2009.

Map 11 gives the location of the housing taken for case studies in this research. The key is as follows:

- 1) Yankin Housing
(Yankin Township, Outer Urban Ring)
- 2) Aung Zaya Housing
(Dagon Myo Thit Township, New Suburbs)
- 3) Malika Housing
(South Okkalapa Township, Outer Suburbs)
- 4) Mahamyaing (Dagon Township, Inner Urban Ring)
- 5) Myakantha Housing (Hlaing Township, Outer Urban Ring)

4.3. Description of selected cases

4.3.1. Front corridor type (Yankin Housing)

Yankin housing is the largest public housing project of Yangon. About 1200 units of dwelling were built within 1952-1955 by the DHSHD and another 2300 units were gradually implemented in 1964-1987. Housing varies from one to four storeys, duplex/apartment, row type/room type, etc. Yankin housing is aimed at low to middle income groups. The Yankin Township is 5 miles away to the north of the city centre. The total area of housing is 218.5 acres. It was the first big housing project of DHSHD together with the ministry of construction. It has many kinds of infrastructure facilities such as parking areas, market, parks, play fields, educational and health facilities. Housing area amounts to 16 % of the total ground area. Others are: parking (1.30 %), market (0.72 %), play fields (1.14%), educational facilities (4.12%), amongst others. Around 75.6 % of the area is, however, vacant area, not used for anything. A large percentage of the housing is of the front corridor type (cf. Section 2.4.2.1. and Figure 82 for description)

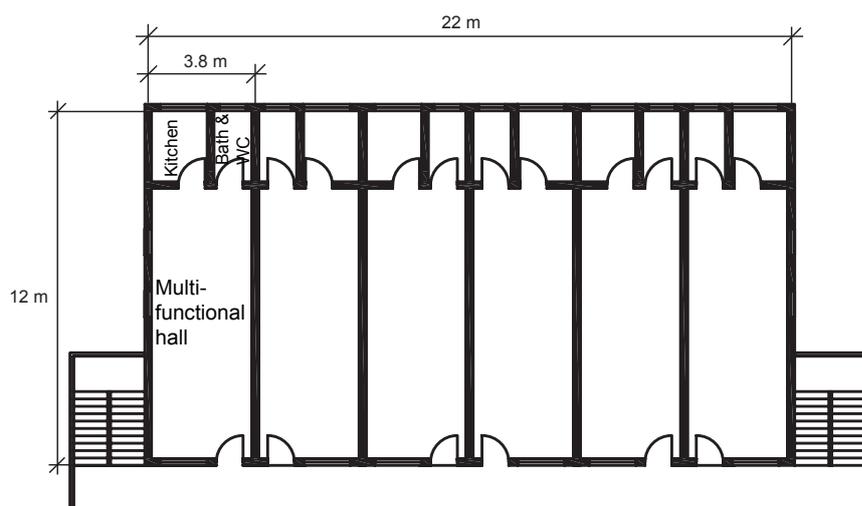


Figure 82: Front corridor type (Yankin Housing)

Source: By author.
Drawing based on San San Moe, 1998, Appendix. 5.



Map 13: Site plan of Yankin Housing

Source: By author.
Data based on: (Than Than Thwe), "Yankin Map", e-mail message to (Khin Lin Nwe), (14.10.2009).

4.3.2. Central corridor type (Aung Zaya Housing)

Aung Zaya housing is situated at the corner of Kye Myin Dine Kanner and Ahlone Roads, in the Ahlone Township (Map 14). The total land area of this housing is 3656 m². This type of housing is found only in two buildings, both with 7 storeys. There are 12 apartment units attached to each floor. The total units per building are therefore 72, and 144 in total for both. Around 720 people live in these buildings. This type is described in Section 2.4.2.2 (Figure 83).

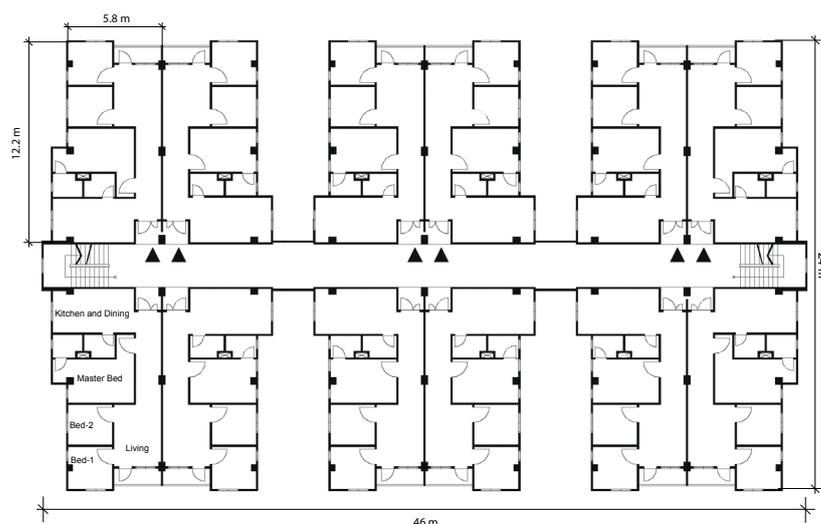
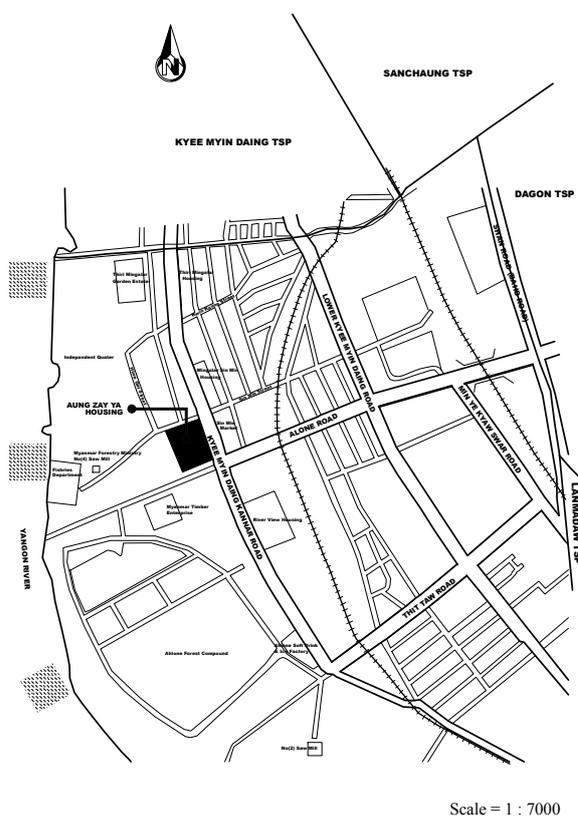


Figure 83: Central corridor type (Aungzaya housing)

Source: By author. Drawing based on Yuzana Lwin, Yangon, Correlation between health and housing for walk-up apartments in Yangon, Yangon, 2006, p. 170.



Map 14: Site plan of Aungzaya Housing

Source: Yuzana Lwin, Yangon, Correlation between health and housing for walk-up apartments in Yangon, Yangon, 2006, p. 165.

4.3.3. Central stair type (Malika Housing)

Malikha housing is located on Yadanar Road in the Thingungyun Township (Map 15). The total land area of housing is 2329 m². There are 20 buildings in the whole housing project. The buildings are all of the central stair type, each with six storeys. Four apartments are found on each floor. Therefore, each building has 24 units. The total population is approx. 2600. The distance between two buildings is only 8 feet from side to side and 15 feet from back to back (Figure 84). This building type has been explained in Section 2.4.1.2.

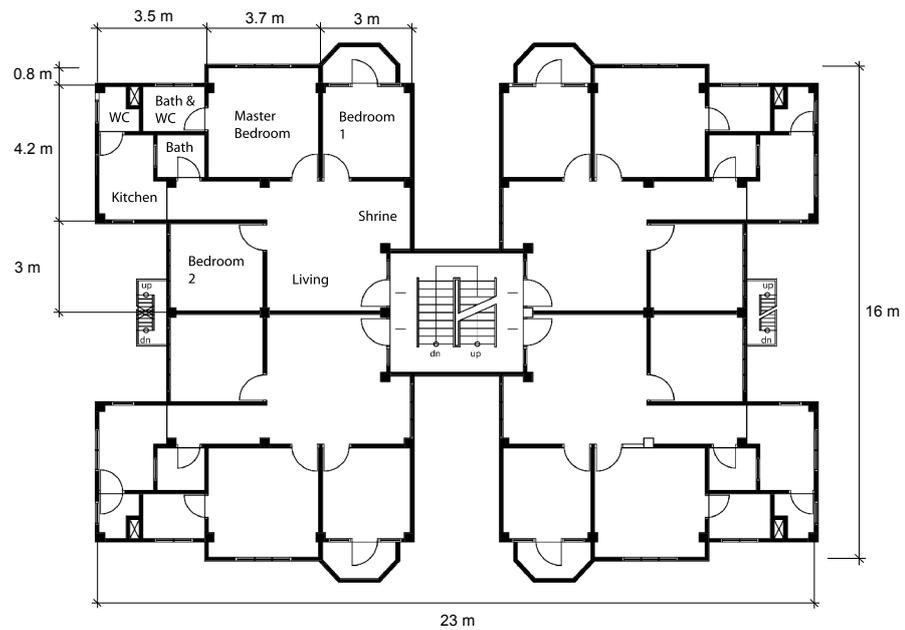
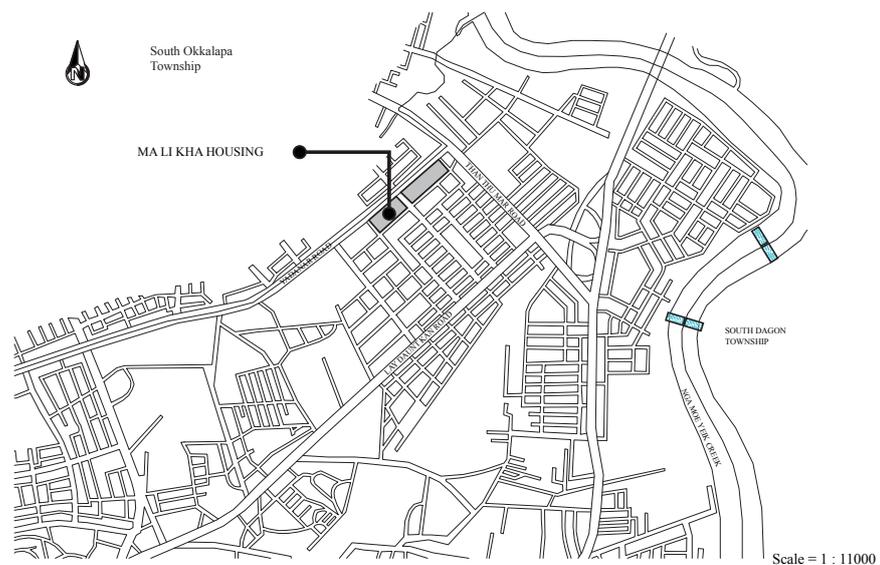


Figure 84: Four unit type (Malika housing)

Source: By author. Drawing based on Yuzana Lwin, Yangon, Correlation between health and housing for walk-up apartments in Yangon, Yangon, 2006, p. 157.



Map 15: Site plan of Malika Housing.

Source: Yuzana Lwin, Yangon, Correlation between health and housing for walk-up apartments in Yangon, Yangon, 2006, p. 155.

4.3.4. Row houses type (Mahamyaing Housing)

They type is located at the North Dagon Township, on the U Wisara Road, northeast of the Nga Moe Yeik Chaung. It was constructed in 1995. The buildings have either 4 or 5 storeys. Each apartment provides 2 bedrooms, one living area with attached kitchen, and one bath and WC. The floor ranges between 576 ft² (54 m²) to 648 ft² (60 m²) per unit. This housing type gives rise to a linear block street pattern. There is no provision for a multi-functional public hall for the people living in the housing. This housing type is intended for the lower middle and middle classes.

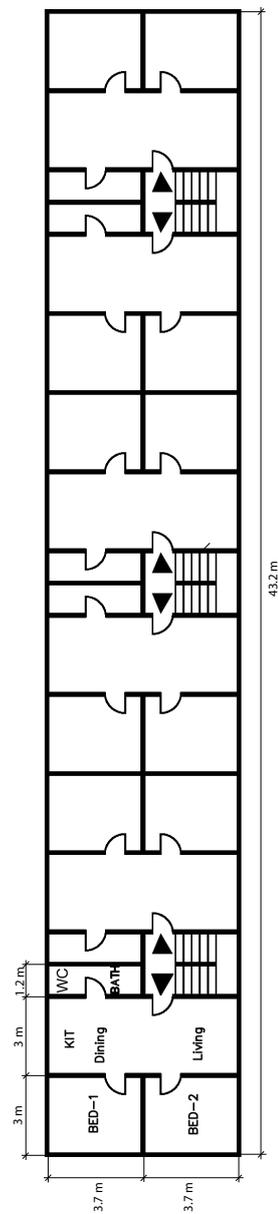


Figure 85: Row houses type (Mahamyaing housing)

Source: By author
Drawing based on Htay Htay Myint, Yangon, 2002, p. 170.

4.3.5. Duplex type (Myakantha Housing)

Myakantha housing is located in the Hlaing Township in the older suburb of Yangon. It consists of two types: either 6 storeys with 4 apartments per floor or 6 storeys with 2 apartments per floor, all of room type apartments (Figure 86). It can also be found in the Mya Kan Tha Road in the Kamayut Township. Each apartment features a living and dining room, kitchen, two bedrooms and bathroom and separate W.C. The area of each apartment is 650 ft² (60 m²).

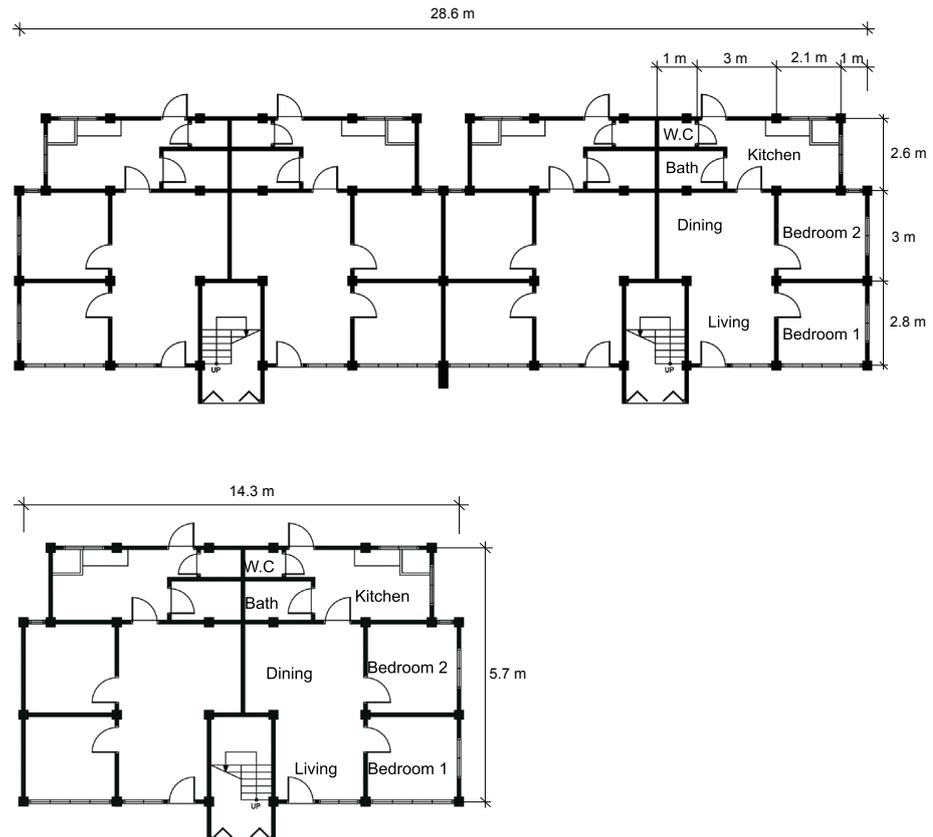


Figure 86: Duplex housing (Myakantha housing)

Source: By author.
Drawing based on San San Moe, 1998, Yangon, p. 59.

4.4. Analysis of selected cases

After selecting the cases, the deficiency analysis is made with respect to the criteria as developed in Chapter 3. They are functional performance, social performance, cultural performance and indoor environmental quality.

4.4.1. Functional performance

In the functional performance, firstly the adequacy of zoning and the sufficiency of area are analyzed. For both selected types, the hall and the room type apartment, the analysis of performance is carried out according to the branch of the aspect tree as developed in Chapter 3 (Figure 87).

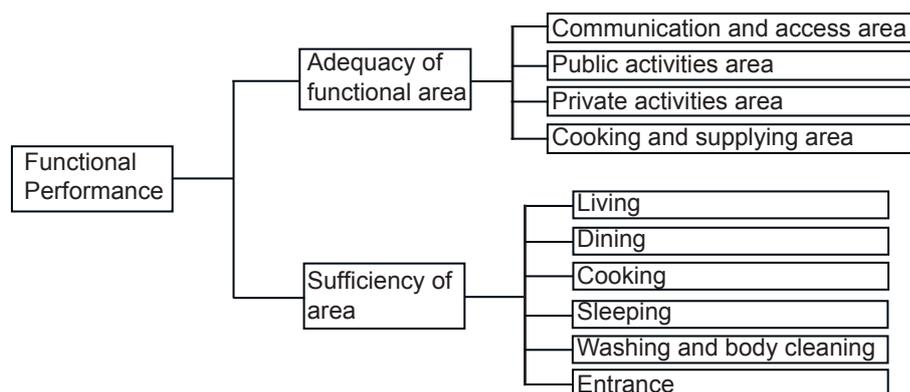


Figure 87 : Aspect tree of functional performance

Source: By author.

4.4.1.1. Adequacy of functional area

There are four main functional areas to be identified: communication and access area, public activities area, private activities area and cooking and supplying area. In the analysis, each type will be represented by a schematic floor plan, a scheme of the circulation and a scheme of the functional order.

4.4.1.1.1. Hall Type Apartment

In the hall type apartment, there can be identified an arrangement of communication and access area, public and private area, and a cooking and supplying area which is shown in Figure 88. The large hall is dedicated for public and private activity functions. The cooking and supplying area is at the back of the apartment.

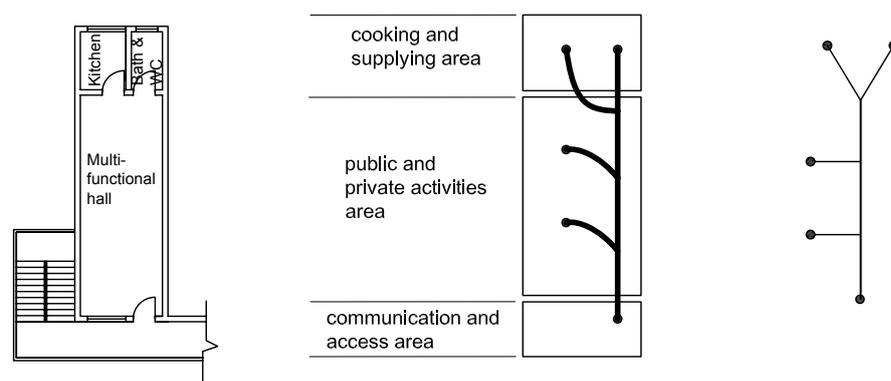


Figure 88: Zoning diagram of Yankin Housing

Source: By author

Evaluating the adequacy of communication and access zone in this type of apartment, the good points are:

- The residents can use the front long corridor as their communication and access zone (Figure 89).
- The children can play and study in this zone.
- The residents can sit and chat with their neighbours in their leisure time.

- This zone can be used as resident's cloth drying area and as entrance area to leave their shoes.

The bad points are:

- There is a high potential disturbance of the respective neighbours concerning their private activities in the public area. This area is used not only for public communication but also as the service zone for the cloth drying and for the children playing and studying.

- There is no defined zone for public and private activities. It is formed as a multifunctional long hall. The users can define living zone, sleeping zone and dining zone according to their needs and wishes. But a multifunctional room, which is flexible to do different activities, needs also privacy. Private activities are e.g. sleeping and changing the clothes.

- The circulation path is long. To go to kitchen, bath and toilet, one must cross through the multifunctional area.



Figure 89: Corridor situation in Yankin Housing

Source : Ayar Lwin, Comfort and efficiency of walk-up apartments in Mandalay, Yangon, 2007.

By the above analysis, it can be stated that the mixing of public and private activities in the multifunctional hall is a deficiency.

The cooking and supplying zone is at the back part of the apartment. The good points are :

- It is conform with the traditional belief and customs that the cooking and supplying area is at the back side of the house (relating to the cultural factors in Myanmar, see Chapter 2)
- It is functional for the sanitation system.

The bad points are:

- When the housewife comes back from the market, she needs to cross through the long multifunctional room.
- When the housewife cooks in the kitchen, there are some difficulties to see if guests come into the house.

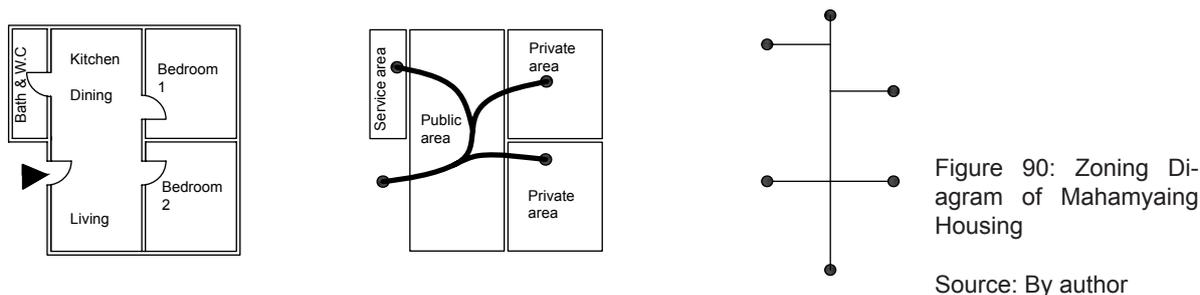
Based on these findings, the place of the kitchen is a deficiency.

4.4.1.1.2. Room type apartment

There are found two different types of the room type apartments. They are the two bed rooms apartment and the three bed rooms apartment. Firstly, the two bed rooms apartment is analyzed.

Type 1 (Mahamyaing Housing, 2 bedroom apartment)

In this type of apartment, as soon as entering into the apartment, there is the public activity area. Communication and access area is placed between public area and cooking and service area. The two main areas, public and private ones, are differentiated (Figure 90). According to the author's field survey in 2006, it is found that the users rearrange the zones depending on their desire. Different arrangements are shown in the figure 90.



Source: By author

In the analysis of two bed rooms apartment, Mahamyang Housing, the good points are:

- The access is at the centre of all functional areas.
- Circulation pattern provides good access to other zones.
- There are 3 flexible interior partitions which are made of plywood. By that the users can define the spaces as they wish (Figure 91).

The bad points is:

- Although the provided zoning arrangement is good for the small families, communication and access area and public activities area have some congestion problem, if the family is bigger than 4 members.

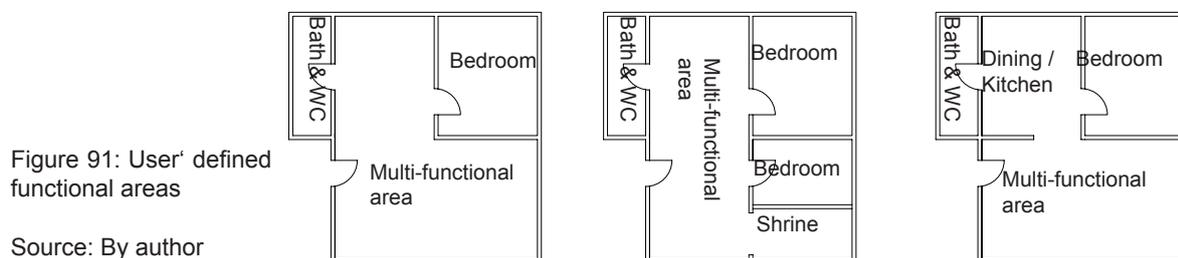


Figure 92: Living/ Dining/ Kitchen Hall (Public Activities Area)

Source: By author.



Figure 93: Bedroom (Private Activities Area)

Source:By author.



Type 2 : (Hlaing Myint Mo Housing, 2 bedroom apartment)

In this type of apartment, public and private functional areas are differentiated clearly. Public activities area is formed as a living room. It is directly accessed when entering into the apartment. The communication and access area is near to the public activities area and cooking and supplying area is found at the back of the house (Figure 94).

Evaluating these factors, the good point is:

- Circulation pattern is formed by the different accesses to the different functional areas.

The bad point is:

- Bath and WC are far from the bedrooms.

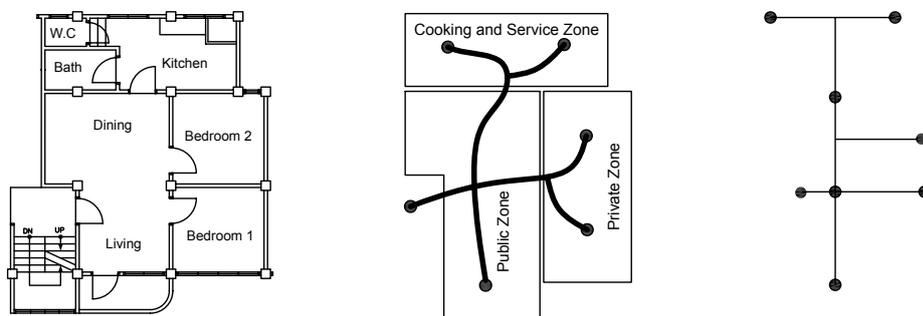


Figure 94: Zoning Diagram of Hlaingmyintmo apartment

Source: By author

Type 3 : (Aungzaya Housing ,3 bed rooms apartment)

In this type of apartment, public and private activities areas are separated by a corridor. Some mixed areas are placed after accessing the apartment. Shrine place is provided in the public activities area. Kitchen, bath and WC are accessed by crossing through the bedroom zone (Figure 95).

Evaluating these factors, the good point is:

- Providing the shrine space in the public activities area is good.

The bad points are:

- There is no clear zoning of private and public sectors.
- There is a functional cross relation. One has to cross the private area of the bed rooms to go to the cooking and service zones which belongs to the public zone and guest receiving zone.

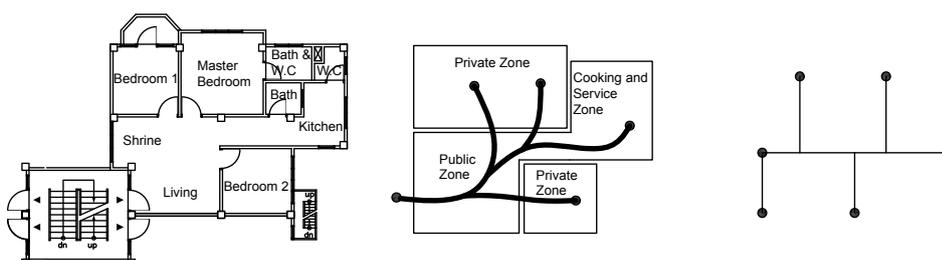


Figure 95: Zoning Diagram of Aungzaya Apartment

Source: By author

Type- 4 : 3 bedroom apartment (Malika Housing)

In this type of apartment, cooking and service zone is found near the entrance. A corridor leads to the living room passing by the bedrooms. The public zone of living is found at the back of the house. There are 3 bedrooms; one is the master bedroom which has an attached bath and WC. Another bath and WC is provided for the public (Figure 96).

By evaluating these factors, the good points are:

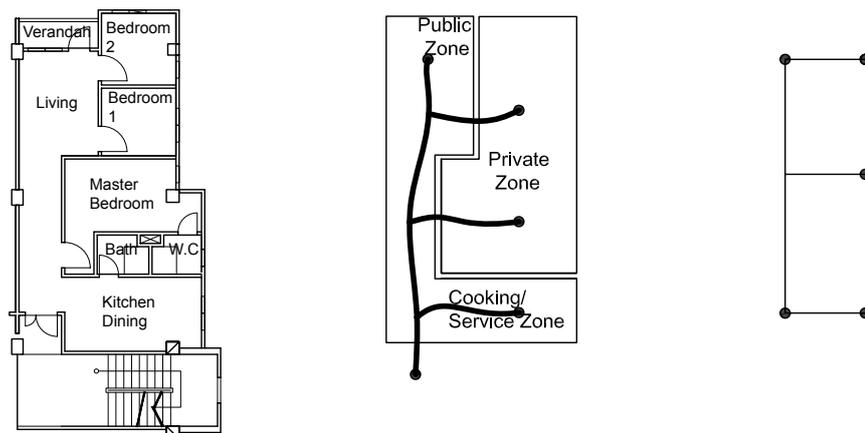
- Cooking and supplying area is nearby the entrance area.
- The verandah is accessed from the living room at the back of the apartment.

The bad points are:

- Although the living area is at the back of the house, it is very near to the private activity areas.
- As the service area is placed at the front of the house, it is far from the last bedroom.
- The bath and WC for the public is far from the bedroom and living area.
- Even though it is at the back of the house with good accessible verandah, it is very near to the private zones, bedrooms.

Figure 96: Zoning Diagram of Malika Apartment

Source: By author.



4.4.1.2. Sufficiency of Area

The sufficiency is the relation of provided m^2 to necessary m^2 . If the provided area is equal or more, it is sufficient. If it is less, it is not sufficient. To define what is necessary there are some possibilities. They are:

- 1) Looking for the standard as they are elaborated and given by international institutions like Time Saver Standard or the minimum space standard by family size of the United Nations.
- 2) To do it by a functional analysis taking into account furniture sizes, distances between the furniture and circulation area.

4.4.1.2.1. Comparative study of occupancy rate in the selected cases

In general the basis of defining the sufficiency of the area will be in the comparison of actual m^2 / person and necessary m^2 / person. Table 7 shows the comparative study of occupancy rate in the selected areas. At least it demonstrates that a high percentage of large amount of people live in relatively small apartments.

According to data collection of Yuzana Lwin, over 7 members family is the largest portion of the chart, and secondary family size is 5 to 5.5 members family. The third one is 4 to 4.5 member family while the average household size of Yangon in 2006 5.56. Therefore it can be assumed that 4 - 7 members families are living in the case studies housing (Figure 97).

Size of Household (person/unit)	Percentage(%)					Average(%) of Household Size
	Hall type	Room type				
		2 bed rooms apartment		3 bed rooms apartment		
		Type-1	Type-2	Type-1	Type-2	
Under 3	3,5	14	12,5	8	9	9,4
3~3.5	10,7	11	20,8	11	12	13,1
4~4.5	17,9	21	16,7	18	29	18,54
5~5.5	18,8	14	23	23	20	19,76
6~6.5	26,8	14	22	22	12	16,2
Over 7	22,3	26	18	18	18	21,02

Table 7: Comparative study of occupancy rate in the selected cases

Source: By author.
Table based on Yuzana Lwin, 2006, p. 106.

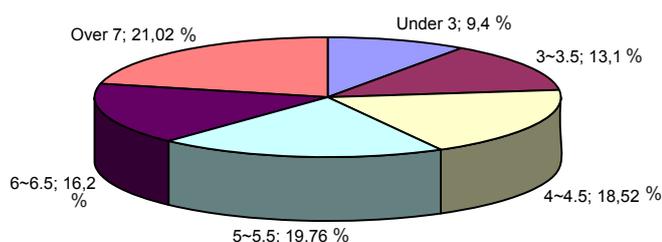


Figure 97: Family sizes in the selected cases

Source: By author.
Data based on:
- Author's data collection, 2005.
- Yuzana Lwin, 2006, p. 93 - 103.

Minimum space standard by family size proposed by United Nations

The index of capacity shows the number of room and the member of family. They are: 4 members family with 2 bedroom apartment, 4 members family with 3 bedroom apartment, 5 members family with 3 bedroom apartment, 6 members family with 3 bedroom apartment and 7 members family with 4 bedroom apartment.

The minimum space standard by family size proposed by UN is shown in Table 8. By this table, it can be seen that 4 members family with 2 bedrooms apartment should have the total of 610 ft² (87.7 m²). The more the family members, the more the number of bed rooms and the total area. Separated WC is provided when the number of members is more than 5 members.

Room	Index of Capacity					
	2 B / 4 M	3 B / 4 M	3 B / 5 M	3 B / 6 M	4 B / 6 M	4 B / 7 M
Living Room	140 ft ²	140 ft ²	150 ft ²	172 ft ²	172 ft ²	182 ft ²
Dining Area	55	55	65	65	65	75
Kitchen	75	75	75	85	85	85
Master Bedroom	150	150	150	150	150	150
Bedroom1	130	85	130	130	130	130
Bedroom2	x	85	85	130	85	130
Bedroom3	x	x	x	x	85	85
Bedroom4	x	x	x	x	x	x
Bathroom with WC	43	43	x	x	x	x
Bathroom without WC	x	x	43	43	43	43
Separate WC	x	x	13	13	13	13
Extra Washbasin	x	x	10	10	10	10
Storage Space	16	16	20	20	20	27
Additional Bedroom	x	x	x	x	x	x
Total	610	630	740	820	860	930

Table 8: Minimum space standard by family size in United Nation

Source: UN Economic Commission for Europe Information Service, Utilization of Space in Dwelling, (Geneva, Switzerland, 1958) available online at < <http://www.unece.org/> accessed on 12.12.2009.

Abbreviation

M = member B = Bedroom (1 m² = 10.7 ft²)

4.4.1.2.2. Comparative analysis of minimum space by family size in 2 bedroom apartments

In order to investigate the sufficiency of areas in the room type apartments, it is necessary to know the area of each space in the apartment. There are mainly two kinds of room type apartments. They are two bedroom apartments and three bedrooms apartment. Table 9 shows the areas and spaces of the two bedroom apartments in Yangon.

Space	Cases in Yangon		Standards in the United Nation						
	2 BR Case-1	2 BR Case-2	4M/ 2BR	4M/3BR	5M/3BR	6M/3BR	6M/4BR	7M/4BR	
Living room	120 ft ² (11.1 m ²)	80 ft ² (7.4 m ²)	140 ft ² (13 m ²)	140 ft ² (13 m ²)	150 ft ² (14 m ²)	172 ft ² (16 m ²)	172 ft ² (16 m ²)	182 ft ² (17 m ²)	
Dining area		80 ft ² (7.4 m ²)	55 ft ² (5.1 m ²)	55 ft ² (5.1 m ²)	65 ft ² (6 m ²)	65 ft ² (6 m ²)	65 ft ² (6 m ²)	75 ft ² (7 m ²)	
Kitchen	120 ft ² (11.1 m ²)	105 ft ² (9.8 m ²)	75 ft ² (7 m ²)	75 ft ² (7 m ²)	75 ft ² (7 m ²)	85 ft ² (8 m ²)	85 ft ² (8 m ²)	85 ft ² (8 m ²)	
Bedroom	240 ft ² (22.3 m ²)	190 ft ² (17.7 m ²)	280 ft ² (26 m ²)	320 ft ² (29 m ²)	365 ft ² (34 m ²)	410 ft ² (38 m ²)	450 ft ² (42 m ²)	495 ft ² (46 m ²)	
Service area	48 ft ² (4.5 m ²)	42 ft ² (3.9 m ²)	59 ft ² (5.5 m ²)	59 ft ² (5.5 m ²)	86 ft ² (8 m ²)	86 ft ² (8 m ²)	86 ft ² (8 m ²)	93 ft ² (8.6 m ²)	
Total area	528 ft ² (49 m ²)	500 ft ² (46.5 m ²)	610 ft ² (56.7 m ²)	630 ft ² (59 m ²)	740 ft ² (69 m ²)	820 ft ² (76 m ²)	860 ft ² (80 m ²)	930 ft ² (86 m ²)	

Table 9: The areas of 2 bedroom apartment in the selected cases and standards in UN
Source: By author

In order to know whether there is enough space according to the family size in each household, the comparative analysis of minimum space between the factual states and proposed standard by United Nation is taken. This comparison is based on the two bedroom type apartments which has 4 to 7 members in the household. It is shown in Figure 98.

Firstly, the factual spaces in the selected two bedroom apartments are taken to compare with the minimum space standard by family size proposed by UN. There are service area, bedrooms, kitchen, dining area and living room. In row 1 and 2, there are the actual ft² of the apartments investigated in the case study of the author. Row 3 to 8 shows the standard of the UN. It can be seen that the factual size is less than the UN standard. If one takes into consideration, that the people live in two bedroom apartment more than the standard in the UN, rather 6 and more as shown in the Table 2 and Figure 96, the difference between the facts and norms in the standards (UN) is even larger. (Row 3 to 8, compared with Row 1 and 2).

By the comparative analysis shown in Table 9, there can be seen that all provided area in local case studies are less than the minimum standard of the family size proposed by UN. The number of bed rooms and areas are proposed according to the household size in the proposed standard of united nation. As 4 to 7 members of household are living in the two bedroom apartment in local case studies (Figure 97), there is not enough space for the residents when the household are more than 4 members.

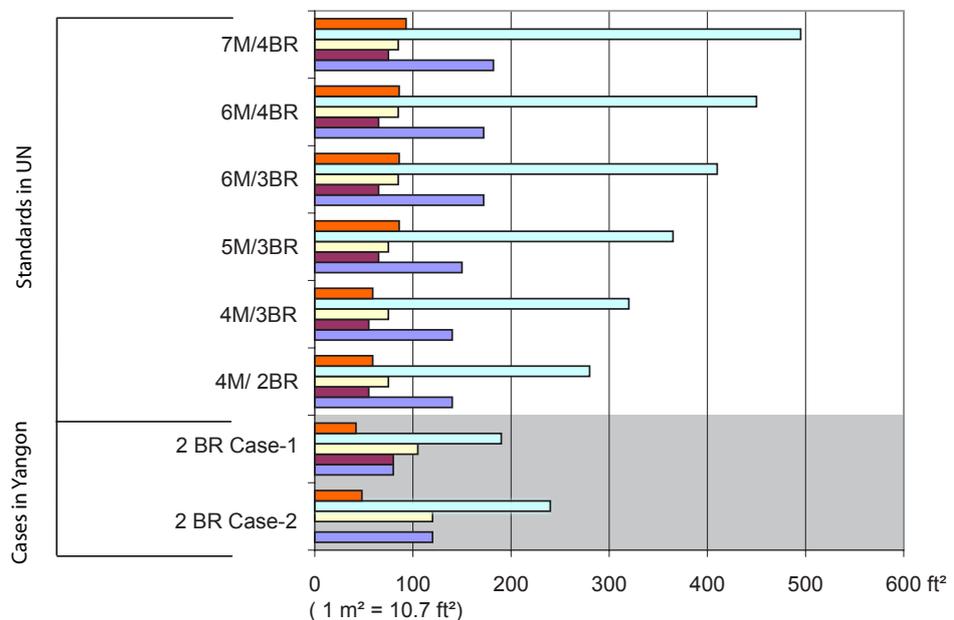


Figure 98: Comparative analysis of minimum space by family size in 2 bedroom apartment

Source: By author

Abbreviation

M = member
 B = Bedroom
 (1 m² = 10.7 ft²)



4.4.1.2.3. Comparative analysis of minimum space by family size in 3 bedroom apartments

The comparison of minimum space by family size between selected 3 bed rooms cases and United Nations is shown in the Figure 99 and Table 10. The representative areas are defined by the different textures. The areas are service area, sleeping area, kitchen, dining area and living room. According to this comparison, the following facts are found.

1) In row 1 and 2, bedroom areas in the apartments of the local cases are met with the proposed area of 4 and 5 members household family in 2 and 3 bed rooms apartments.

2) Row 4 to 8 show the areas of the UN standard with a family member number, which in the reality of Yangon is found in smaller apartments. Already this comparison shows that the factual area size of the apartments is below the standards and that the sufficiency is in the negative. If the members are up to 5 person in the household, there can be congestion problems in the selected 3 bedrooms cases in Yangon (Figure 99).

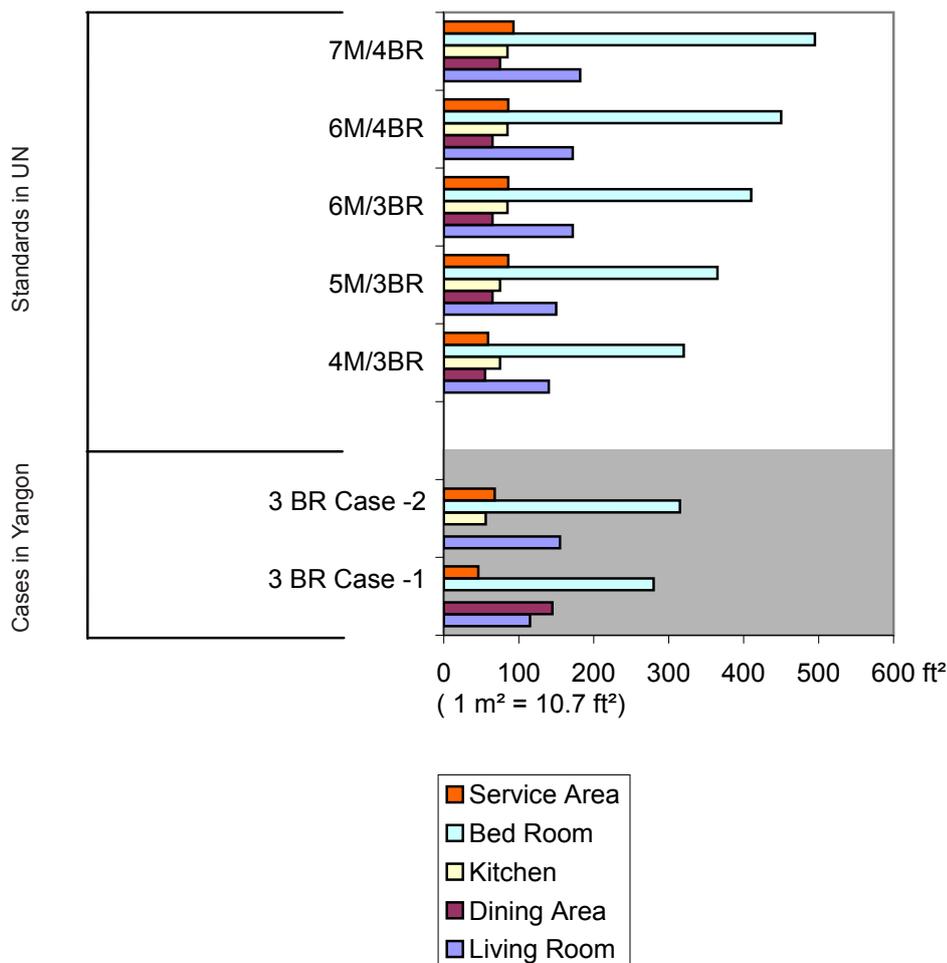


Figure 99: Comparative analysis of minimum space by family size in 3 bedroom apartment

Source: By author

Space	Cases in Yangon		Standards in United Nations				
	3 BR Case -1	3 BR Case-2	4M/3BR	5M/3BR	6M/3BR	6M/4BR	7M/4BR
Living Room	115 ft ² (10.1 m ²)	155 ft ² (14.4 m ²)	140 ft ² (13 m ²)	150 ft ² (14 m ²)	172 ft ² (16 m ²)	172 ft ² (16 m ²)	182 ft ² (17 m ²)
Dining Area	145 ft ² (13.5 m ²)		55 ft ² (5.1 m ²)	65 ft ² (6 m ²)	65 ft ² (6 m ²)	65 ft ² (6 m ²)	75 ft ² (7 m ²)
Kitchen		56 ft ² (5.2 m ²)	75 ft ² (7 m ²)	75 ft ² (7 m ²)	85 ft ² (8 m ²)	85 ft ² (8 m ²)	85 ft ² (8 m ²)
Bed Room	280 ft ² (26 m ²)	315 ft ² (29.3 m ²)	320 ft ² (29 m ²)	365 ft ² (34 m ²)	410 ft ² (38 m ²)	450 ft ² (42 m ²)	495 ft ² (46 m ²)
Service Area	46 ft ² (4.3 m ²)	68 ft ² (6.3 m ²)	59 ft ² (5.5 m ²)	86 ft ² (8 m ²)	86 ft ² (8 m ²)	86 ft ² (8 m ²)	93 ft ² (8.6 m ²)
Total Area	586 ft ² (54.4 m ²)	594 ft ² (55 m ²)	630 ft ² (59 m ²)	740 ft ² (69 m ²)	820 ft ² (76 m ²)	860 ft ² (80 m ²)	930 ft ² (86 m ²)

Table 10: The areas of 3 bedroom apartment in the selected cases and standards in UN
Source: By author

4.4.1.2.4. Sufficiency investigation by person/ habitation room

Total habitation room area per person is widely used as an indicator of crowding. The calculation takes the total habitable room areas, excluding circulation spaces, stairs, verandahs, bathrooms, toilets, and storage areas, divided by the total permanent occupants of permanent private dwellings. There is no data available in Myanmar with respect to that indicator.

Another investigation is the number of person in the selected apartments with respect to the indication per room. Figure 100 shows the density of person / room in two bedroom apartments and three bedroom apartments. 2.5 to 3.0 users are using the habitable rooms in the two bed room apartments. 1.5 to 2 person are using the habitable rooms in 3 bedroom apartments.

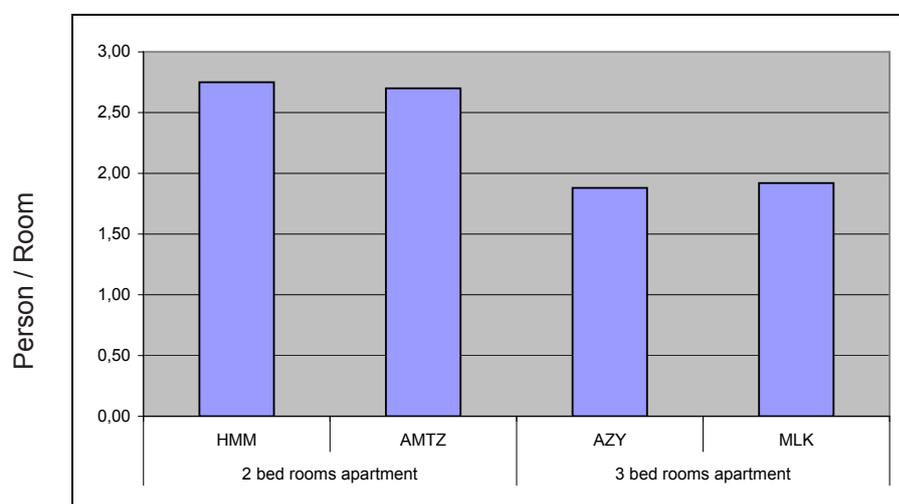


Figure 100: Person / habitation room in the selected cases

Source: By author.
Table based on Yuzana Lwin, 2006, p. 109.

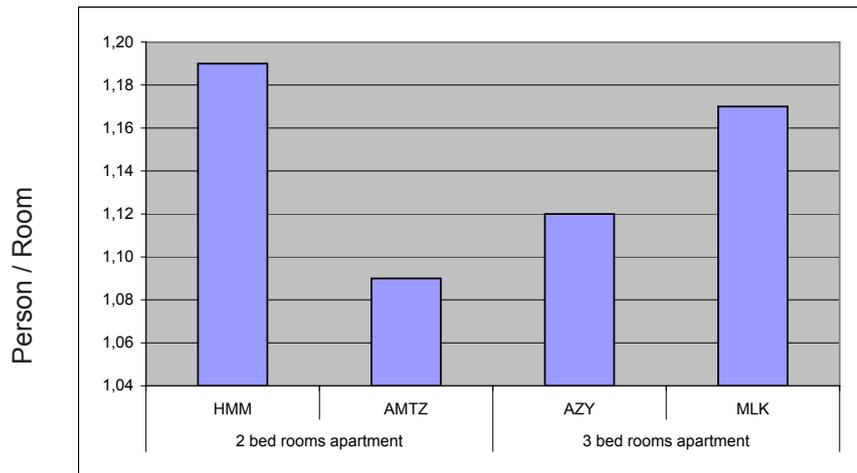
HMM = Hlaingmyintmo housing
AMTZ = Aungmyaytharzi housing
AZY = Aungzaya housing
MLK = Malika housing

4.4.1.2.5. Sufficiency investigation by person / bedroom

The sufficiency of area per person in the bedroom is investigated. Figure 101 shows the density per bedrooms in the selected apartments. According to this graph, more than one person are using the bedrooms in the two bedroom apartments. The bedroom 1 has 8.4 m² and bedroom 2 has 9.3 m². In the three bedroom apartments. There are 13 m² for the master bedroom, 6.5 m² for bedroom 1 and 8.4 m² for bedroom 2.

Figure 101 : Person/ bedrooms in the selected cases

Source: By author.
Table based on Yuzana Lwin, 2006, Yangon, p. 109.



HMM = Hlaingmyintmo housing
AMTZ = Aungmyaytharzi housing
AZY = Aungzaya housing
MLK = Malika housing

4.4.1.2.6. Sufficiency investigation of factual stage of selected room type apartments and the standards in the DHSHD

How many persons per unit are using a room and how much area is given for one person are questions for the analysis of sufficiency of area in the selected cases. The norms and standards of spaces of the Department of Housing Settlement and Housing Department (DHSHD) in Yangon are taken. The factual stage in the selected room type apartments and the standards of the DHSHD are compared. Due to this analysis, the factual stage of space is less than the room standard of DHSHD, when the number of persons sleeping in a dwelling and the number of rooms available as sleeping accommodation is such that two persons of opposite sexes who are not husband and wife must sleep in a same room. Children under the age of ten are not counted in the standard. Table 10, 11 and 12 show the standards of DHSHD.

Standard of number of room and person

Table 11: Standard of numbers of room per person

Source: DHSHD, Year report, Yangon, 2005.

Number of Rooms	Number of Person
1	2
2	3
3	5
4	7.5
5 or more	2 for each room

Standard of floor area of room and number of person

Floor area of room	Number of person
110 ft ² or more	2.0
Between 90 ft ² and 110 ft ²	1.5
Between 70 ft ² and 90 ft ²	1.0
Between 50 ft ² and 70 ft ²	0.5

Table 12: Standard of floor area of room and numbers of person

Source: DHSHD, Year report, Yangon, 2005.

Note: A child under the age of one is not counted and a child under the age of ten is one-half (1 / 2) of a person.

Standard for number of persons permitted to sleep in a bed room

Area of Bedroom	Number of Persons
Less than 50 ft ²	0
Greater than 50 ft ² and less than 65 ft ²	0.5
Greater than 65 ft ² and less than 85 ft ²	1
Greater than 85 ft ² and less than 110 ft ²	1.5
Greater than 110 ft ² and less than 130 ft ²	2
Greater than 130 ft ² and less than 150 ft ²	2.5
Greater than 150 ft ² and less than 182 ft ²	3
Greater than 182 ft ² and less than 215 ft ²	3.5
Greater than 215 ft ²	5

Table 13: Standard for number of persons permitted to sleep in a bedroom

Source: DHSHD, Year report, Yangon, 2005.

In order to know whether the factual stage of provided area in the cases is enough with the household size of apartments, the number of household and habitable room area per person are collected (Table 14).

Size of Household (Person/unit)	Two bedroom apartment				Three bedroom apartment			
	Type-1		Type-2		Type-1		Type-2	
	Person/room	ft ² /Person	Person/room	ft ² /Person	Person/room	ft ² /Person	Person/room	ft ² /Person
Under 3	>0,5	>225	>0,5	>250	>0,5	>285	>0,5	>245
3~3.5	0,7	160	0,7	180	0,7	200	0,7	175
4~4.5	0,9	125	0,9	140	0,9	160	0,9	135
5~5.5	1	100	1	115	1	130	1	110
6~6.5	1,25	85	1,25	95	1,25	110	1,25	95
Over 7	<1,5	< 75	<1,5	< 85	< 1,5	< 100	< 1,5	< 80

Table 14: Habitable area / person in the two and three bedroom apartments

Source: By author Table based on Yuza-na Lwin, 2006, p. 106-107.

Comparing the factual stage of selected room type apartments and the standards in the DHSHD, the following facts are found.

(1) More than 6 person families have not enough space for habitation rooms.

(2) By comparing the area of bedrooms (in both room and hall type cases) with the standards of the area of bedrooms, (in hall type apartments and two bedroom apartments), there can be identified problems for sleeping space, if the household is more than 5 person.

4.4.1.2.7. Sufficiency analysis by comparing Time Saver Standard with factual states

0 bedroom apartment

The factual state of housing in Yangon is needed to examine with the Time Saver Standard for housing. First of all, 0 bedroom apartment (Yankin apartment) is analyzed. The comparison of the space utilization in 0 bedroom apartment in between Yankin apartment and Time Saver Standard is shown in Table 15. By this comparison, there can be seen that terrace area in Yankin apartment is needed to be larger. A balcony is not provided in the local case. Instead of this, an open long corridor is provided. Living room and bedrooms' areas are enough. But this area is for a single person or one couple or one couple with one child. For more than a 3 person family, there will be a congestion problem. Kitchen and dining area of the Yankin apartment are less than the standard.

Name of Space	Yankin Area(ft ²)	Time Saver Standard Area (ft ²)
LR (LR-BR)	375	190
DR/ DA	x	x
K	x	x
KN	x	40
(K-DA)	70	100
BR(Primary)	x	x
BR(Secondary)	x	NA
BR(Tertiary)	x	x
Total area(bed rooms)	x	NA
OHR	x	NA
Bathrooms	45	x
Foyer	x	25
Balcony	x	70
Terrace	72	120

Table 15: Sufficiency analysis by comparing Time saver standard with 0 bed room apartment

Source: By author

1 m² = 10.8 ft²

2 bedroom apartment

In the comparison of the area of a two bedroom apartment with the area suggested by Time Saver Standard, there are some missing spaces in the factual cases even though some other and total floor areas are quite equal with the standard. However, there is no space for balcony and foyer in the factual cases (Table 16).

Name of Space	2 Bed Rooms Apartments		Time Saver Standard Area (ft ²)
	Mahamyaing	Hlaingmyintmo	
LR	120	80	160
DR/ DA	x	80	100
K	x	105	60
KN	x		NA
(K-DA)	120		
BR(Primary)	120	100	120
BR(Secondary)	120	90	80
Total area(bedrooms)	240	190	200
OHR	x		80
Bathrooms	48	42	x
Foyer	x		25
Balcony	x		70
Terrace	x		120

Table 16: Sufficiency analysis by comparing Time Saver Standard with 2 bedroom apartment

Source: By author

3 bedroom apartment

In the comparison of the factual area of 3 bedroom apartments and the area suggested by Time Saver Standard, Malika housing has less area for kitchen and dining area. Also there is no space provided for foyer and balcony in the factual cases (Table 17).

Name of Space	3 Bed Rooms Apartments		Time Saver Standard Area (ft ²)
	Aungzaya	Malika	
LR	115	155	170
DR/ DA	x	x	110
K	x	x	70
KN	x		NA
(K-DA)	145	56	x
BR-1	140	135	120
BR-2	70	90	80
BR-3	70	90	80
Total area (bed rooms)	280	215	280
OHR	x		80
Bathrooms	46	68	x
Foyer	x		25
Balcony	x		70
Terrace	x		120

Table 17: Sufficiency analysis by comparing Time saver standard with 3 bedroom apartment

Source: By author

Abbreviation:

LR = Living Room

BR = Bed Room

DR = Dining Room

DA= Dining Area

K = Kitchen

KN = Kitchennette

OHR = Other Habitable Room

Minimum space for combined areas

Combined areas mean different functions are combined and done in one room. The minimum area suggested by the Time Saver Standard is shown in Table 18.

Table 18: Minimum space for combined areas.

Source: Joseph de chiara et.al., Housing and residential development, Time Saver Standard, Singapore, 1995, p. 558.

Combined Space	Minimum Area (ft ²)			
	LU with 0BR	LU with 1BR	LU with 2BR	LU with 3BR
LR-DA	NA	200	200	220
LR-DA or (DR Size)	NA	240	240	260
LR-DR-BR	NA	NA	NA	NA
LR-DR-K	240	260	270	290
LR-BR	190	NA	NA	NA
K-DA	100	110	110	120
K-DA(DR Size)	NA	150	150	160
KN-DA	80	80	NA	NA

Comparative analysis of minimum area (LU with 2 BR)

Case studies: 2 Bedroom apartment

L/D = 160 ft² (Hlaingmyintmo Housing) < 200 ft² (Time Saver Standard)

L/D/K = 240 ft² (Mahamyaing Housing) < 270 ft² (Time Saver Standard)

The value shows that the actual provided area for the combination of space is less than the minimum standard of space proposed by Time Saver Standard.

Comparative analysis of minimum area (LU with 3 BR)

Case studies: 3 Bedroom apartment

K/D = 145 ft² (Aungzaya Housing) > 120 ft² (Time Saver Standard)

K/D = 56 ft² (Malika Housing) < 120 ft² (Time Saver Standard)

In 3 bedroom apartment, the actual provided area for the combination of space in Aungzaya housing is more than the standard. However the combined area of kitchen and dining in Malika housing is less than the minimum standard of space proposed by Time Saver Standard.

4.4.1.3. Summary of functional performance

Due to the deficiency analysis of functional performance in the analysis of adequacy of functional areas, the following evaluative results can be reported.

- In the hall type apartment, the place of the kitchen at the back of the apartment is a deficiency. In 2 bedroom apartments, living, dining and cooking functions in the multi-functional hall can be congested if there are more than 5 members in a family which is the normal case.

- There can be found some mixture of private and public zones.

In the analysis of the sufficiency of area, the following facts are summarized:

- By the comparative analysis of minimum space by family size, the private areas in two bedroom apartments with more than 4 member families are less than the minimum standard proposed by United Nations.

- In the 3 bedroom apartments, there can be congestion problems if the members are up to 5 person in the household. The factual area in local cases is below the standards. The sufficiency is in the negative.

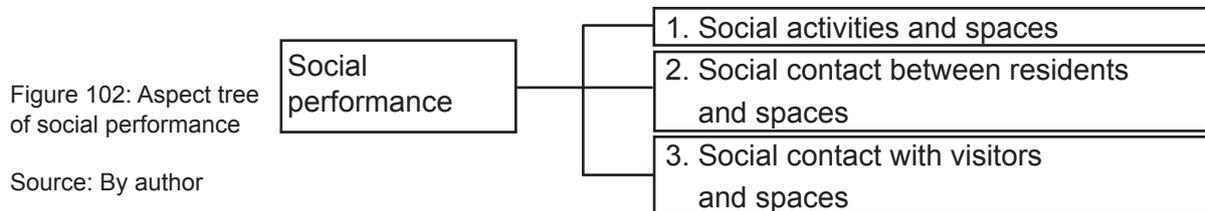
- Compared to the standards in the DHSHD, more than 6 person families have no enough space for habitation rooms in the selected cases. Hall type and 2 bedroom apartments have some problems with sleeping space, if the household is more than 5 persons.

- By the comparative calculation of need and factual offer, the area needed in the main hall at the hall type apartment and 2 bedroom apartment is more than the actual offered areas.

- Due to the sufficiency analysis by comparing Time Saver Standard with factual states, there can be found that some spaces such as balcony and foyer spaces are missed in the both room and hall type apartments.

4.4.2. Social Performance

In the analysis of social performance, there are mainly 3 aspects in order to analyze the deficiency of social performance and spaces. They are shown in the following figure.



This analysis is intended to figure out the social performance of apartments. It is seen as fitting between the needs for social activities and available spaces. In order to discuss the relationship between the spatial parameters and social activities of residents, it is necessary to describe what kind of social activities are normally done in a household. The needs of residents for social activities can determine the spatial organization of housing. The distribution of activities within a house reflects the design of the apartments which should allow the residents to fulfil their social needs.

The following list shows activities with social potential:

- 1) Cooking
- 2) Eating
- 3) Studying
- 4) Reading
- 5) Writing
- 6) Working
 - Working business
 - Housework
 - sewing
 - ironing
- 7) Entertaining (watching TV, singing karaoke)
- 8) Family meeting
- 9) Neighbouring meeting
- 10) Daily charity
- 11) Children playing
- 12) Washing
- 13) Drying clothes
- 14) Praying

There are mainly 14 social activities which are generally done in a Myanmar household. (About the Myanmar family and their lifestyle, see Chapter 2). Among them, activities 3, 4, and 5 can sometimes be public social activities; to a part they are individual, not social. The activity 'working' can be several kinds of working. It can be business work and also housework. If it is business work, it can partly be individual work. Housework is generally opened for social communication.

The social performance is analyzed by focusing on the suitability of the apartment type for the different social activities. Three kinds of social performance are differentiated. They are:

- Suitability of available space for social activities
- Fitting of needs for social contacts between residents to available spaces, and
- Fitting of needs for social contacts between residents and visitors to available spaces.

4.4.2.1. Suitability of available space for social activities in hall type apartment

By analyzing the relation between the social activities and spaces, the following aspects are considered:

- which social activities are done at which space primarily.
- which social activities are done at which space secondary.

Table 19 shows the analysis of activities and spaces in the hall type apartment. Each of the activities is analyzed in order to know whether the activities have appropriate spaces or not. The positive and negative values (+ and -) are decided according to the criterion whether there have appropriate spaces or not in the selected cases. The '+' and '-' indicate the performance. '+' means that the space allows the respective activities; '-' means that the social activity is difficult to perform. The reason of insufficiency can be that the space is too small, too big, not adaptive, too far away or that there is too much disturbance.

By this questionnaire survey which is done by author in 2006, we can see that most of the social activities are primarily done in the hall way and most of the social activities are secondary done at the verandah or open corridor area (Figure 103).

Activities with social potential	Hall way	Kitchen	Bath & W.C	Verandah	Stair
Cooking		● -			
Eating	○ +	○ +			
Studying	● +			○ +	
Reading	● +			○ +	
Writing	● +				
Working	● +			○ +	
Sewing	○ +				
Ironing	○ +				
Entertaining	● +				
Family meeting	● +	○ +		○ -	
Neighbourhood meeting	● +	○ +		○ -	○ -
Daily Charity	● +			○ +	
Praying	● -				
Washing			● -		
Drying clothes				● -	
Playing	○ +			○ -	

Table 19: Analysis of suitability of available space for social activities in hall type apartment

Source : Questionaries survey by author, 2006.

- Primarily use
- Secondary use
- + suitable
- not suitable

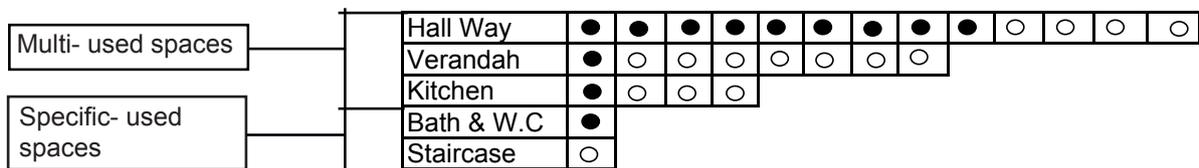


Figure 103: Relation of social activities and spaces in the hall type apartment

Source: By author

Nevertheless, some activities are mixed at the spaces. For example, 'studying' activity has some disturbance when the two activities of studying and playing or chatting or watching television are done at the same time. The other activities like neighbourhood meeting and children playing are done sometimes at the stair case area. The stair cases are neither designed nor suitable for these activities such that the value '-' is decided for the staircase area. Also the verandah is not suitable for the different kinds of activities as it is too small.

Regarding to this points, hall way is an important space for the hall type apartment as many social activities are primarily done at that space. Verandah area or long corridor space is an important space for the resident's secondary social activities.

The analysis of suitability of available space for social activities in the hall type apartment has shown the primary use and the secondary use of space by the social activities. Furthermore, one can see multi - used spaces and specific - used spaces.

Based on the results of the analysis of suitability of available space for social activities, the selected hall type apartment (Yankin apartment) is analyzed to investigate whether the spatial organization fits with the social potential requirements. The selected hall type apartment is a special case but in all its features identical with the hall type apartment as analyzed in survey.

The figure 104 shows the multi - used space and specific - used space in the hall type apartment. The multi - used space at which most of the activities with social potential are done, is at the front of the house while the specific - used space is at the back of the house.

From the above findings, it can be pointed out that the hall way is an appropriate space for many social activities. However there is needed privacy for the other activities because of the disturbance (-).

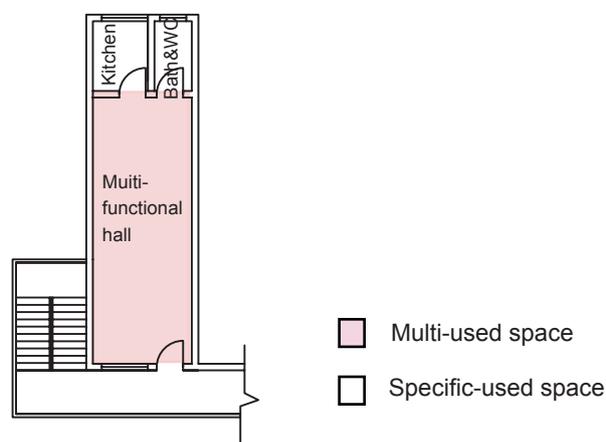


Figure 104: Spatial differentiation according to the social activities in hall type apartment

Source: By author

4.4.2.2. Suitability of available space for social activities in the room type apartment

The primary and secondary activities are differentiated with the purpose of observing which dominant activities are done mostly at which space. The analysis of activities and spaces in the room type apartment is described in Table 20.

Table 20: Analysis of suitability of available space for social activities in room type apartment

Source: Questionnaires survey by author, 2006.

- Primarily use
- Secondary use
- + suitable
- not suitable

Activities with social potential	Living/ Dining	Dining/ Kitchen	Bed 1	Bed 2	Master Bed	Bath & W.C	Verandah	Stair
Cooking		● +						
Eating	○ +	● +					○ +/-	
Studying	○ +	○ +	● -	● -	○ -		○ +/-	
Reading	○ +	○ +	● -	● -	○ -		○ +/-	
Writing	○ +	○ +	● -	● -	○ -		○ +/-	
Working	○ +	○ +	● -	● -	○ -		○ +/-	
Sewing	○ +	○ +						
Ironing	○ +		○ -	○ -	○ -			
Entertaining	● +							
Family meeting	● +	○ +					○ -	
Neighbourhood meeting	● +	○ +					○ -	○ -
Daily Charity	● +							
Praying	● +/-							
Washing						● -		
Drying clothes							● +	
Playing	○ +	○ +					○ -	

As stated in the Table 20, most of the social activities are done in the living, dining and open verandah area. Some secondary activities are done in the bedrooms. Some are done at the stair case area. A deficiency can be stated that the verandah is too small and not equipped for the different activities. Some social activities are done at the living and dining hall. However some activities such as studying, reading, writing, working and ironing are sometimes individual works. In the families who have children, the children will mainly use their bedrooms for their individual works such as doing homeworks. While they are doing their individual works, it is bad for the social potential. There can be seen that the residents meet sometimes and chat with their neighbours at the staircase area. Nevertheless the staircase area is not sufficiently designed for this social potential.

Living, dining, kitchen and open verandah spaces are multi-used spaces for the activities with social potential and the other spaces are specific-used spaces. Living, dining, kitchen and open verandah spaces are important spaces for both primary and secondary social activities.

The analysis of activities and spaces in the room type apartment shows the primary and secondary activities. It is also stated that the primary

social activities are done mostly at the multi-used spaces, and others are done at the specific- used spaces (Figure 105).

Multi- used spaces	Living/ Dining	●	●	●	●	●	○	○	○	○	○	○	○	○
	Dining/ Kitchen	●	●	○	○	○	○	○	○	○	○	○	○	○
	Open verandah	●	○	○	○	○	○	○	○	○	○	○	○	○
Specific- used spaces	Bed 1	●	●	●	●	○								
	Bed 2	●	●	●	●	○								
	Bed 3	○	○	○	○	○								
	Bath & WC	○												
	Staircase	○												

Figure 105: Relation of social activities and spaces in the room type apartment

Source: By author

The following is an analysis of the room type apartments. The selected apartments are analyzed under the question where the social activities are done and whether they produce some disturbance according to the spatial organization. There are some deficiencies in the different room type apartments concerning the disturbance of private activities by the social communication.

The Mahamyang apartment type (Figure 106) is very good for the social activities as it is divided in multi-used spaces as a living, dining and kitchen hall and in specific- used spaces.

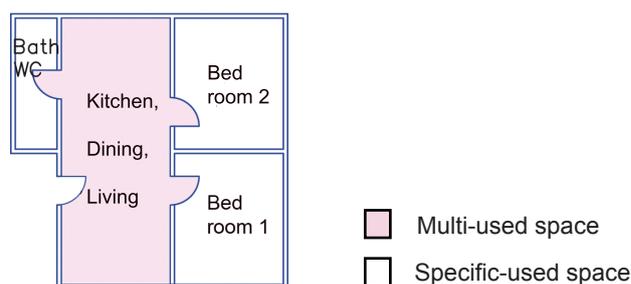


Figure 106: Mahamyang Apartment

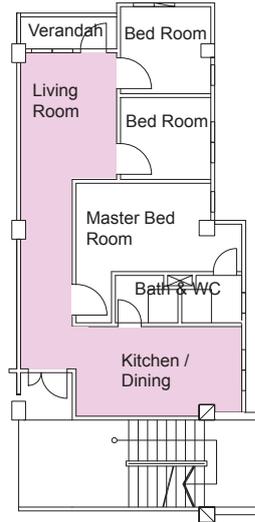
Source: By author

In the Malika apartment (Figure 107), there can happen some disturbance for the users according to the spatial layout. The living room is at the back of the apartment. When someone is doing social activities like entertaining at the living room, somebody in the private bed rooms may be disturbed in his individual activities (For e.g. studying, reading, doing homework, etc.).

Figure 107: Malika apartment

Source: By author

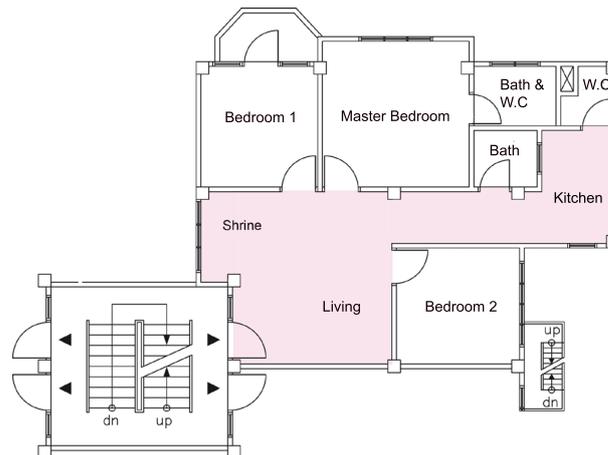
- Multi-used space
- Specific-used space



In the Aungzaya apartment (Figure 108), there are some inconveniences by crossing through the private areas (bedrooms) for social activities because the kitchen area is far from the living area.

Figure 108: Aungzaya apartment

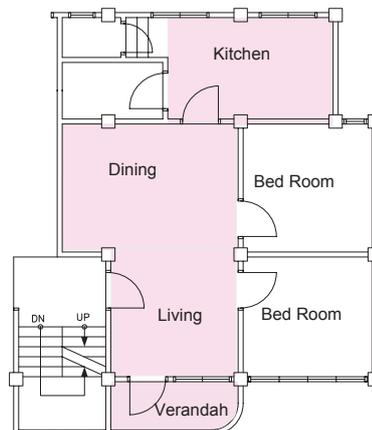
Source: By author



The Hlaingmyingmo apartment (Figure 109) is very good for social activities as living and dining are connected. Also there is a good access to the verandah. However the kitchen is at the back of the house such that there can be some disturbance of the social contacts for the users.

Figure 109: Hlaingmyintmo apartment

Source: By author



There are some deficiencies in the different room type apartments concerning the fitting of social activities and spaces. There is sometimes disturbance of private activities by the social communication.

4.4.2.3. Pattern of social communication between members of family and the availability of space.

The analysis differentiated in three times, early morning, afternoon, and at night to show the pattern of social communication between residents.

'●' represents 'Yes' which means the activities are done at the present time and place. '-' represents 'No' that means the activity is not done at that time and place (Table 21).

Social activities between members of family in one bedroom apartment

Time Space	Morning	Afternoon	Evening
Living	●	●	●
Dining	●	●	●
Bed room	—	—	●
Kitchen	●	●	●
Verandah	—	●	●
Bath and Water Closet	—	—	—

Social activities between members of family in two bedroom apartment

Time Space	Morning	Afternoon	Evening
Living	●	●	●
Dining	●	●	●
Bed room	—	●	●
Kitchen	●	—	●
Verandah	●	●	●
Bath and Water Closet	—	—	—

Social activities between members of family in three bedroom apartment

Time Space	Morning	Afternoon	Evening
Living	●	●	●
Dining	●	●	●
Bed room	—	●	●
Kitchen	●	—	
Verandah	—	●	●
Bath and Water Closet	—	—	—

● Yes

— No

Table 21: Social activities between members of family in room type apartment

Source: By author

By the questionnaire survey in 2006 in each housing type emphasizing on inner family social activities and used space, the following findings can be stated:

- (1) Living and bedrooms are mostly used as social space within the family in the apartments.
- (2) Their social interaction time is mostly evening time.
- (3) Living and dining areas are the most used ones. Moreover verandah is used for social communication and people's relaxing in the afternoon and evening.
- (4) There are some deficiencies in the different room type apartments concerning the fitting of social activities and spaces. There is disturbance of private activities by social communication.
- (5) In the actual situation of verandah area, there is less space for relaxation and communication area (Figure 110).



Figure 110: Verandah situation in Aungzaya housing

Source: By author

4.4.2.4. Suitability of available space for social contact between members of family and visitors

With regard to the pattern of social activities and spaces, it is also necessary to analyze how the social interaction takes place when the visitors come into the apartment. There are several visitors. Therefore, three kinds of visitors, father's visitors, mother's visitors and son's and daughter's visitors are differentiated. People can use various spaces, when the visitors arrive at the same time. For example, the mother can use the kitchen for receiving guests, which the father receives his guests in the living area.

Social activities between members of family and visitors in one bed room apartment

People Space	Father	Mother	Children
Living	●	●	●
Dining	—	●	●
Bed Room	—	—	●
Kitchen	—	●	—
Verandah	—	—	●
Bath and Water Closet	—	—	—

Social activities between members of family and visitors in two bed room apartment

People Space	Father	Mother	Children
Living	●	●	●
Dining	—	●	●
Bed Room	—	—	●
Kitchen	—	●	—
Verandah	●	—	●
Bath and Water Closet	—	—	—

Social activities between members of family and visitors in three bedroom apartment

● Yes
— No

People Space	Father	Mother	Children
Living	●	●	●
Dining	—	●	●
Bed Room	—	—	●
Kitchen	—	●	—
Verandah	●	—	●
Bath and Water Closet	—	—	—

Table 22: Analysis of the suitability of available space for social contact between members of family and visitors

Source: By author

According to the questionnaire survey in 2006, the following results are found:

- (1) The space which is used for social interaction between residents and visitors is mostly living, dining and bedroom. It is sometimes used parallel, when many visitors arrive at the same time.
- (2) Most of the residents use kitchen and fire escape area for the interaction between the residents and neighbours.
- (3) Verandah is used for receiving guests and social communication with neighbours.

4.4.2.5. Summary of social performance

With respect to the suitability of available space for social activities in hall and room type apartments, the hall way and the front corridor access area are the multi-used areas in the hall type apartment. Living, dining as well as verandah area are important spaces in the room type apartment.

Due to the analysis of the suitability of available space for social contact between members of family and visitors, people can use various spaces when the visitors arrive at the same time. Living, dining and verandah areas are mostly used area for the social communication between residents and visitors. Also semi-opened space such as verandah is important for the social communication of residents. But the verandah space is mostly used for drying the clothes. Sometimes, it is used for the shrine (Figure 115).

Regarding the suitability of spaces to the need for social communication with visitors (and neighbours), it is mainly positive in the room type apartments. A deficiency is the large distance between kitchen and entrance in the hall type apartment, such that the mother cannot recognize, if a visitor enters the apartment. The position of kitchen and entrance can be seen in Figure 88.

4.4.3. Cultural performance

The development of apartments is influenced by the residents' cultural activities which are also dependent on the social and cultural background of the country. The objective of this part is to observe whether the socio-cultural attitude of Myanmar people is reflected sufficiently in the housing in Yangon, specially at hand of the selected cases.

The analysis refers to the residents' cultural activities which mainly influence the spatial composition of apartments in Yangon. There are mainly three questions of analysis with regard to the cultural performance at the selected housing cases in Yangon.

They are:

- Is there provided space for praying (shrine space)?
- Is there provided space for leaving the shoes and slippers?
- Is there provided space for donation activities?

The criteria tree for the deficiency of analysis of cultural performance is shown in Figure 111.

The questions to be analyzed are whether the cultural spaces exist in the urban apartments, and whether the inhabitants can do their cultural activities in the existing spaces. Related with housing, Myanmar culture and peoples' behavior have been described in Chapter 2. First of all, the space for the shrine area is analyzed in the various types of apartment.

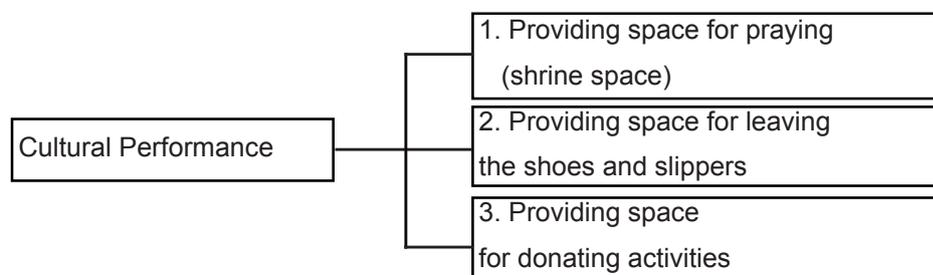


Figure 111: Aspect tree of cultural performance

Source: By author

4.4.3.1. Providing space for praying (shrine space)

(1) Hall type apartment

In hall type apartments, there is no planned space for the shrine, although there has still a strong belief and cultural behavior in Myanmar. In most of the apartments, a provisional area for a shrine is found in the living area. Either some area is separated, or the shrine is placed at one corner of the living area, or it is placed in the living area near by the entertainment equipment. If someone in the household wants to pray the Buddha, there can be some disturbance because children are studying or watching TV in the living area at the same time. In some apartments, the people use the verandah as their shrine space.

(2) Room type apartment

In two bedroom apartments, the activities such as praying, living, entertaining and guest receiving are done in the living hall (Figures 112 and 113). By the mixture of these activities, there can occur congestion problems and some disturbance when someone is praying and another one at the same time is watching television or receiving guests.

Figure 112: Shrine space in two bedroom apartment (Mahamyaing Housing)

Source: By author



Figure 113: Shrine space in two bedroom apartment (Hlaingmyintmo Housing)

Source: By author



The shrine space in the three bedroom apartment is placed in the living area. Sometimes it is separated by a curtain (Figure 114). One can see that the residents try to keep that area by themselves and want to keep that area for their belief.

In some cases, the shrine is found at the verandah area (Figure 115). The analysis has shown that there are deficiencies in providing space for the shrine. There can be found that the people who are living in the apartments, in the hall type apartments as well as in the room type apartments, are trying to serve their culture by placing the shrine provisional by somewhere at the living area or verandah.



Figure 114: Shrine space in three bedroom apartment

Source: By author



Figure 115: Shrine at the verandah area in Aungzaya housing

Source: By author

4.4.3.2. Providing space for leaving the shoes and slippers

In the long history of Myanmar culture, Myanmar houses had an entrance space in order to enable the people to take out the slippers and shoes before entering the main lobby of the house. This belongs to their cultural attitude. By that, Myanmar people have their belief to pay respect in approaching Buddha, and to pay respect to old people, parents and grand parents, who are living at home. Also this space can be a transition space between indoor and outdoor (Figures 42 and 43 in Chapter 2).

In hall type apartment, there is no space provided for leaving the shoes. The people must take off their slippers and shoes at the front corridor. That disturbs the public corridor area.

In the three bedroom apartment, there is no defined space for taking out shoes and slippers. In stead of that, a shoe shelf is used at the corner of the room to leave the shoes before entering the house (Figure 116).

Figure 116: Placing the shoes at the corner of living area in two bed room apartment

Source: By author



In Mahamyang Housing, the residents preserve their culture although there is no defined space for leaving the shoes. However the residents make a space by leaving some space for taking the shoes and slippers out and by placing a shoe shaft near by the entrance door (Figure 117).

Figure 117: Entrance space in the two bed room apartment

Source: By author



To conclude the above findings, in Yangon apartments, hall type as well as the room type, a designed entrance space cannot be found. In some apartments, entrance space is not designed in the primary planning stage. This is a deficiency, the inhabitants need that space to deposit their slippers or shoes. They try to provide that space by themselves; they make the space nearby the entrance door.

4.4.3.3. Providing space for donation activities

In a Myanmar family, the daily charity to the monks and small celebration such as inviting the monks, neighbours and relatives, donating something to the monk, and listening the teachings from the monk are normally done at the hall way area in the traditional houses (Figure 118).

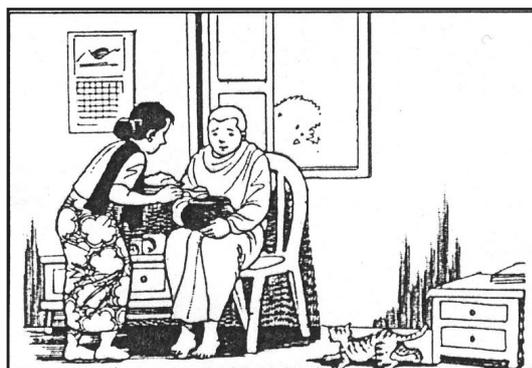


Figure 118: Donation activities

Source: Moe Thae Phyu, Analysis on housing for low income community in Yangon, Yangon, 2006, p. 69, 90.

However there is only one possibility for this cultural function in the urban hall and room type apartments, such as inviting, receiving the monks and guests, and donating something to the monks. It is done at the hall room in the hall type apartment and at the living and dining area in the room type apartment. In the room type apartment, providing living and dining hall is quite enough for those cultural activities (Figure 119). However in the hall type apartment, there is some disturbing mixture of cultural activities and private activities because of too small spaces (Figure 120).

Figure 119: Donation activity and used space in the typical room type apartment

Source: By author

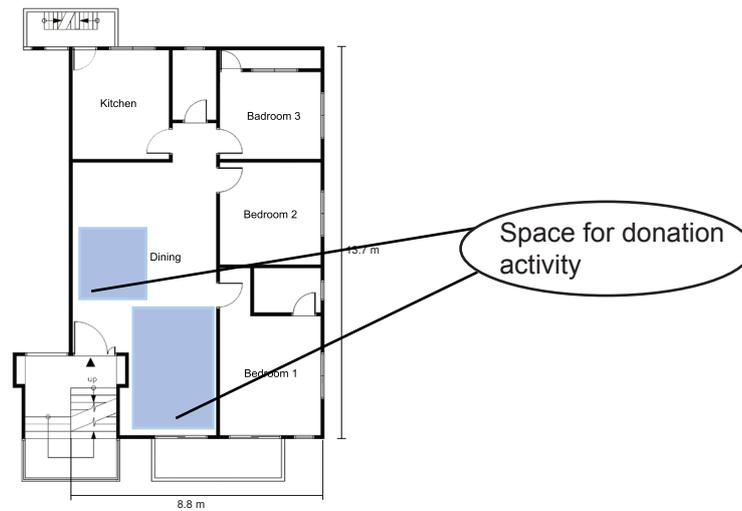
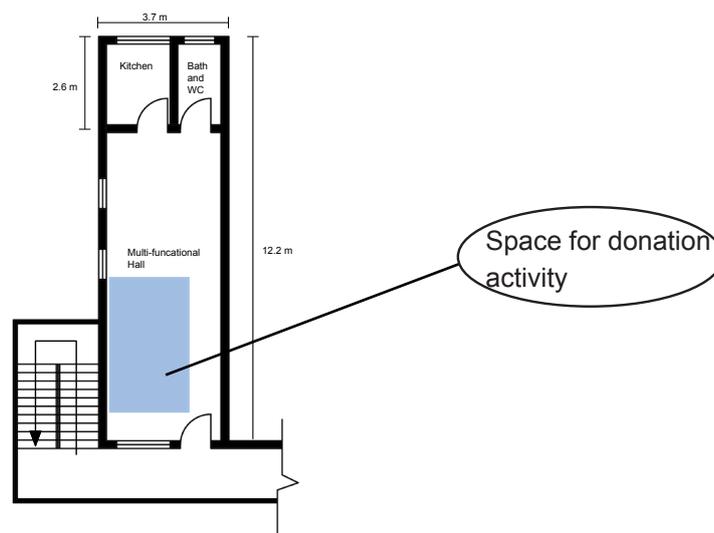


Figure 120: Donation activity and used space in the typical hall type apartment

Source: By author



4.4.3.4. Summary of cultural performance

There are some deficiencies to be stated:

- There is a mixture of praying activities and public activities in the hall type apartment as well as in the room type apartment.
- The residents try to provide that area as much as they can.
- There is no provided space at entrance area to take off the shoes before entering the main area.
- In the hall type apartments there is no sufficient space for donating activities.

4.4.4. Indoor environmental performance

The main concern of indoor environmental quality in architecture is to create a building in such a way that it has an optional and comfortable climate for the users. With respect to the indoor climate housing, there are many factors. Among them, natural ventilation and lighting are analyzed.

4.4.4.1. Natural ventilation

With respect to the analysis of the ventilation quality in the apartments and buildings, the following factors are analyzed:

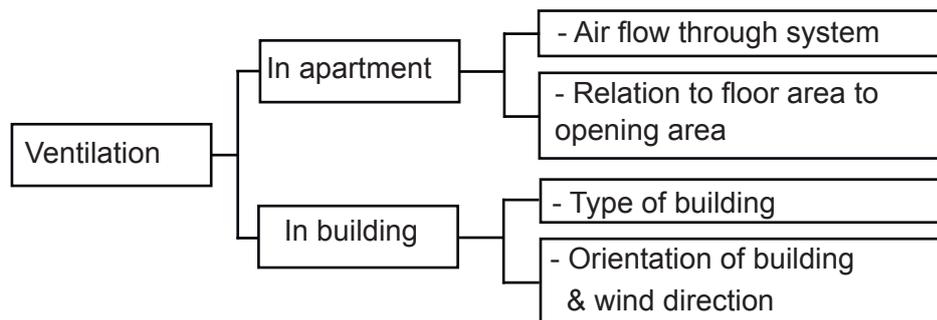


Figure 121: Aspect free of natural ventilation

Source: By author

4.4.4.1.1. Ventilation in hall type apartment

In natural ventilation system, natural air is provided through the type of opening. There is a wide range of possibilities with regard to the selection of opening type, size and location.

Air flow through system

According to the analysis of the openings and the air flow through system,⁹⁷ the hall type apartment has a laminar air flow, if the apartment is planned without any partition according to the original plan (Figure 122). If partitions are added, there can be a different air flow through system. Also the sleeping, and the dining area cannot get enough ventilation.

Relation to floor area and opening area

According to the analysis of opening to floor area, the ratio between opening area and the floor area in the hall room is 1/10 at the edge apartments, it is 1/7 at the other apartments, 1/5 area of opening is provided at the kitchen and 1/7 of floor area creates good ventilation in the bath and toilet. Due to standard in relation to the opening area to floor area⁹⁸, all rooms have quite well enough ventilation. One exception is that the hall

⁹⁷ Robert Lechner, Heating, Cooling, Lighting, (New York, 2002), p. 256.

⁹⁸ According to the architectural standards in relation to the area of opening per floor area is described in chapter 2.

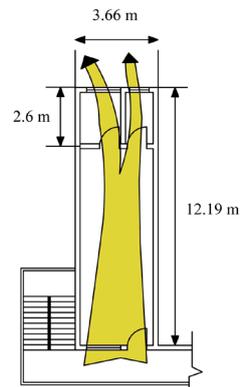


Figure 122: Air flow through system in the hall type apartment

Source: By author



analysis of ventilation

room is bad, if one takes the Hong Kong standard. By seeing that, all rooms have good ventilation. However, if the partitions are added in the hall area, there can be some disturbance for the air flow system, and the quality will be worth. The residents need to make at least light partitions for sleeping. Consequently the air flow in the normal case will be deficient.

Ventilation dependency on type of building

Typically there are 6 hall type apartments accessed by a front corridor. Each apartment is attached on one side by the corridor and on the other side by an external wall. Due to the corridor in front of the apartment, the air flow can be deflected in the upward direction. According to the location of windows,⁹⁹ very good cross ventilation between windows on opposite walls is found. Therefore, the ventilation system is very good in this hall type apartment, if no partition is added. If the partitions are added for the bedrooms in the apartment, there can be some disturbing for the air flow system (Figure 122). Cross ventilation is possible in the apartments along an open corridor. But the open corridor with the front access system reduces greatly the visual and acoustical privacy of the occupants. Therefore the windows and doors will be sometimes needed to close in order to protect against the disturbance. Then the ventilation is reduced which it is a potential deficiency.

.....
99 Lechner, Heating, cooling, lighting, p. 260.

Orientation of building and wind direction

According to the monthly wind velocity and direction in Yangon, the average wind speed from May to October is 5.3 miles / hour. The wind direction is from south-east. From November to February, the average wind speed is 4.3 miles / hour and the wind direction is from south. In the analyzed cases, the buildings orient to the two directions, one is east-west and another one is north-south.

Building with south - north orientation (Wind speed: 5.3m/hr, wind direction by south - east)

This orientation of the building allows the air to flow. Each apartment can get the natural ventilation by the oblique wind, which comes through from the front corridor. The apartment at the east of the building can get better ventilation than the other apartments (Figure 123). By seeing that, the building orientation in south - north direction is good for the oblique wind during the time from May to October.

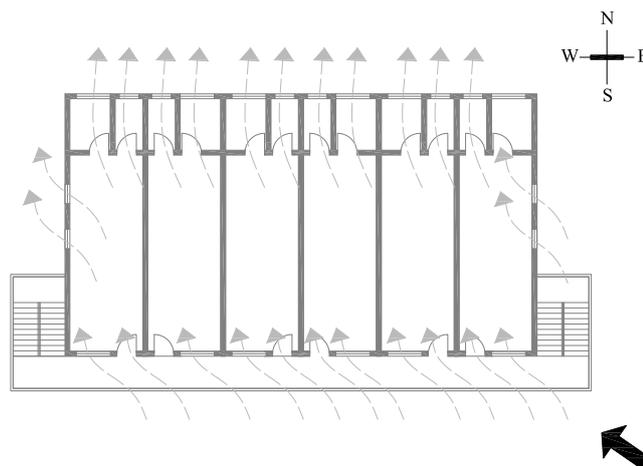


Figure 123: Wind access system to the building with the south -north orientation and wind direction by south-east

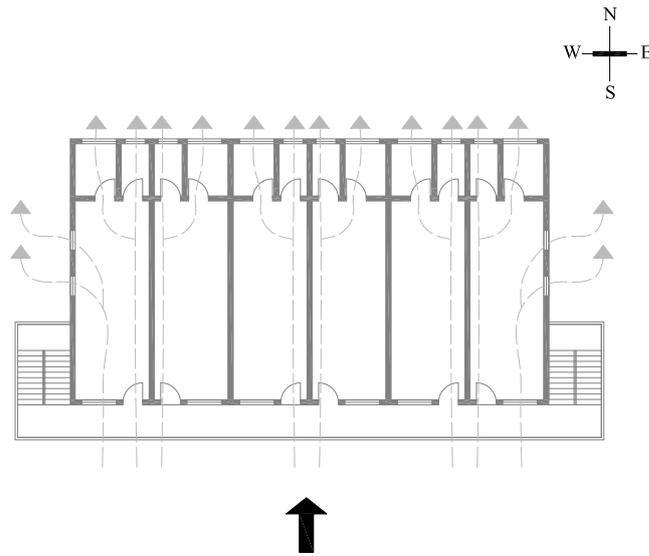
Source: By author

Building with the south - north orientation (Wind speed: 5.3 m / hr, wind direction by south)

The wind direction is from the south and the building faces to the south. In this case, every unit can get good ventilation (Figure 124). South orientation of the building is the best orientation to get the direct and full air flow.

Figure 124: Wind access system to the building with the south-north orientation and wind direction by south

Source: By author

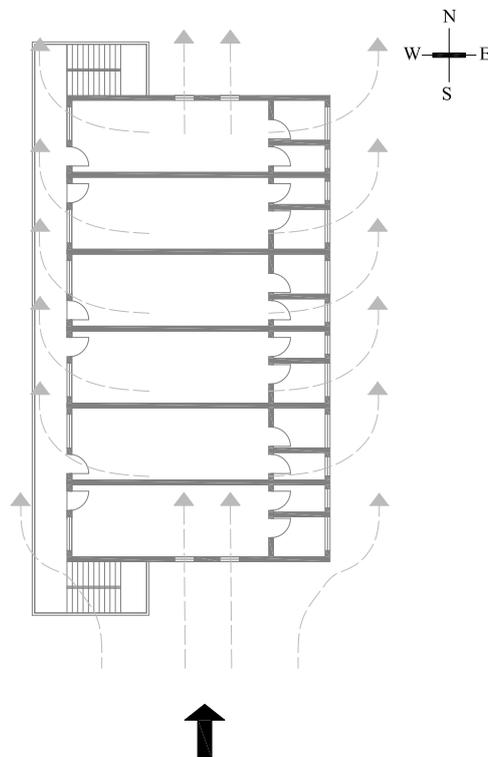


Building with the east - west orientation (Wind speed: 5.3 m / hr, wind direction by south - east)

The back side of the building can get the oblique wind. The apartment at the south side can get very good ventilation. The other apartments get the wind from the kitchen. The wind will go through to the living and sleeping area after crossing the cooking area. Therefore, the east - west orientation of the building with wind from south - east is not good for ventilation (Figure 125).

Figure 125: Wind access system to the building with the east - west orientation and wind direction by south - east.

Source: By author



Building with the east - west orientation (Wind speed: 5.3 m / hr, wind direction by south)

In case of south wind direction and the west orientation of the building, only the apartment at the south edge of the building can be provided with very good ventilation. The other apartments cannot get enough ventilation. They can only get a little indirect wind from the corridor (Figure 126). As a result, the west orientation of building is not good for the south wind direction during the time from November to February.

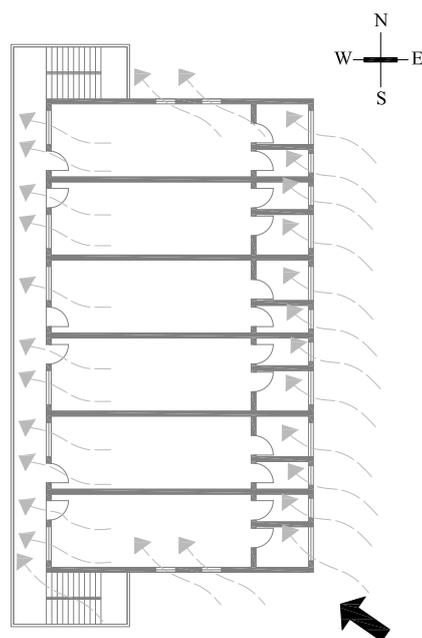


Figure 126: Wind access system to the building with the east - west orientation and wind direction by south.

Source: By author

4.4.4.1.2. Ventilation in room type apartments

Duplex apartment

Window location and air flow through system

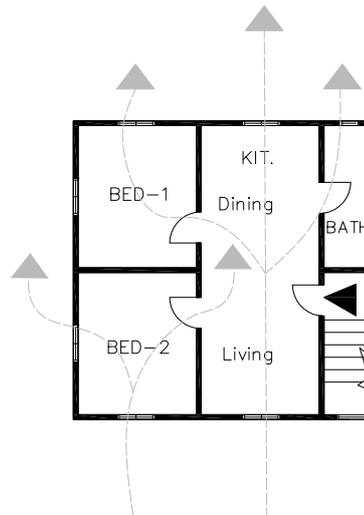
In this type of apartment, cross ventilation effects from the relation of the positive pressure to the negative pressure due to the location of windows. It can also enable the laminar air flow through system in the living, dining and kitchen hall.

The ventilation is possible in the asymmetric placement of windows because the relative pressure is greater at the centre than at the sides of the windward wall.¹⁰⁰ In the duplex apartment, poor ventilation can occur due to the asymmetric placement of windows at the external wall of living and sleeping area. However it has a good ventilation system due to the window's locations at opposite sides (Figure 127).

.....
100 Lechner, Heating, cooling, lighting, p. 260.

Figure 127: Air flow through system in duplex apartment

Source: By author



Opening area and floor area

According to the relation of opening area to the floor area in this type of apartment, the window area with 1 / 13.3 (7.5 %) of floor area provides a good ventilation in the living, dining and kitchen room as well as in the bedrooms.

Ventilation in duplex building

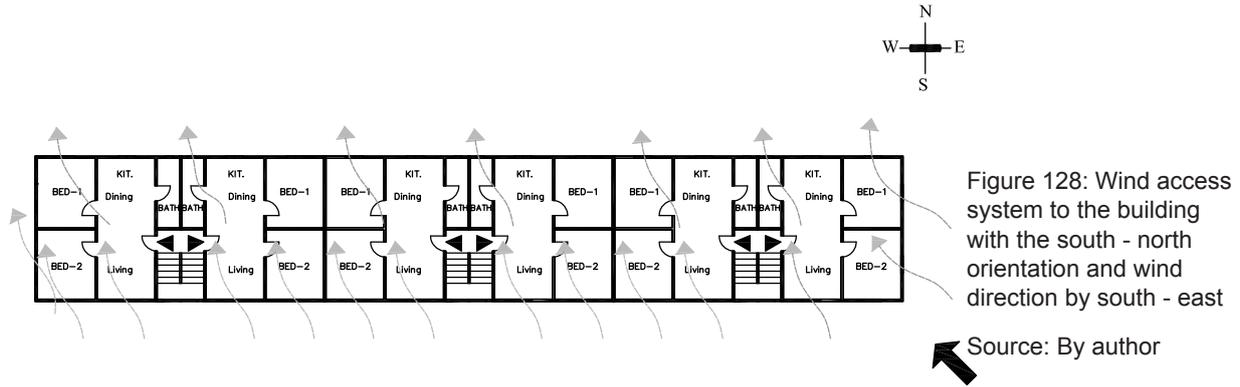
This type of building is a low rise 5 storey building with staircases directly serving two apartments on each floor. Most units, except the end ones, have only two external walls. The cross ventilation can provide from the strong positive inlet to the strong negative inlet. It is a better design than other building types because each apartment has two opposite external walls.

Orientation of building and wind direction

The building types are situated with many different orientations. Among them, only two orientations are analyzed. The one is south orientation and the other one is west orientation. The main two wind directions are taken. One is from south, mainly from November to February and the other one is from south - east direction, which is from May to October.

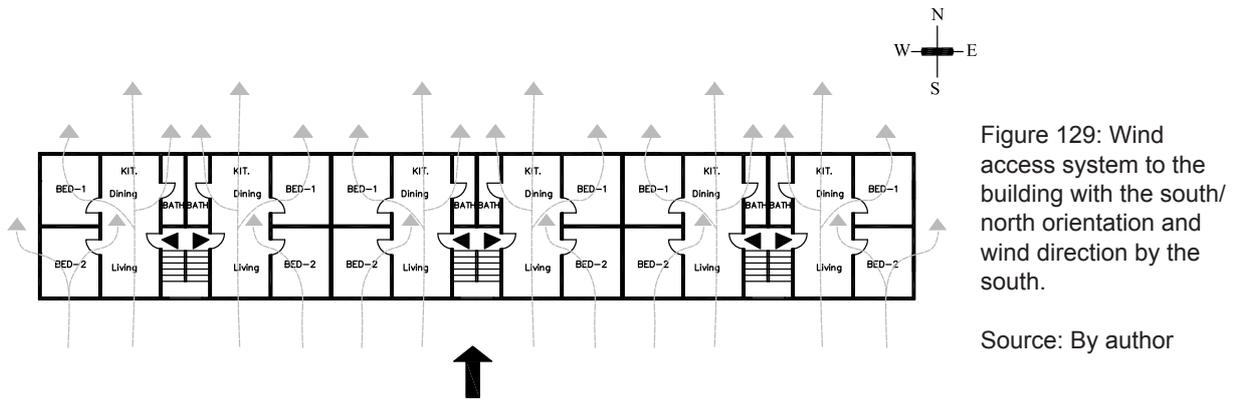
Ventilation of duplex apartment buildings with the south - north orientation (Wind speed: 5.3 m / hr, wind direction by south - east)

If the building orients to the south, the building can get oblique wind from May to October. Each room can get good ventilation. The apartment at the east gets better ventilation than the other apartments (Figure 128).



Ventilation of duplex apartment buildings with the north - south orientation (Wind speed: 5.3 m / hr, wind direction by south)

While the orientation of building is to the south, however, due to the south wind direction from November to February, all rooms can have very good ventilation. Wind can provide maximum pressure when they are perpendicular to a surface of the building. If the building faces to the south, it is the best orientation for a good ventilation (Figure 129).



Ventilation of duplex apartment buildings with the east - west orientation (Wind speed: 5.3 m / hr, wind direction by south - east)

If the building is east - west orientated, it can get oblique wind. But only the apartment at the south edge of the building can get very good ventilation. The other apartments can only have a minor one by the oblique wind (Figure 130).

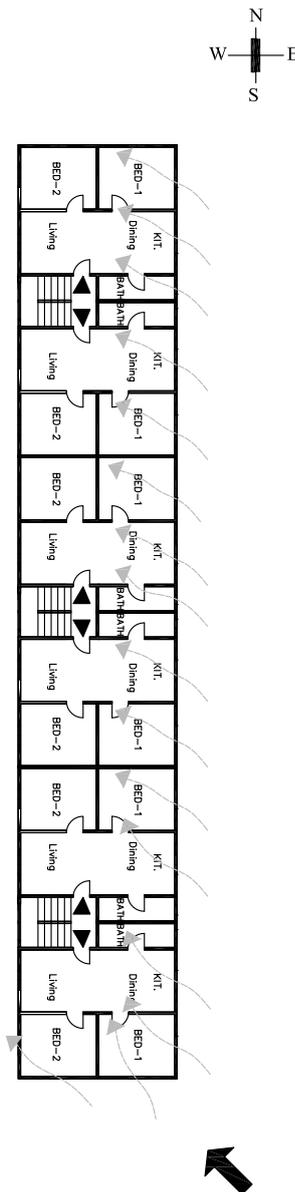


Figure 130: Wind access system to the building with the east-west orientation and wind direction by the south - east.

Source: By author

Ventilation of duplex apartment buildings with west - east orientation (Wind speed: 5.3m / hr, wind direction by south)

From November to February, the wind comes from the south. Only one apartment at the south part of the building can get good ventilation. The duplex building with west - east orientation is bad for natural ventilation from November to February (Figure 131).

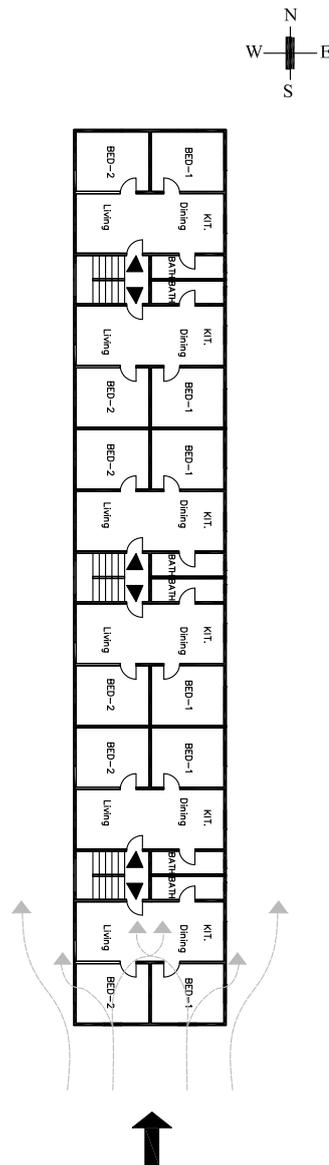


Figure 131: Wind access system to the building with the west-east orientation and wind direction by south.

Source: By author

Ventilation in four unit central stair type apartment Location of window and air flow through system

Ventilation from windows on one side and opposite side of the apartment can vary from very good to poor depending on the location of windows. According to the window location, the air flow system can change sometimes from laminar to turbulent.¹⁰¹ Because of the location of windows and the air flow system, the living area has poor ventilation. There is only one small window and one entrance door provided for the living area. Therefore, poor or turbulent air flow will occur at the living area. The corridor way from shrine to kitchen can have good laminar air flow because of two direct windows at the opposite walls. In each bed room, the window can let the air inside the room. By seeing that, the air flow system due to the location of windows in this apartment is good in the bedrooms and corridor way, but it will have a ventilation deficiency in the living area (Figure 132).

101 The air flow systems are described on page 74 in chapter 2.

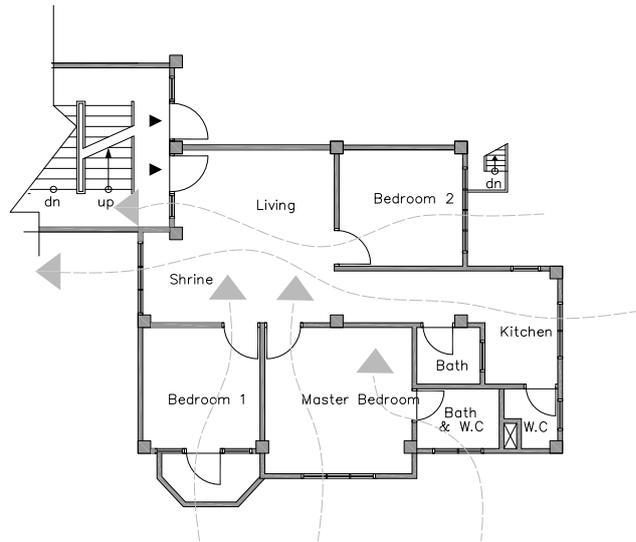


Figure 132: Air flow through system in four unit central stair type apartment

Source: By author

Floor area and opening area

Concerning the relation of opening area to the floor area, the bedrooms and the kitchen except the living area get good ventilation. The ratio of opening area to the floor area in master bedroom is $1/7.5$, bedroom 1 has $1/3.5$ of the floor area, and the opening of bedroom 2 has $1/5.56$ of floor area. The opening area of living hall has $1/9.72$ and the opening area of kitchen has $1/5.4$. By the natural ventilation regulations (Chapter 2) every room has enough ventilation. However the living area has weak ventilation.

Type of building

This building type is a multi-storey four units building with a central stair access. When the apartments are accessed from one central stair case, the orientation can be sensitive and the wind direction will generate some wind shadow. This wind shadow happens to the apartments behind of the apartments which get the direct wind when the wind direction is perpendicular to the building. Due to the form of the building, only one orientation with two wind directions (south-east and south direction) is analyzed.

Ventilation of the building with the wind speed: 5.3m / hr, wind direction by south - east

From May to October, when the wind is oblique to the building from south - east direction with 5.3 m / hr speed, the apartment at the north - west of the building will get wind shadow. Due to the edges of the apartment design, bedroom 2 in the apartment at the south east and south - west of the building can't get good ventilation when the wind direction is from south-east. The apartments in the south-west and south-east have fairly

good ventilation. There is a strong deficiency in the case of the apartment with the north - east orientation (Figure 133).

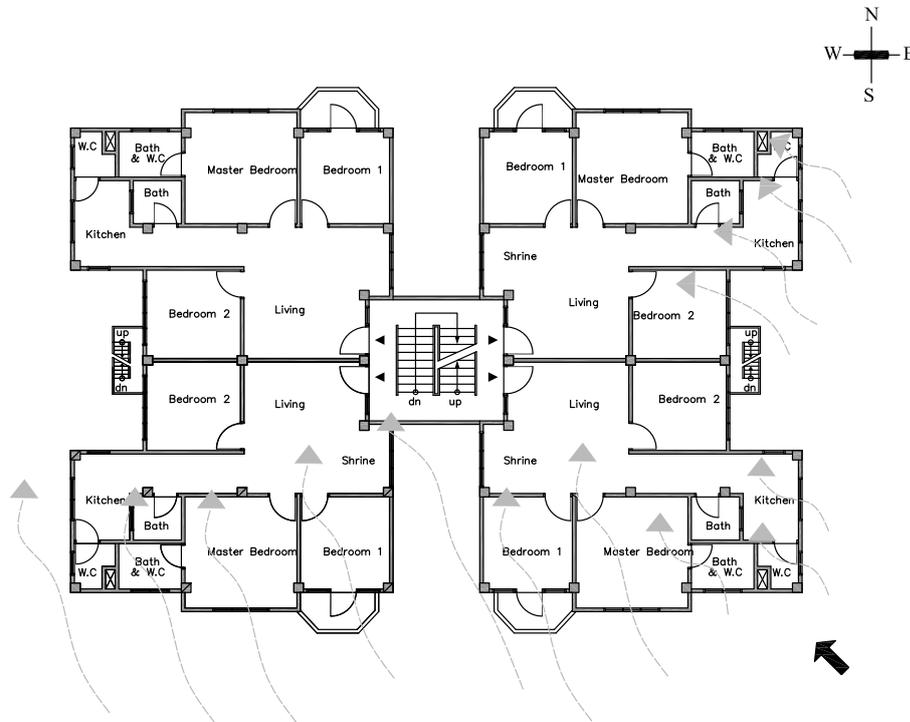


Figure 133: Wind access system to the building with wind direction by south - east.

Source: By author

Ventilation of the building with the wind speed: 4.3m / hr, wind direction by south

From November to February, the wind direction is from the south and wind speed is 4.3 m / hr. When the building position is perpendicular to the wind direction, two apartments behind the two front apartments cannot get good ventilation. Not only living and bedroom 1 can get indirect ventilation which comes through from the central stair case but also bedroom 2 in the front apartments have poor ventilation (Figure 134).

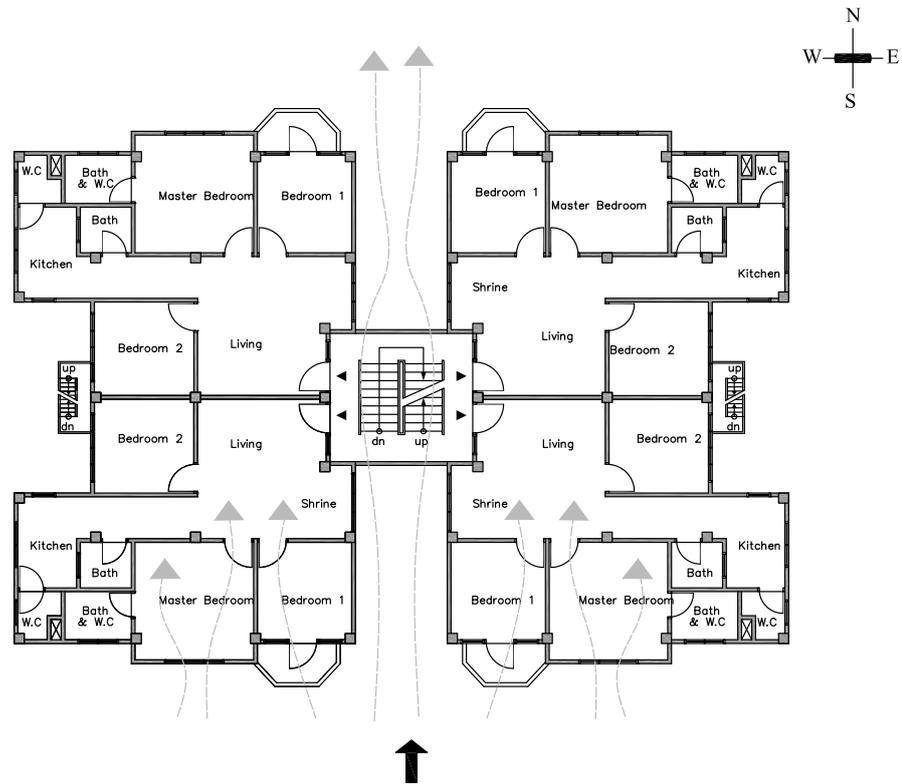


Figure 134: Wind access system to the building with wind direction by south.

Source: By author

Ventilation in central corridor type apartment Air flow through system

Due to the room organization, the living room and corridor way can get the direct laminar air flow. The oblique wind can provide ventilation to the bedrooms and to the master bedroom. However there can be eddy and turbulent air flow due to the deep and narrow place between two apartments. Poor ventilation is provided in the kitchen and dining room because there is only one window on the external wall, which faces to the neighbour apartment. The cooking and dining area can only have a little ventilation from the central corridor (Figure 135).

Floor area and opening area

Due to the analysis of opening area and floor area, the opening area in the living area is $1/4$ time (23%) of the living floor area. Bedroom 1 has $1/6.3$ time (15.8%) of floor area in the bedroom. In the bedroom 2, the opening area is $1/8.8$ time (11.4%) of the bedroom floor area. In master bedroom, the opening area is $1/33.9$ time (2.9%) of the bedroom area. And the opening area in the kitchen is $1/16$ times (6.4%) of the cooking area. The examination shows that all rooms may have adequate ventilation according to the ratio of opening area to floor area except the master bedroom at which only one external small opening is provided.

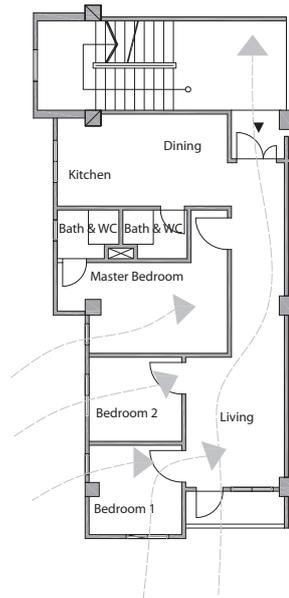


Figure 135: Air flow through system in central corridor type apartment

Source: By author

Ventilation in central corridor building type **Type of building**

This type of building is a multi-storey building with 12 units per floor accessed by a central corridor. Stairs are provided at each side of the building. The corridor is located at the centre of the building. It provides the access to the units on both sides. Each unit has three external walls. However, due to the deep and narrow void between two apartments, the rooms at the side of the void can get only poor ventilation.

Orientation of building and wind direction **Ventilation of the building with north - south orientation (Wind speed: 5.3 m / hr, wind direction by south - east)**

South - east wind comes from May to October. Because of the building form, only the two external walls of the apartment which is at the south east of the building can get good ventilation. The front facades of the apartments which face to the south will have oblique wind. However the rooms beside of the void at these apartments can't get enough ventilation when the wind comes from the south east direction. Moreover, the apartments at the north can't get enough ventilation. Hence, north - south orientation means a strong deficiency for this type of building (Figure 136).

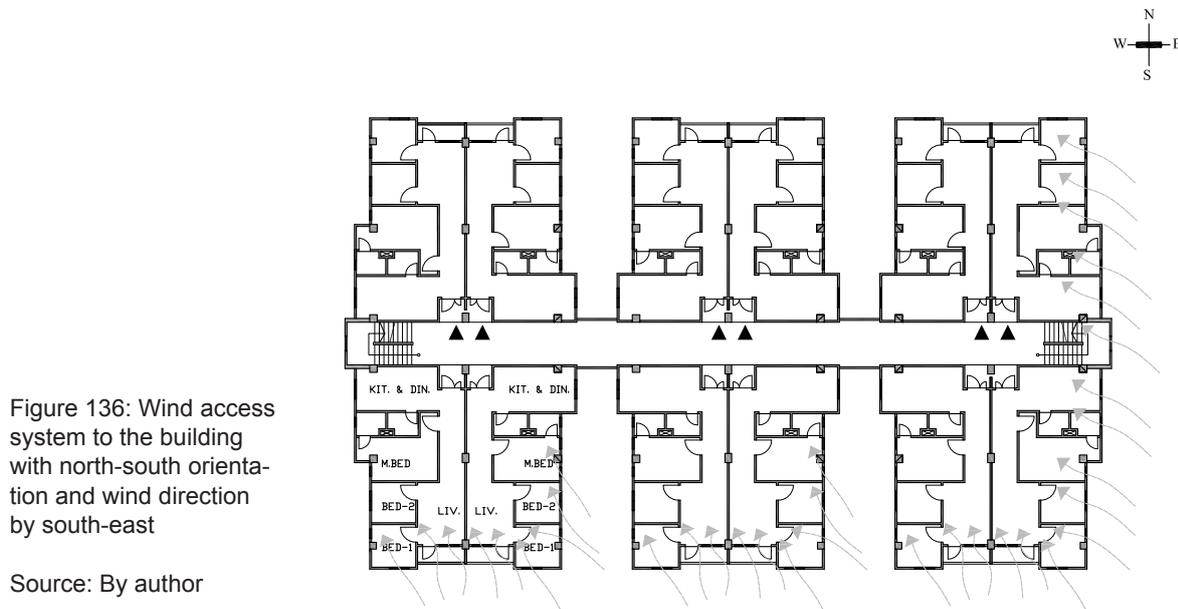


Figure 136: Wind access system to the building with north-south orientation and wind direction by south-east

Source: By author

Ventilation of the building with the north - south orientation (Wind speed: 5.3 m / hr, wind direction by south)

Having the same orientation of the building, but a different wind direction (south) from November to February, only one half of the building, the apartments at the south of the building can get good ventilation. The apartments which face to the north will get bad ventilation (Figure 137).

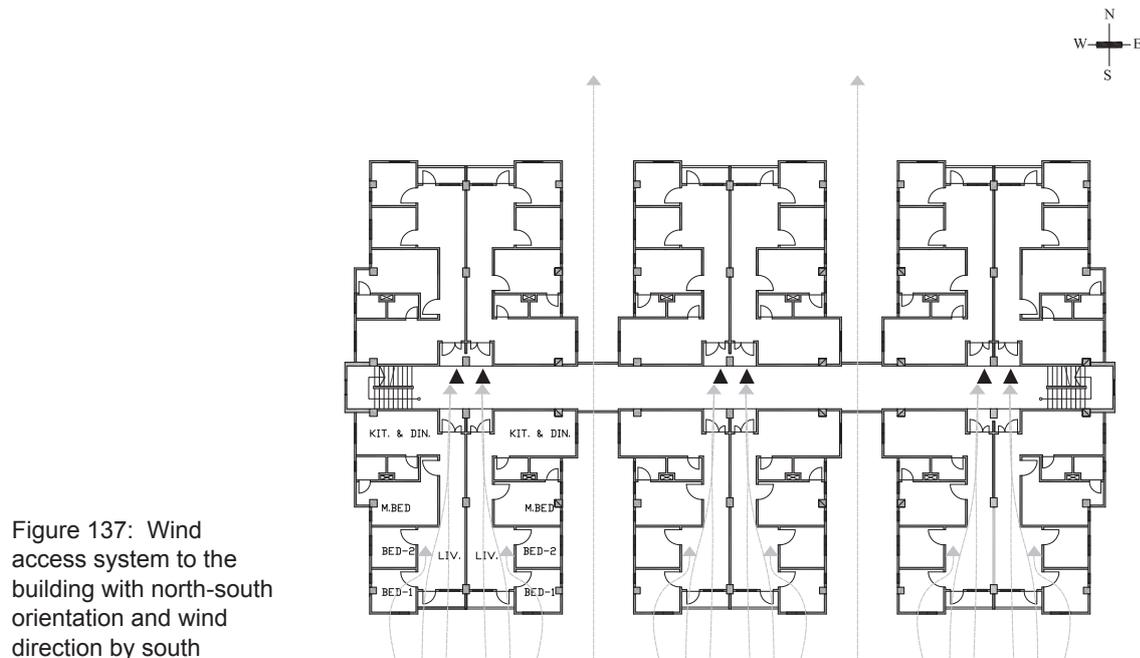


Figure 137: Wind access system to the building with north-south orientation and wind direction by south

Source: By author

Ventilation of the building with the east - west orientation (Wind speed: 5.3 m / hr, wind direction by south - east)

When the building orients to the east and west, the oblique wind hits the building from the south - east direction. Most of the apartments except the apartments which are at the north - west can get oblique wind. Some apartments which are at the north - west get wind shadow and have a bad ventilation (Figure 138).

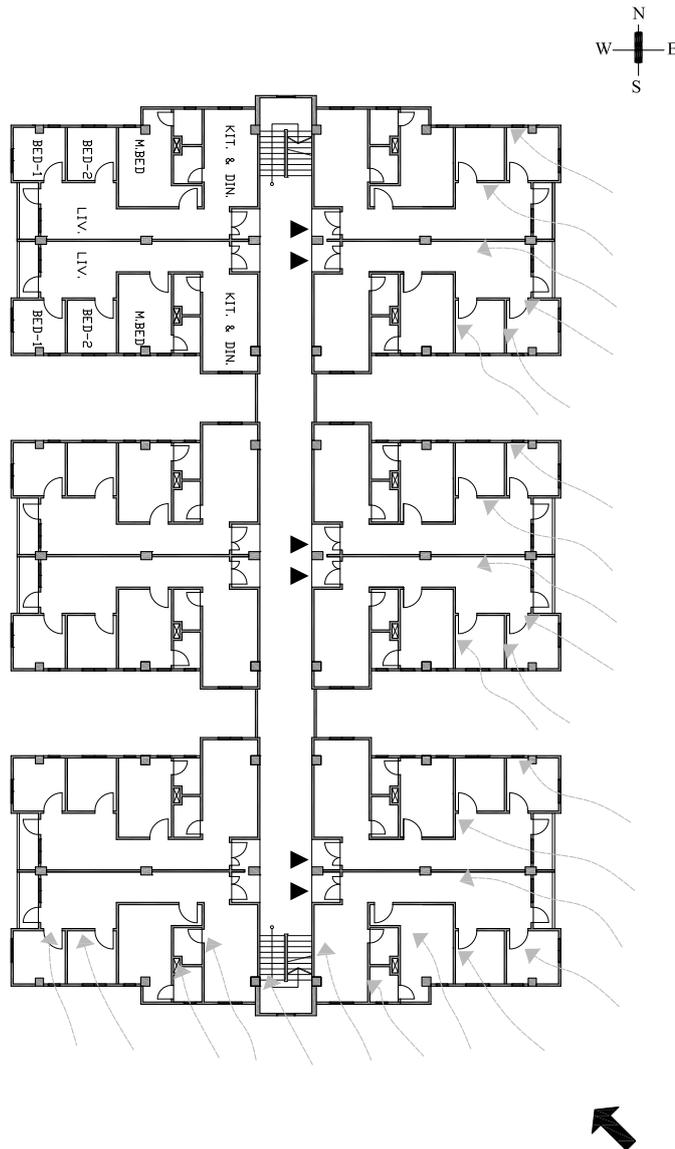


Figure 138: Wind accessible system to the building with east- west orientation and wind direction by south-east

Source: By author

Ventilation of the building with the east - west orientation (Wind speed: 5.3 m / hr, wind direction by south)

If the wind direction is from the south when the building orients to the east and west, only the apartments which are at the end of the building at the south get good enough ventilation. The corridor way can have good enough ventilation which comes through from the south. The other apartments lie in the wind shadow. Therefore, the central corridor building is not suitable for the natural ventilation. It would be a strong deficiency (Figure 139).

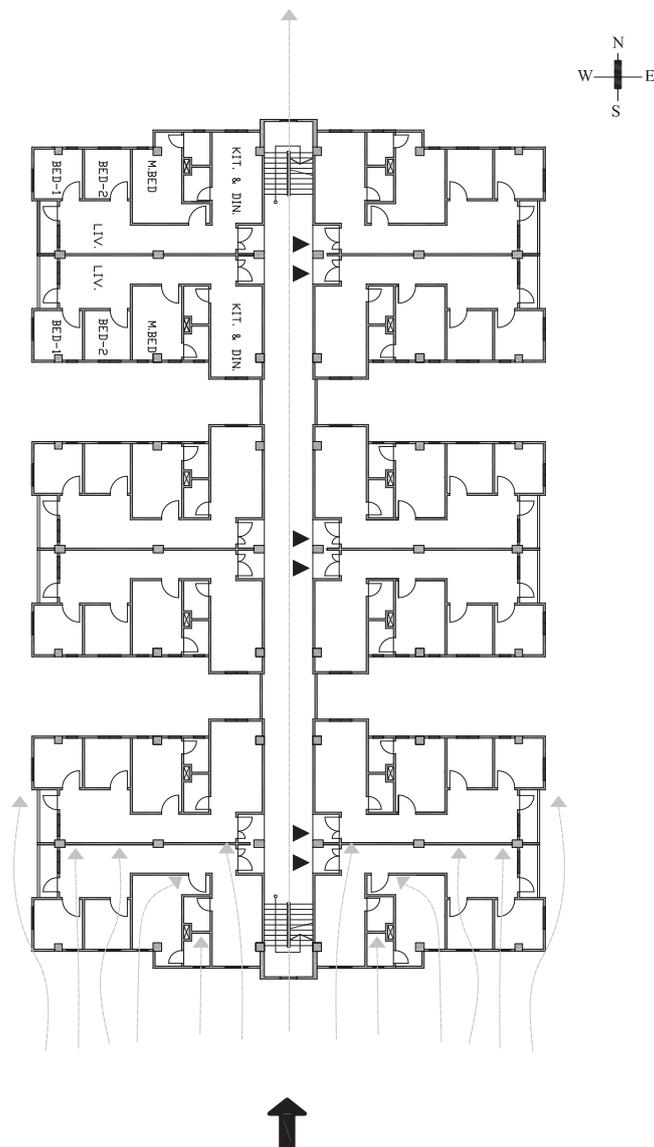


Figure 139: Wind access system to the building with the east - west orientation and wind direction by south

Source: By author

4.4.4.2. Summary with respect to natural ventilation

The main results of the above examinations are compiled in Table 23. Type 2 (duplex) is a very good apartment and building type because the depth of the apartment is not large. Also the windows in the opposite walls can allow the laminar air flow (Figures 122 and 124). Due to the large depth of the apartments in the hall type building, the apartments which have only two external walls may have less ventilation specially if partitions are added. In the four unit central stair type (Figure 132), the apartments may be provided with fair air flow. Due to the outside space between the apartments in this type, the ventilation system can be better than the one at central corridor type. The air flow system at each apartment in the central corridor type is fair, however, due to the central corridor access for the building, it is bad. The one apartment in the wind shadow can't get enough ventilation. It seems that the building types which don't create wind shadow have a principle advantage, which the other ones, the central stair and central corridor type create strong deficiencies for the shadow side apartments.

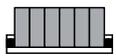
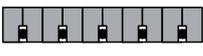
No	Building type	In Apartment					In Building			
		Air Flow System	Opening Area / Floor Area					Type of Building	Orientation of Building	
			L	D	K	BR	Bath WC		West	South
1	 Front corridor type	Good	Fair	Good	Good		Good	Fair	Bad	Good
2	 Duplex type	Very good	Good	Good	Good	Good	Good	Good	Bad	Good
3	 Central stair type	Fair	Good	Good	Good	Good	Good	Fair	Bad	Bad
4	 Central corridor type	Bad	Good	Good	Good	Good	Good	Fair	Very bad	Bad

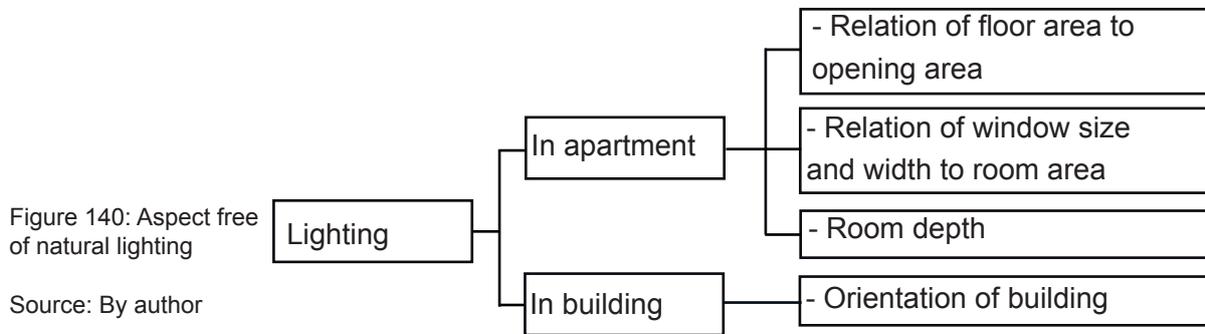
Table 23: Analysis of ventilation in the selected case studies.

Source: By author

L = Living room
D = Dining area
K = Kitchen or cooking area
BR = Bed rooms

4.4.4.3. Natural lighting

To have sufficient light is one of the important conditions of the quality of housing. With respect to the lighting quality in the hall and room type apartments and the different types of buildings, the following fundamental aspects will be examined.



4.4.4.3.1. Lighting quality in the hall type apartment

To explore the lighting quality, the above three factors in relation to the apartment are focused.

Relation of floor area to opening area

According to the lighting standard (see pages 88 and 89), there can be calculated an opening area of only 8.8 % (1/11.4) of the floor area in the living hall. In kitchen, there can be found 21 % (1/4.8) of the floor area. By seeing that it can get quite enough lighting. Bath and toilet has only 10 % (1/10) of floor area. By the minimum day lighting standard, we can see that the living hall has not enough lighting.

Relation of window height and width to room area

In relation with the window height and width to the room area¹⁰², and due to the form of apartment, one third of living hall at the back part is dark (Figure 141).

Room depth

Taking into account the form of the room and day lighting penetration¹⁰³, only 4.6 m floor length in living hall can get good lighting. It is shown in Figure 142.

102 Evans, AIA, Daylight in architecture, (New York, 1981).

103 Robert Lechner, Heating, Cooling and Lighting, 2001, mentioned in the advanced window strategies section that the rule for day lighting penetration is 1.5 times the height of window and 2 times the height of window with a light shelf under direct sunlight.

The lack of sufficient light is a serious deficiency which is due to the bad proportion of apartment.

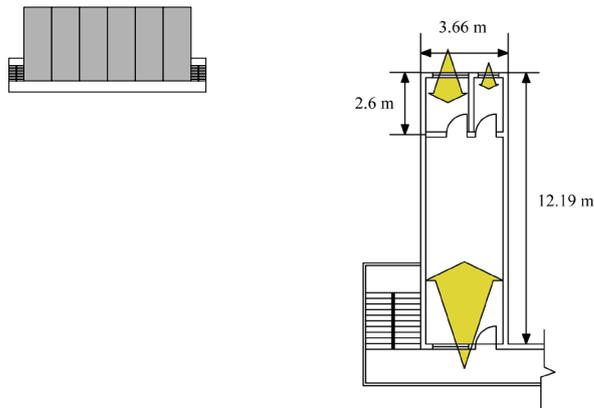


Figure 141: Windows and day light penetration in hall type apartment

Source: By author

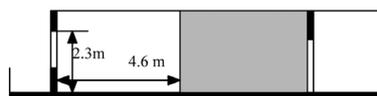


Figure 142: Room depth and day light penetration

Source: By author

Lighting quality in the building Orientation of building and sun angle

The following analysis is focused on the orientation of the corridor type building. In this analysis, four building orientations are analyzed by the different sun directions during summer, raining season and winter. Three months, March, June and December, which are mainly in three different seasons, are focused in this analysis.

Building with south orientation

Regarding the extreme sun directions and angles in Yangon (Figure 58), the apartments which face to the south get the morning and evening sun in March and December. However, the back of the building can get morning and evening sun in June. Due to the amount of sun shine in Yangon (Figure 53), the building can receive the sun lighting only almost 3 1/2 hours a day in June. Concerning the extreme sun angles in Yangon and due to the form of building, there will be less sun lighting in the living hall (Figure 143).

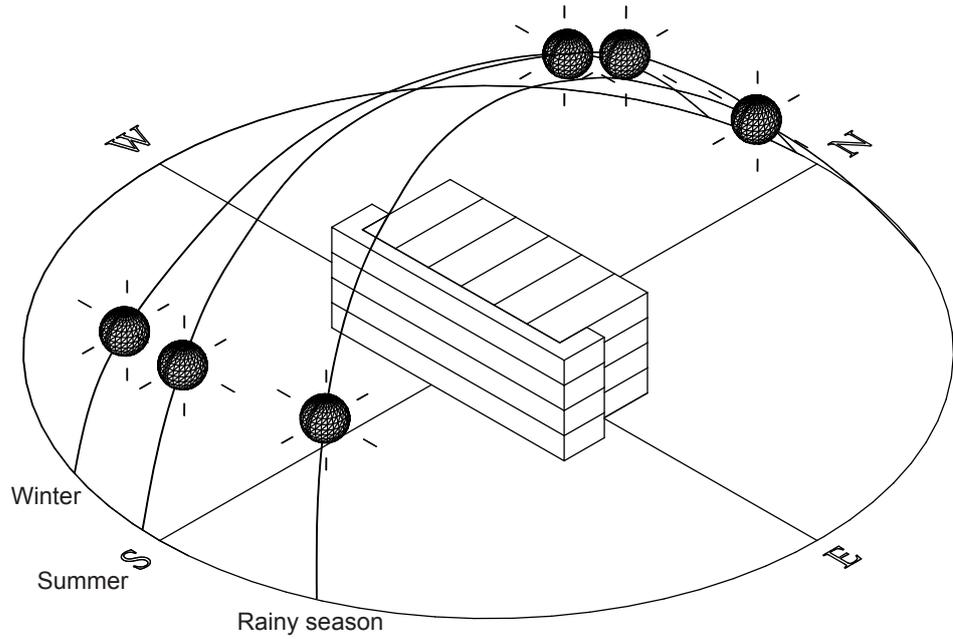


Figure 143: Building orientation to south

Source: By author

Building with north orientation

When the building orients to the north, the front of the building can get only the sun shine in June in which the daily sun shine is only about 2 hours. However, the back of the house can get good enough lighting if it is as a free standing building. By seeing that, the orientation to north is bad for this type of building.

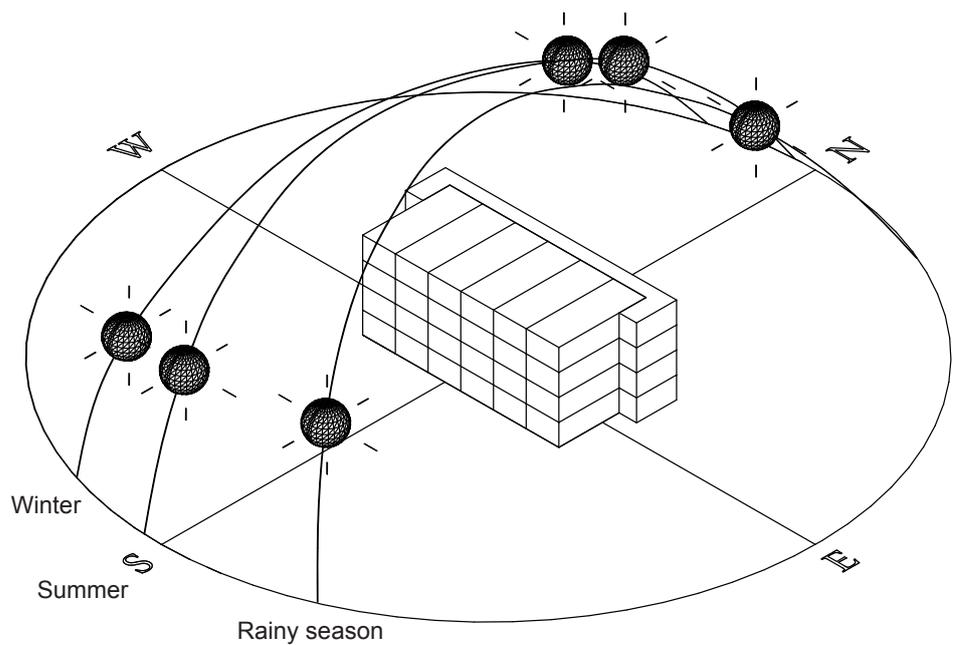


Figure 144: Building orientation to north

Source: By author

Building with west orientation

When the building orients to the west, the front of the building gets evening sun shine in March, June and December, while the back of the building is provided with morning sun in three seasons. By seeing that, the orientation of the building to the west direction is good (Figure 145).

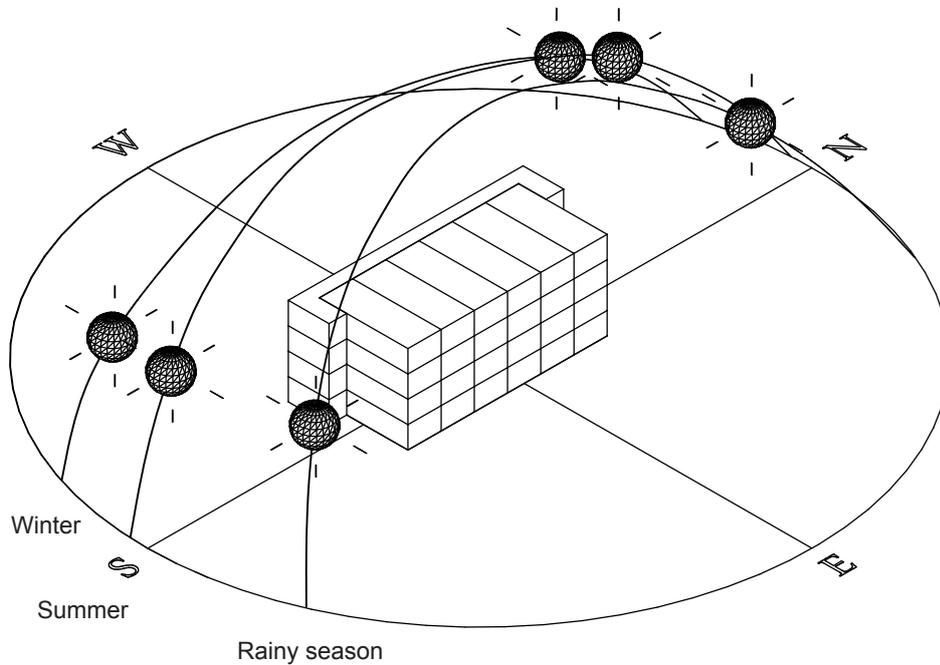


Figure 145: Building orientation to west

Source: By author

Building with east orientation

When the building faces to the east, the facade of the building can get 3 season morning sun and the back of the building can receive 3 different seasons' evening sun. By seeing that, this orientation to the east is the best orientation for this type of building (Figure 146).

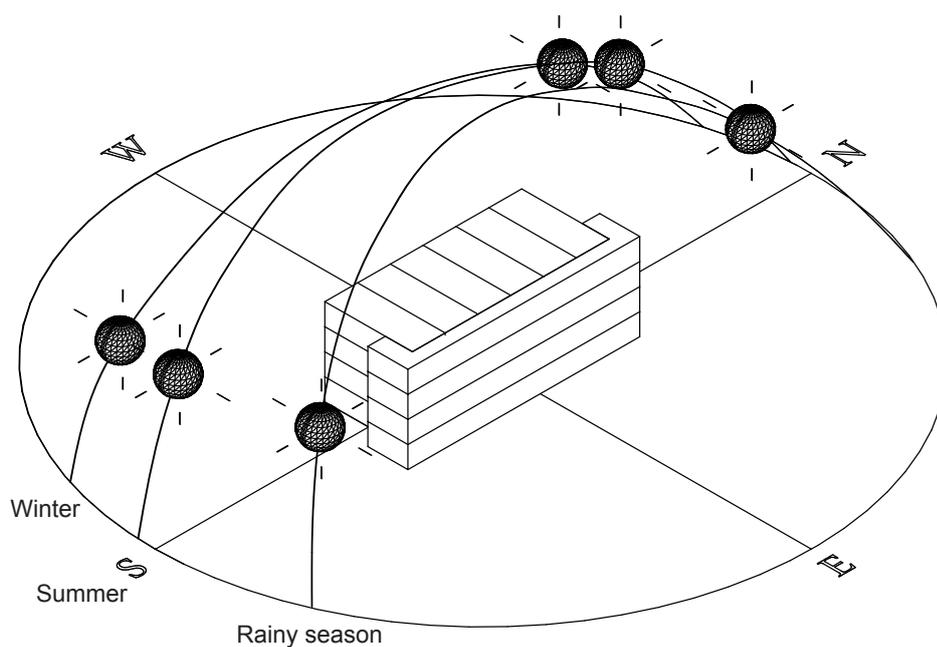


Figure 146: Building orientation to east

Source: By author

Analysis of lighting in room type apartment

The first case under the consideration is the central corridor type apartment.

Lighting in the central corridor type apartment

Relation of floor area to opening area

Due to the window height and width, all rooms except the master bed room have quite good lighting. Due to the only one window which has 1.5 ft x 3 ft, there is less lighting in the master bed room. According to the natural lighting standards (Pages 92 and 93), there is some problem of natural lighting in the master bedroom because only one window is provided in this room. It is provided a window area of 5 % of total floor area of the room. Bedroom 1 and bath & W.C of the master bed room have 30% lighting respectively.¹⁰⁴

Room depth and the penetration of lighting

According to the room depth, all rooms have quite good lighting in relation to their room depth. However, the passage going to living area with be dark. Due to the height of 6 storeys and the narrow space between two apartments, kitchen and dining area of the inner apartments have not enough natural lighting (Figure 147).

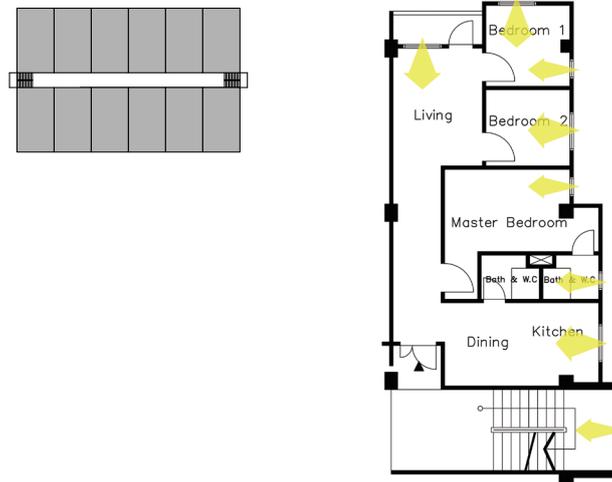


Figure 147: Room depth and the penetration of lighting in the central corridor type apartment

Source: By author

104 Yazana Lwin, Correlation between health and housing for walk up apartments in Yangon, (Yangon, 2006), p. 113.

Lighting in the quality due to building design

Building orientation and sun direction

According to the building orientations to the east or the west, the east-west and south side of the building have good natural lighting. The vertical sun angle is 40° to 52° from the south - east direction in the morning in March and December. In June, the morning sun reaches 60° to the north and east side of the building. And evening sun light can provide with 34° $58'$ to the north and west side of the building.

The east side of the building gets morning sun in March, June and December. The west side of the building gets evening sun shine in March, June and December. The south side of the building gets the sun the whole year all over the day. The north side of the building gets morning and evening sun in June. The apartments at the north part of building can only get the sun in June which is mainly in the raining season. This is a lighting deficiency (Figure 148).

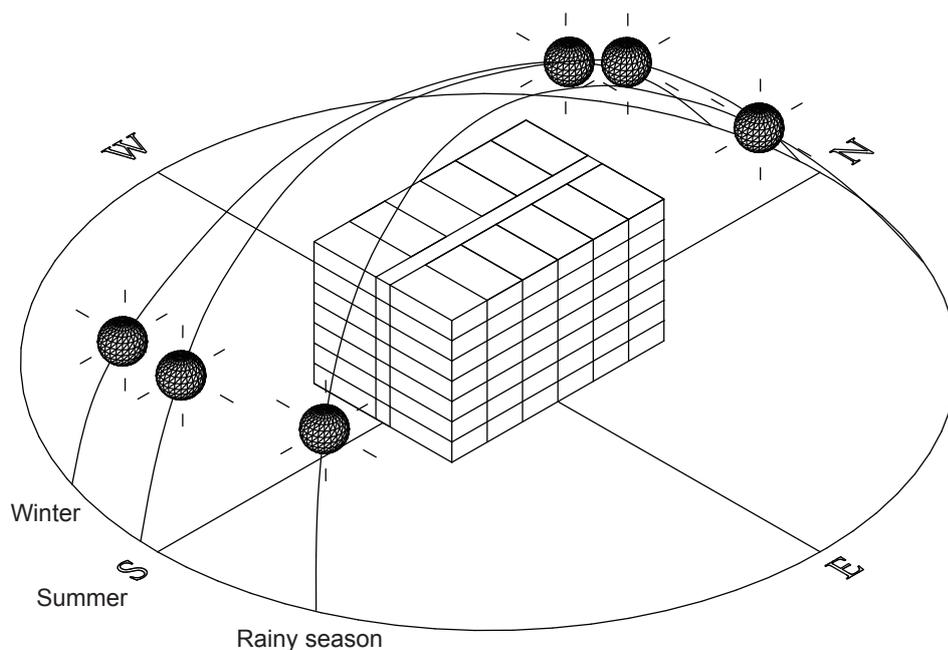


Figure 148: Building orientation to east - west

Source: By author

When the building orients to the north - south, all apartments face to the east or west. They can get good sun lighting in March, June and December. The apartments facing to the north can get morning and evening sun in June. As a result, this orientation is good for the natural lighting (Figure 149).

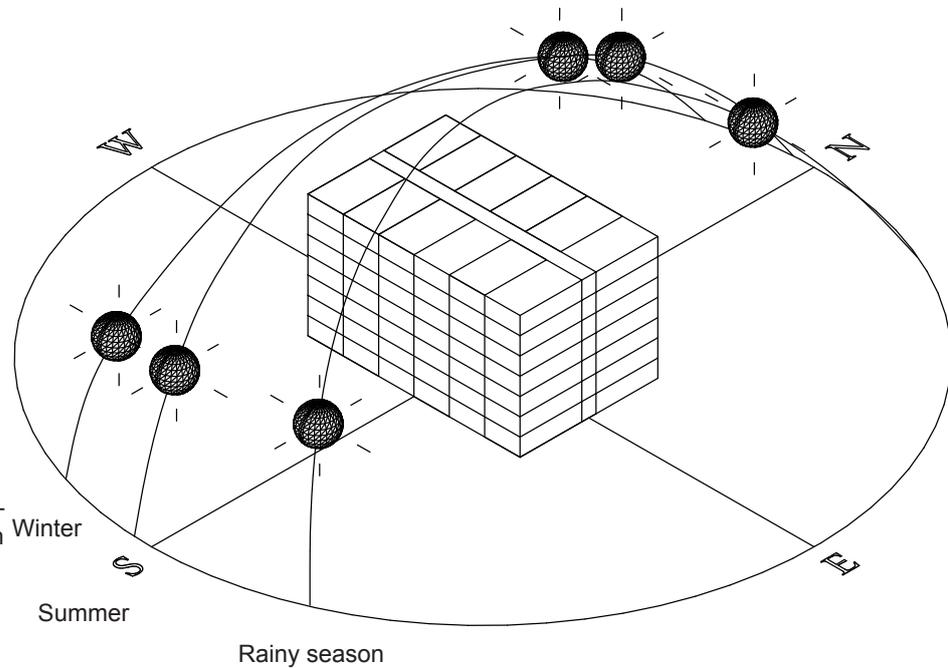


Figure 149: Building orientation to north - south

Source: By author

Lighting in the four unit central stair type Relation of floor area to opening area

According to the analysis of floor area to opening area, living room has $1/13$ (7.7 %) of opening area to the floor area. Bedroom 1 has $1/4$ (25 %) of opening area, bedroom 2 has $1/5.5$ (18.2 %), opening area in Master bedroom is $1/11$ (9 %) of room area, in the kitchen it is $1/6.4$ (15.6 %) and bath and W.C has $1/9.9$ (10.1 %) of opening area to the room area. Due to the natural lighting standards, all rooms have quite enough lighting. The shrine has very good lighting. The master bedroom and the living room have less lighting than other rooms. Most of the rooms have quite enough lighting. Due to the relation of window size and width to room area, all rooms have quite enough lighting with the provided openings, except the living room. The minor lighting at the living room is a strong deficiency, since it is a room with the most frequent use during the day.

Relation of window height and width to room area

Due to the window height and width to room area analysis, all rooms have quite enough lighting with the provided openings.

Room depth and the penetration of lighting

By the analysis of room depth, the natural lighting can provide all rooms to have good enough lighting (Figure 150).

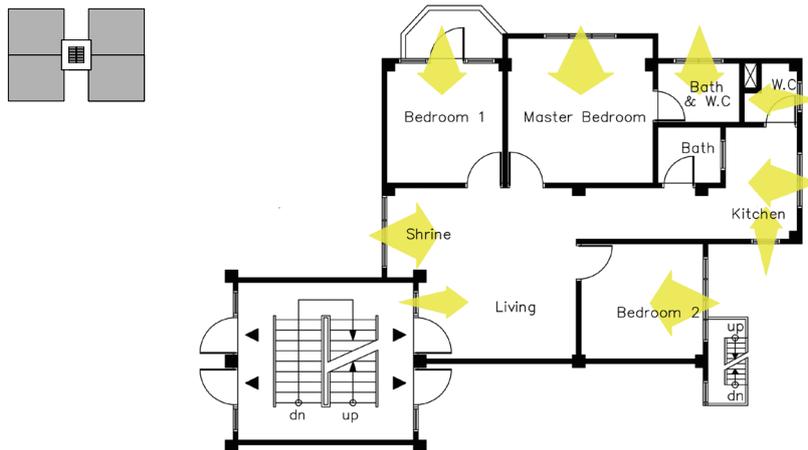


Figure 150: Room depth and the penetration of lighting in central stair type apartment

Source: By author

Lighting in the building

Building orientation and sun direction

This type of building is a square four unit type accessed by a central stair (Figure 12). Most apartments get sun light from south, east or west. The north side only gets light in June if the sun is rising and going down in north of the $90^\circ - 180^\circ$ line. The inner living room have lighting problem which is a lighting deficiency (Figure 151).

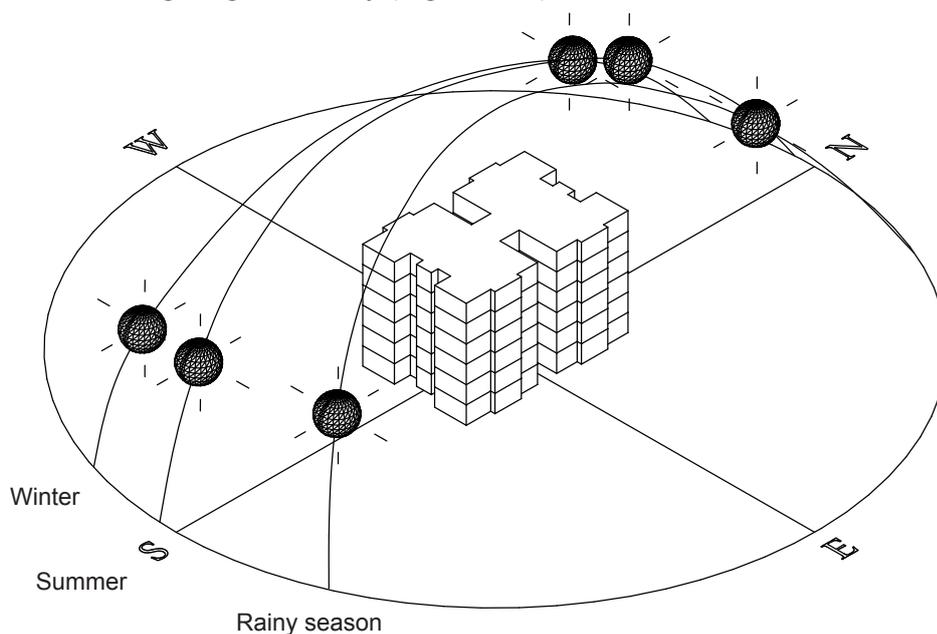


Figure 151: Building orientation and sun direction at central stair type building

Source: By author

Lighting quality in the row type apartment Relation of floor area to opening area

According to the analysis of opening area to floor area, in the living, dining and kitchen area, there is 1/13 (7.7 %). In each bedroom, there is 1/13 (7.7 %). In the bath and WC, there is only 1/21 (4.8 %). By seeing that, all habitable rooms have enough natural lighting. However, in the bath and WC, the provision of lighting is a little bit less than in the other rooms.

Relation of window height and width to room area

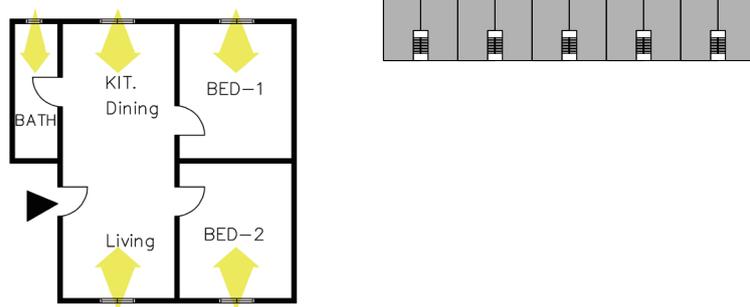
Regarding the relation of the window height and width to the room area, all rooms have good enough lighting except the bath room.

Room depth and the penetration of lighting

Due to the room depth and natural lighting, every room receives good lighting (Figure 152).

Figure 152: Room depth and the penetration of lighting in row type apartment

Source: By author



Lighting quality in the row type building Building orientation and sun direction

Two orientations of the building are analyzed. One is north - south orientation and the other one is east - west orientation. When the building orients to the north - south, the front of the building receives morning and evening sun during two seasons, in summer and winter. The back of the building receives morning and evening sun in raining season. When the building orients to the east-west, the front of the building can get evening sun in summer, raining season and winter. The back of the building can receive morning sun in summer, raining season and winter.

One result has come out from the above analysis: if the depth of the apartments is not too long, the light penetration into the room can provide enough lighting.

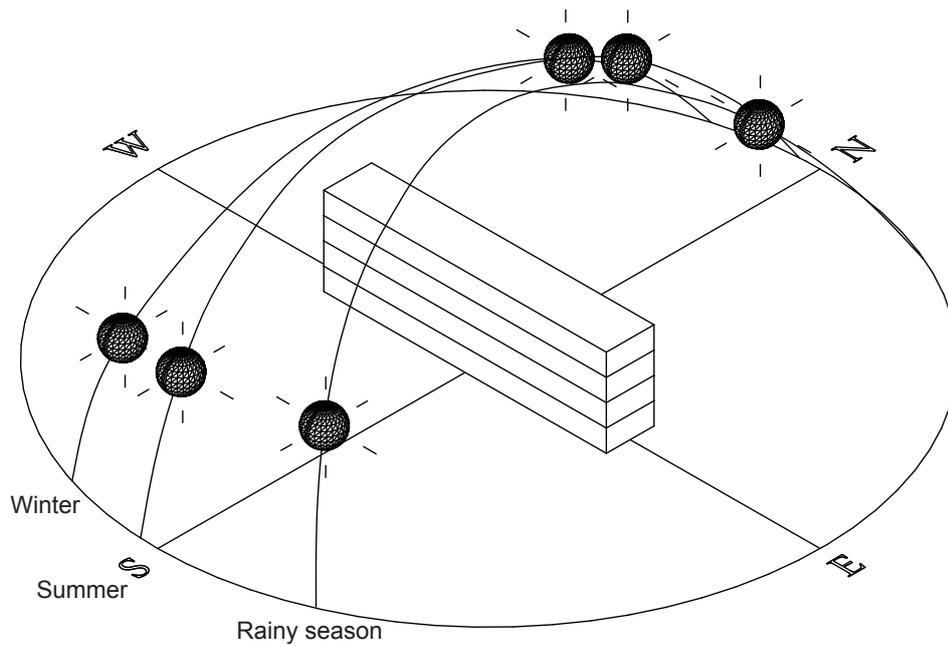


Figure 153: Building orientation to north-south

Source: By author

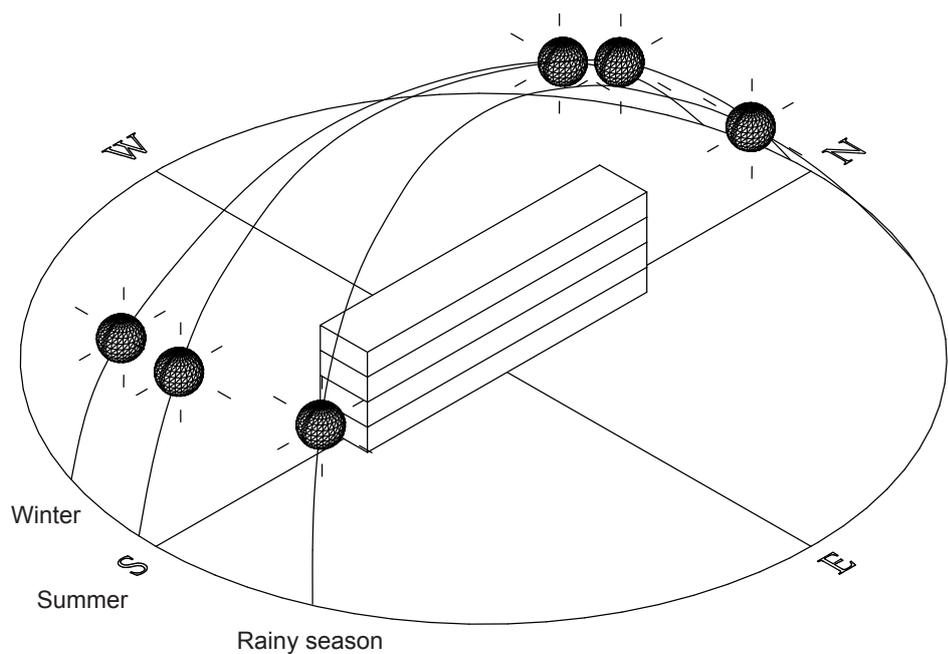


Figure 154: Building orientation to east-west

Source: By author

4.4.4.4. Summary with respect to natural lighting

The following can be concluded from the above investigations:

- In the front corridor type, the average opening area for total floor area is 13.3 %, in the central corridor type building, it is 10 %, in the four unit central stair type, it is 23 %, and in the row house type, it is only 6.7 %. By seeing that, the four unit central stair type is the best type for the natural lighting under the aspect of the ratio of opening area to floor area.

- In the apartments, most of the rooms have adequate lighting. Bath rooms, dining area and master bed rooms in some cases are not provided with sufficient natural lighting.
- In the hall type apartment, due to the long rectangular plan, the hall way area is almost dark.
- According to the building type and due to the provided exterior walls, the four unit central stair type is the best type for the natural lighting.
- There are some major deficiencies in the lighting of hall type and the lighting of the living area in the central stair type.

5.

ANALYSIS OF GERMAN CASES



CHAPTER 5: Analysis of German Cases

5.1. Aspects of potential input

This chapter concentrates on a selection of German cases, which can be used as input for the planning of housing in Yangon. Looking for candidates to offer an input, it is difficult to find cases, because the situation of the two countries in Germany and Myanmar is very different. The criterion of selection is, whether there is a similarity, i.e., some features of cases in Germany with the case in Myanmar. At present time the situations are too different, although there were some similar cases in the past time. They happened to exist in a comparable situation: the similarity is in urgent demand for housing, high number of demanders, rare economic resources of the people concerned. These similarities are found in projects of German housing after the First World War. They can be used as input for housing in Yangon.

The similarity is due to the situation. In both cases there is a shortage of housing offers on the market mainly for poor and lower middle class people. At the same time there is a limited budget. Therefore the reaction is to develop low standard minimum size units to affordable prices. At the same time they should be well functioning with respect to various aspects. The analysis illustrates German cases, which aimed at solving problems in the context of high demand and poor resources.

After the First World War, European nations were faced with an unprecedented demand for urban housing, particularly for the working classes. Germany falls into a prolonged period of chaos and disorder. When this chaos and disorder found a coherent political voice, whether through social calm and political stability would be predicated on the capacity of the state to provide healthy, affordable housing in well-functioning cities.¹⁰⁵

In Germany, the housing shortage has lasted more or less ever since the so-called founding years "*Gründerjahre*", that is, the 1870s. After the war, owing to the shortage of building materials, the act of capital, and the inflation that wiped out profits, for a number of years, it was impossible to launch any significant construction. However, the housing shortage could not be entirely blamed on the neglect of building activities during four to eight years, but on an accelerated increase in population.

The housing census of 1927 shows that 1,500,000 families were looking for housing during that year: 300,000 are needed to ease the overcrowding in existing dwellings. One of the main indicator of the housing shortage was overcrowding: density of habitation is defined as the ratio of dwellers to overall dwelling space (*Wohnungsdichte je Wohnung*), or the ratio in each individual dwelling of the number of persons per room (*Wohndichte je Wohnraum*).

.....
 105 Leif Jerram, Kitchen sink dramas, women, modernity and space in Weimar Germany, journal of cultural geographies, 2006, available online at: < <http://cgj.sagepub.com/content/13/4/538> >, assessed on 9.01.2011.

Three million people living in German cities lived in overcrowded dwellings after the war. In Berlin there were about 70,000 basement apartments, in which 50,000 children were growing up during the year 1930. In Germany an apartment is defined as overcrowded when more than two persons inhabit a single room. Statistics showed that in Germany every tenth person in the cities lived in an overcrowded dwelling. However, this number applies only to small apartments. Moreover disproportionately excessive overcrowding exists in one - third of the apartments, where four persons or more are forced to live in one room. In general, it may be stated that pre war over-crowding was slightly worse, for the simple reason that overall birth rates have decreased since the war.¹⁰⁶

At the end of the 20s, the issue of flexibility was raised in Germany. Due to this issue in 1929, the second international CIAM (*International Congress of Modern Architecture*) congress was held with the title, '*Die Wohnung für das Existenzminimum*', (literally translated as '*The Subsistence Dwelling*') in Frankfurt on the side of the concepts from the architects for the flexibility.¹⁰⁷

In order to provide sufficient numbers of dwellings at the minimal cost, the second CIAM congress of international architects was a forum for debate to best solutions for new reduced space standards. The ideas of architects and planners in the CIAM conference in Frankfurt provided maximum opportunities for a usage of minimum floor space. Based on this fact, the activities could be added together in a large room. Regarding the function of flexibility: folding, rotating, adjusting, and sliding, the room can be converted and therefore useful for different uses.

In the congress, Ernst May dealt with the development of housing especially for worker classes, that could be extended by starting from this intermediate specific designed apartments. Victor Bourgeois worked with a different concept of land use in day-night rhythm, where a room could equally serve as a living room and bed room.

Gerrit Rietveld presented a structure of cross bearing walls in varying distances, which could be implemented within a system of apartments of different sizes. Le Corbusier differentiated between the support structure and what was called the 'biological conditions of the functional classification'. In his *Maison Loucheur* the open floor plan with the help of sliding walls and movable cabinets can be divided, so that a living room at night turns into several bedrooms.¹⁰⁸

106 Karel Teige, *The minimum dwelling*, (Prague, 1932), p. 64.

107 *Arch + Zeitschrift für Architektur und Städtebau*, Vol 100-101, October 1989, p. 65. (translated by the author)

108 *Ibid.*, p. 66. (translated by the author)

5.2. Selected cases

The aspects to select cases suitable for a potential input for Yangon are mainly their contribution to solve a supply shortage under conditions of rare money.

As most fruitful contributions were considered:

- 1) Plans of minimum apartments
(The design proposals for minimum apartments at the CIAM conference ,Frankfurt am Main, Germany, 1929)
- 2) Frankfurt kitchen
- 3) Frankfurt housing

5.2.1. Plans of minimum apartments

The following apartments are the type of proposals which were suggested in CIAM conference, which is the first attempt to find a solution for the problem of housing shortage in Germany and other European countries after the First World War. The ground plan schemes illustrate almost completely the idea of the exhibition entitled: 'Homes for Minimum Incomes'. These ground plans have been selected for the further development of housing in Frankfurt.

(1) A type of row housing with two rooms flat for four families was developed in Frankfurt. Figure 155 shows a unit, which has a floor area of 30.3 m². The living room is used also as a bedroom by means of folding-beds. This design is carried out as a proposal design of CIAM conference. The architects and designers tried to work with flexible space by supplying double functions, living area at the day time as sleeping area at night.

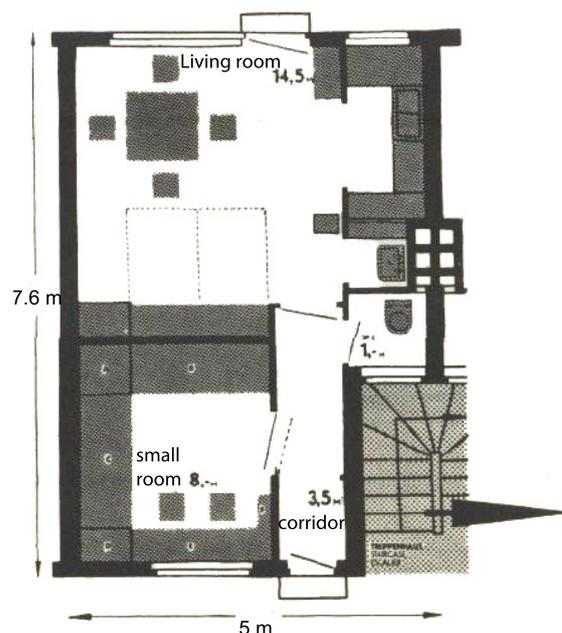


Figure 155: Proposed plan-1 for the development of Frankfurt housing

Source: Städtischen Hochbauamt in Frankfurt am Main, Die Wohnung für das Existenzminimum, Frankfurt am Main, 1929, p.106.

(2) Another type with a floor area of 31.8 m² (342 ft²) was developed with an open front corridor and a semi-open loggia with seat. It is at the back side. The living area is provided at the front of the apartment. Providing these spaces, it is demonstrated that an open long corridor with semi-open living space can be provided for social contacts of residents as well as with neighbours. Even the total floor area of the apartment is small for the residents; it is found that there is flexible space for the residents inside the apartment as well as outside of the apartment (Figure 156).

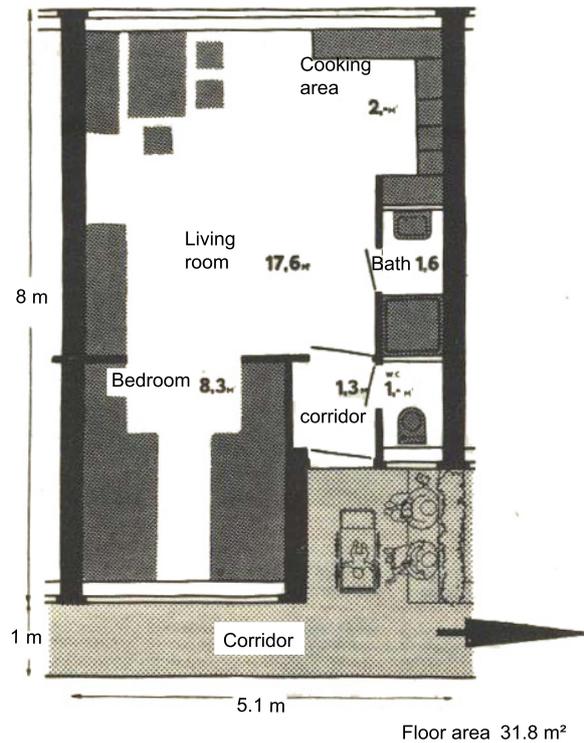


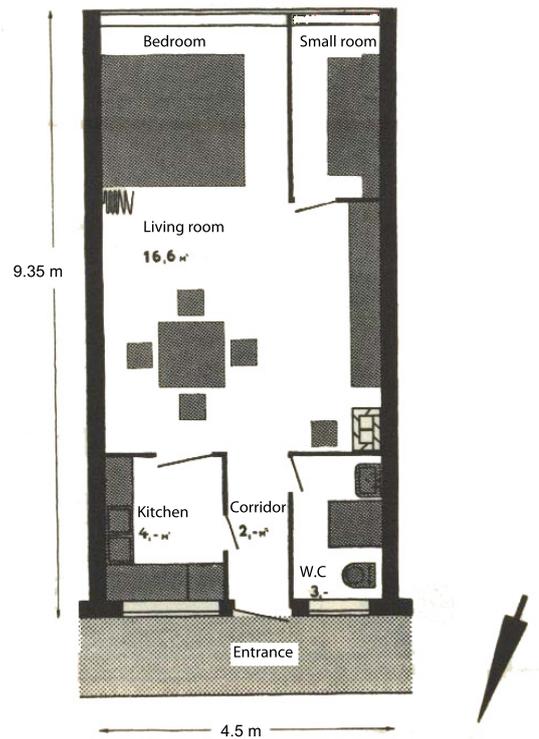
Figure 156: Proposed plan - 2 for the development of Frankfurt housing

Source: Städtischen Hochbauamt in Frankfurt am Main, Die Wohnung für das Existenzminimum, Frankfurt am Main, 1929, p.108.

(3) Another proposal has a long depth of 9.35 m with a narrow front. It has a floor area of 37.4 m² (402 ft²). A folding partition between sitting room and bedroom is provided. The sleeping space is added to the bedroom in the day time by strapping up the beds. In this apartment, the service zone is found as soon as entering the apartment. This type shows double function in the interior space by providing the foldable partitions and foldable beds, as well as open long corridor that can serve as the people's social space (Figure 157).

Figure 157: Proposed apartment plan-3 for development of Frankfurt housing

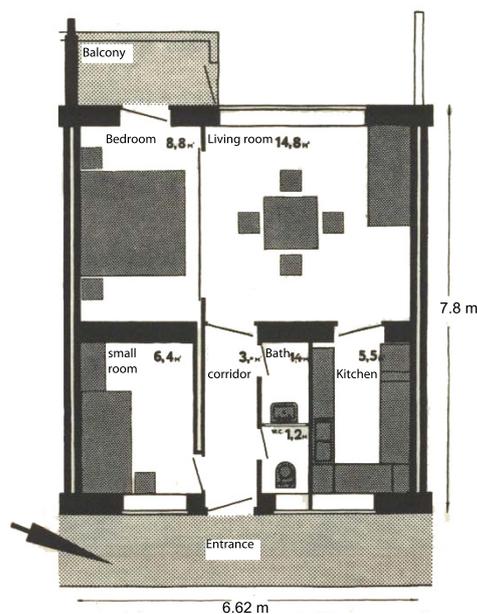
Source: Städtischen Hochbauamt in Frankfurt am Main, Die Wohnung für das Existenzminimum, Frankfurt am Main, 1929, p.114.



(4) The type shown in figure 156 has a floor area of 41.3 m² (444 ft²) with a parents bed room with folding beds and fitted cupboards separated from the living room by wide sliding doors. Thus the living room at the day time serves as a room with 6 m wide by means of a sliding wall and folding beds.

Figure 158: Proposed plan-4 for the development of Frankfurt housing

Source: Städtischen Hochbauamt in Frankfurt am Main, Die Wohnung für das Existenzminimum, Frankfurt am Main, 1929, p.122.



(5) Another type was proposed in Karlsruhe, with a floor area of 41.3 m². It was designed with the access from a front corridor. All rooms have easy access from the entrance. The service area is reached as soon as entering the house. A private verandah near by the living area is provided at the back of the apartment (Figure 159).

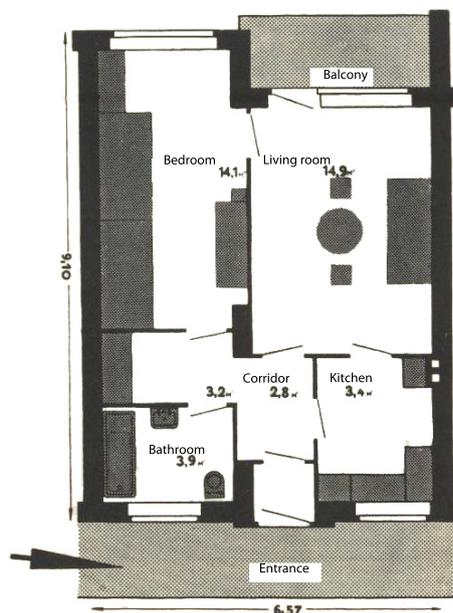


Figure 159: Proposed apartment plan in Karlsruhe housing settlement

Source: Städtischen Hochbauamt in Frankfurt am Main, *Die Wohnung für das Existenzminimum*, Frankfurt am Main, 1929, p.124.

The following is learned from the above types:

- The architects and designers solved the problems of supply shortfall and small income by the strategy of the minimal space with basic facilities.
- They planned folding beds and sliding partition in order to provide double functions for the day and night use.
- The designers planned the access into the apartment by a front corridor. The front corridor offered as one of the relaxation spaces for the residents as well as communication space with the neighbours.

5.2.2. Frankfurt kitchen

Frankfurt kitchen is a milestone of domestic architecture in Germany after the First World War. The kitchen plan was realized for the first time after a unified concept, designed to enable efficient work and to be built with low cost. It was designed in 1926 by the Austrian architect Margarete Schütte-Lihotzky¹⁰⁹ for the social housing project Römerstadt in Frankfurt of architect Ernst May. It was a classic example of a solution in the housing revolution in Germany. The essential actions of food preparation were measured and mapped. The resulting data was then transferred into an 'ideal' kitchen design, predicated on notions of spatial and social efficiency.¹¹⁰

¹⁰⁹ Margarete Schütte-Lihotzky (1897-2000) was the first woman to be studied at the Vienna School of Applied Arts architecture.

¹¹⁰ Karen Melching, *Frankfurt Kitchen: Patina follows function*, V&A journal, number 53, available online at: http://www.vam.ac.uk/res_cons/conservation/journal/number_53/frankfurt/index.html, 2006, accessed on 10.01.2011.

Because of the various types of housing, many different types of 'Frankfurt kitchen' were developed. Brenner indicated in an article in the 'Construction World' in 1927, that the 'Frankfurt kitchen' was designed with more than thirty variations due to the different kitchen size. Organized by the Building Department of Frankfurt in cooperation with the Frankfurt Housewife Club, three different 'Frankfurt Kitchen' were proposed:

1. For a household without maid (for a total annual income of about 5,000 marks)
2. For a household with a maid (with an annual income of about 10,000 marks)
3. For a household of two maids (with an annual income of over 10000 marks)

These three kitchens should serve as models for small, middle and big apartments. The last types, the kitchen with two maids, consisted of the actual functional kitchen space, but also included a pantry and a broom. The second and third types of households are marked less by the target group of the Frankfurt housing, but it clarifies that the functional kitchen is not just a 'Modern Working Kitchen' (Figure 160).¹¹¹

Figure 160: The developing plans of Frankfurt kitchen

Source: Gerd Kuhn, "Die Frankfurter Küche" in Tilman Harlander, (Ed), Sozialwissenschaftliche Planungsgrundlagen, Institute Housing and Design, University of Stuttgart, Stuttgart, 2001, p. 50.



The 'Frankfurt kitchen' in 1926 was one of the first kitchens designed with the aim of minimizing the housework for a generation of women who had to balance their household chores and jobs outside the house. Later thousands of units were produced in the following four years and incorporated into housing projects in Frankfurt. The large scale projects had to provide affordable apartments for a great number of typical working class families. The kitchen is a small room separated from the main room. It measured 1.9 m by 3.4 m, approximately 6 ft 2 in by 11 ft 2 in with a standard layout.¹¹²

111 Gerd Kuhn, "Die Frankfurter Küche" in Tilman Harlander, (Ed), "Sozialwissenschaftliche Planungsgrundlagen", Institute Housing and Design, University of Stuttgart, Stuttgart, 2001, p. 49-50. (translated by the author)

112 Susie Steiner, Frankfurter Küche The guardian online newspaper, available online at: <<http://www.guardian.co.uk/lifeandstyle/2006/apr/01/homes1>>, 2006, accessed on 09.01.2011.

It was designed for two purposes:

- To optimize kitchen work in order to reduce cooking time and
- To be cheaper in building decently equipped kitchens.¹¹³

The 'Frankfurt Kitchen' of the so-called normal type which was fixed in the urban standards known as the Frankfurter Register Journal IX recorded the following parts:

1. Stove
2. Drawer for flour and salt
3. Gas stoves
4. Foldable ironing board
5. Food closet
6. Rotating stool
7. Working counter
8. Garbage slot
9. 10. 11. Sink and counter
12. Closets for pots and pans
13. Broom closet
14. Heater (it is not always provided)
15. Movable plates¹¹⁴ (Figure 161)

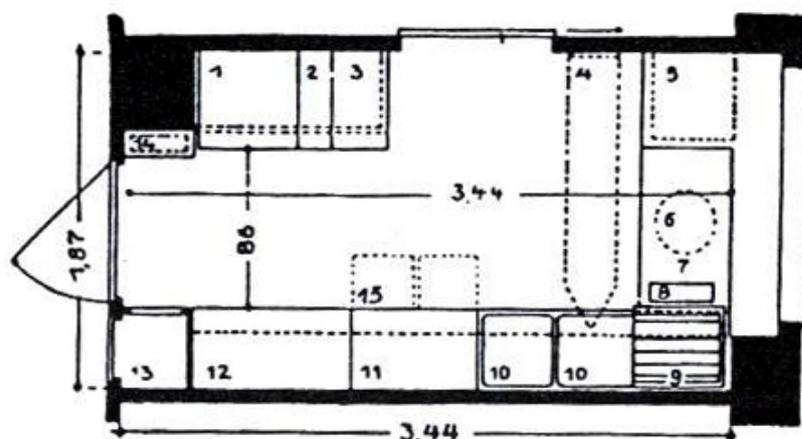


Figure 161: Plan of cooking zone in Frankfurt kitchen

Source: Gerd Kuhn, "Die Frankfurter Küche" in Tilman Harlander, (Ed), Sozialwissenschaftliche Planungsgrundlagen, Institute Housing and Design, University of Stuttgart, Stuttgart, 2001, p. 50.

Margarthe Schütte-Lihutzky applied the basic concept of the scientific management of functions consistently on the Frankfurt apartment types. The path area between the 'Frankfurt kitchen' and the dining table in the living room at the 'normal type' should be not more than 3.2 meters.¹¹⁵

113 Gerd Kuhn, Die Frankfurter Küche, Wohnkultur und kommunal Wohnungspolitik in Frankfurt am Main 1880-1930, Bonn, 1998, p.155. (translated by the author)

114 Gerd Kuhn, "Die Frankfurter Küche" in Tilman Harlander (Ed), Sozialwissenschaftliche Planungsgrundlagen, Institute Housing and Design, University of Stuttgart, Stuttgart, Germany, 2001, p.50. (translated by the author)

115 Gerd Kuhn, Die Frankfurter Küche, Wohnkultur und kommunal Wohnungspolitik in Frankfurt am Main 1880-1930, p.161. (translated by the author)

The design was the result of detailed time-motion studies and the need of future tenants. The wide opening to the living & dining room is separated by a sliding door. This allows the woman to oversee the children or talking with family members in the living room while working in the kitchen.¹¹⁶

The kitchen had a separate entrance in one of the short walls, opposite of the window. Along the left side, the stove was placed. Then a sliding door follows, which connects the kitchen to the dining and living room. On the right wall were cabinets and the sink. In front of the window, there is a working space. There was no refrigerator, but a foldable ironing board was installed (Figure 161). The kitchen cabinets were made of functional and hygienic materials: softwood and plywood units, beech and linoleum surfaces. The prototype of the kitchen was painted monochrome blue due to the fact that flies don't perceive it as solid and are therefore discouraged from landing on the surface. Later models were painted in a wider range of colours, including grey, green, white and blue, after they were installed.

Schütte-Lihotzky incorporated other methods to discourage insects and pests in the kitchen. She recommended oak wood for the flour drawers to repel meal worms, and utilized raised concrete plinths to avoid dirt-catching and insect-attracting nooks and crannies. She designed a wall cupboard for the refuse bin which opened on the kitchen side for rubbish disposal and on the hall side for rubbish removal. Finally, Schütte-Lihotzky's design for the storage cupboards included holes in the doors, and grids instead of boards to facilitate ventilation and thereby prevent mould growth.¹¹⁷

A wooden plate stand served the drying of dishes, the working plate made by metal can be used while cleaning and peeling vegetables. Also the kitchen waste can be thrown from there directly into the garbage. The cooking boxes save the energy of residents which is in relation to the money and time of the people.¹¹⁸

Magarete Schütte-Lihotzky's plan separated the kitchen from the rest of the flat in order to isolate cooking noises and smells (Figure 162). She followed the new trend away from the unhygienic 'eat-in' kitchen to a compact household 'laboratory'. These small rooms were intended to create space for cooking, washing, food storage and ironing, even in the tiniest of flats.¹¹⁹

116 Peter Noever, *Die Frankfurter Küche von Margarete Schütte-Lihotzky*, Berlin, Germany, 1992, p.8. (translation by the author)

117 Melching, *Frankfurt Kitchen: Patina follows function*, available online at: http://www.vam.ac.uk/res_cons/conservation/journal/number_53/frankfurt/index.html, accessed on 10.01.2011.

118 Lihotzky Margarete Schütte, *Warum ich Architektin wurde*, Salzburg, 2004, p.159-160. (translation by the author)

119 Melching, *Frankfurt Kitchen: Patina follows function*, available online at: http://www.vam.ac.uk/res_cons/conservation/journal/number_53/frankfurt/index.html, accessed on 10.01.2011.

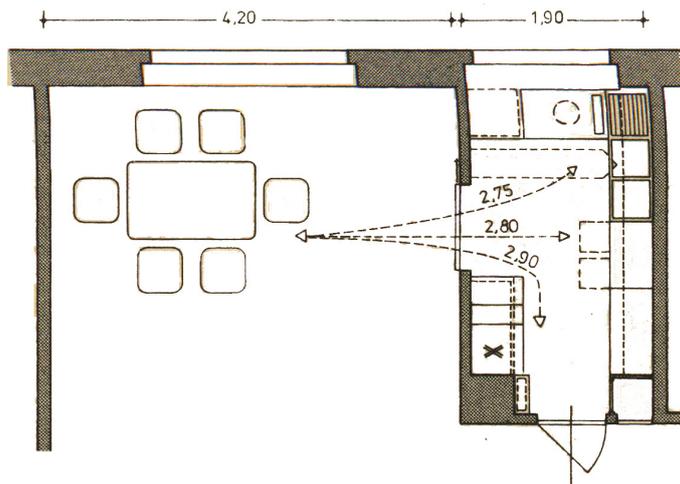


Figure 162: Plan of Frankfurt Kitchen, access to dining area in living room.

Source: Peter Noever, Die Frankfurter Küche von Margarete Schütte-Lihotzky, Berlin, 1992, p. 8.

The working area is functioning well because of giving much light through the window (Figure 163). Organic waste can be pushed directly into a removable garbage box. Right-handed women do not need to cross their hands while washing dishes. To avoid the unnecessary drying of dishes by hands with towels, a frame for drying was fixed, such that they can dry by themselves.¹²⁰



Figure 163: Frankfurt kitchen

Source: By author

According to the demand for reduction of energy and time, Margarete Schütte-Lihotzky chose a rectangular floor plan. In the reaction of the National Research Foundation 'Reichforschungsgesellschaft, (RFG)', the plan of the kitchen had been criticized as being too narrow for the double sided furniture. While entering from the hallway into the kitchen, one could crash directly with the head against the cupboard door if it was currently opened. But also the space was narrow at work, if the cabinets had to be opened partially.

120 Gerd Kuhn, Die Frankfurter Küche, Wohnkultur und kommunal Wohnungspolitik in Frankfurt am Main 1880-1930, Bonn, 1998, p.162-163. (translated by the author)

During the visit of RFG, it was found that the storage containers were placed too low such that the children could pull them out easily. The storage of supplies was also problematic, since the bins opened to the top. Therefore, many women kept their food in the bags. However, the users of these kitchens often had difficulties with them. It was frequently described as it was not flexible enough. The dedicated storage bins often were used for other things than their functions. Another problem with these bins was that they were easily reachable by small children. Schütte-Lihotzky had designed the kitchen for one adult person only, children or even a second adult had not entered the imagination, and in fact, the kitchen was too small for two people to work in.

The followings can be learned from the design of Frankfurt kitchen:

1. Over eighty years ago, the kitchen was conceptualized as a modern laboratory with the performance to work as time and effort saving as possible.
2. The functional requirements of that time were fulfilled by the Frankfurt kitchen.
3. It is a good practical example in the history of housing in Germany after the First World War, especially regarding the saving of time and costs.
4. The design is not only to fulfill the functional requirements but also to create required spaces in which people feel comfortable doing their activities.
5. Moreover, the architect planned for the social communication between mother and children while she is cooking by a sliding door.
6. The architects planned a minimal space with low costs, and at the same time considered the effectiveness of the basic functions for a house wife in the kitchen, such sparing time and efforts.

The points 4,5 and 6 are the main results of the case studies, which may serve as an input for further developments of housing design in contemporary Yangon.

5.2.3. Frankfurt Housing

In Frankfurt since 1890, small apartments for working families were mostly built by urban corporations. These apartments had a kitchen, one or two rooms and a bath and toilet. They were small scale living facilities, and were combined in 3 to 4 buildings with two flats on each floor which is called two spanned apartments.¹²¹

Frankfurt am Main in the 19th century had grown a major industrial and trading center in Germany. Also it had developed to a modern city with cosmopolitan flair. Accordingly, in a few decades, the number of residents in the city had increased. The housing problem with the growth rate of population remained as an unresolved problem. The architecture of housing in Germany, that time was influenced by the ideals of the 'new architecture' of the beginning 20th century.

The concepts of living and the form of the dwelling in new Frankfurt were oriented at the demands of the workers' movement to individual dwelling of the small family. The people wanted areas for families with two to three children, for the activities such as sleeping, eating, washing, and dressing. For the type of the small family, a relatively homogenous routine of the day was supposed, as well as the consideration of work and income of the father. Despite all regularity, the type of small apartment had to give space to various needs. At the beginning of the period of modern architecture, the housing development as an example of the experimental settlements of new building in Frankfurt am Main under Ernst May shows the standardized housing solutions.¹²²

The '*Roman Town*' (Römerstadt) is a residential development of early modernism in Frankfurt am Main. It is located in the southwest of the district Heddernheim. A plot of 32 hectares was designated for the development of the Praunheim and Römerstadt housings. These satellite cities are located within 45 minutes from the center of Frankfurt by public transportation. The areas separating the satellites from the city were reserved for a greenbelt, designed to act as a reservoir of fresh air for the city. Thus, buses travelling from the city to one of its satellites have to pass through about 5 kilometer wide band of open green space. These remarkable planning and construction activities, organized by Ernst May, drew the attention of the whole world to the accomplishments of Frankfurt settlement policies and significantly influenced the course of modern housing planning. Within 5 years between 1925 and 1930, in the context of a modern social democratic planning policy, Ernst May had changed Frankfurt city. The approximately ten major municipal projects provided about 30,000 public housing units. The projects were Roman city (Römerstadt) (Figure 164), Praunheim (Figure 166), Niederrad, Bornheimer Hang, Riederwald, Hellerhof, Westhausen (Figure 167) and Heimatsiedlung.

121 Ernst May and Heinrich Klotz, *Ernst May und das Neue Frankfurt, 1925- 1930*, Berlin, 1986, p. 73.

122 Ernst May and Franz Roeckle, *Das neue Frankfurt, vergessene moderne die Heimatsiedlung*, available online at < <http://www.may-siedlung.de/architektur.htm>>, accessed on 18.01.2011.

Figure 164: Römerstadt, Praunheim and Westhausen housing estate in Frankfurt

Source: By author. Map based on www.googlemap.de, accessed on 25.01.2011



Figure 165: Site plan of Römerstadt housing

Source: Dietrich W. Dreyse, *May- Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930*, Köln, 2001, p. 13.

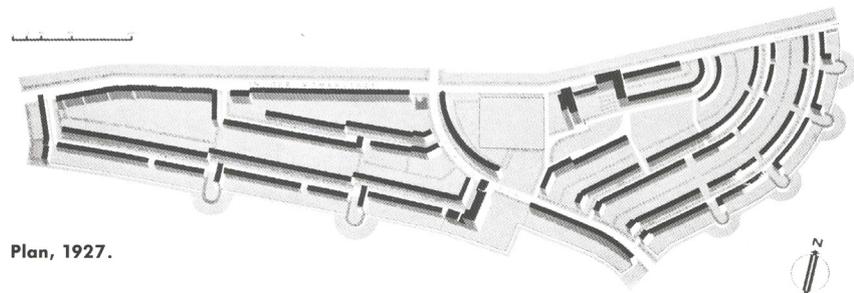


Figure 166: Site plan of Praunheim housing

Source: Dietrich W. Dreyse, *May- Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930*, Köln, 2001, p. 7.

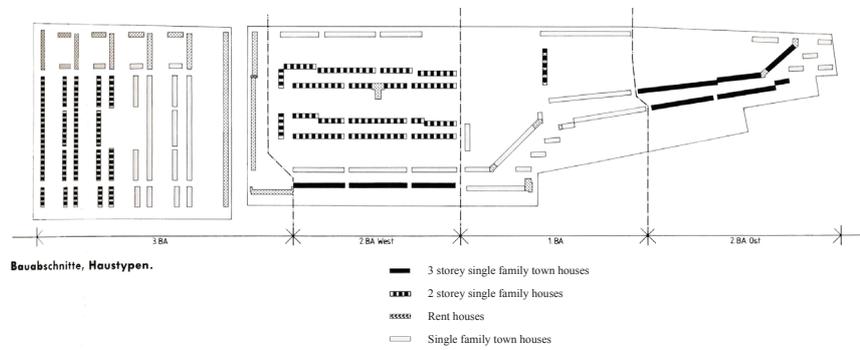


Figure 167: Site plan of Westhausen housing

Source: Dietrich W. Dreyse, *May- Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930*, Köln, 2001, p. 21.



On the one hand they contributed to solve the problems of housing congestion in the early 20th century accompanied by unemployment, and problems of economic needs as consequence of the war in Frankfurt. On the other hand, they introduced the combination of the principle of urban satellites and garden city with the types and shapes of a rationalist architecture. The 'New Frankfurt' from 1925-1930 was a synonym for the practical realization of the social requirements in the new political system of the Weimar Republic.^{123 124}

Among the 8 housing projects in the development of Frankfurt city, 3 housings are selected for the further analysis. They are:

1. Praunheim housing project which is the first planning project of Ernst May
2. Römerstadt as the consequential development next to the Praunheim housing
3. Westhausen which is the last implemented housing project.

*"According to Ernst May's ten-years plan, Frankfurt's housing shortage was to be eliminated completely during the years 1925 to 1935. He also pledged to clear the city of its worst slums and to strictly enforce health and safety regulations in the older parts of the city. During the first years of the program, housing construction actually exceeded the plan. But, in 1929, instead of the 4,000 projected apartments, only 3,650 were actually built. In 1930, it had to be reduced to 2,600 units. The only way to achieve more reductions in cost was to reduce the floor area."*¹²⁵

*"Initially, Ernst May established a floor area of 40 m² as a minimum for an average family household in a minimum dwelling, but already in 1929 it became necessary to build most of the apartments with an area reduced to 36 m² and some even to less than 30 m²."*¹²⁶

He considered the family house to be the most natural and ideal form of dwelling. He explained in full detail the principles of his program. The single family row house became the preeminent housing type which was used in the Frankfurt settlements. May tried as much as possible to use his ideal of the single family house and agreed to include larger multi-family rental houses only under the pressure of economic necessity and the requirements of economy. He rejected the multistory stairwell type, as he considered the balcony accessed type (*Aussengangshaus*) type.

He recognized that the additional cost would be offset by the benefit of each apartment which is having direct access to the open space, an airy balcony, rather than the poorly ventilated and poorly lit corridor of the stair wall type.

123 The Weimar Republic is the name given by historians to the parliamentary republic established in 1919 in Germany to replace the imperial form of government.

124 May and Klotz, Ernst May und das Neue Frankfurt 1925- 1930 (Berlin, 1986), p. 7-9.

125 Karel Teige, The minimum dwelling (Prague, 1932), p. 207-208.

126 Ibid., p. 208.

The floor area norms for a minimum dwelling were originally based on the following factors:

- For a childless couple, the norm was to have an apartment with 2 rooms, that is a bedroom and a living room.
- The norm for a family was to have a three rooms apartment (44 m²) even though the preferred size should have been four rooms.
- It was frequently necessary to accommodate poor families, regardless of the number of children, in one-or-two room apartments.¹²⁷

The Frankfurt housing was essentially based on the principle of low-rise construction. In general, the layout of these apartments consists of a small kitchen, a bath, a living room, and a bedroom. In journal of '*Das neue Frankfurt*', Ernst May explained in full detailed principles of his program. The Frankfurt building program was based on the idea of building small and low rise family houses (Figure 168).



Figure 168: Low rise town houses in Römerstadt housing

Source: By author

Praunheim housing

Praunheim housing (Figure 169) was the first housing planning of new Frankfurt. It was also one of the first experimental housings. All together 1441 houses, with 322 rent houses, 996 owned houses and 123 town houses were planned. 3 storey town houses, 3 storey town houses with basement, two storey houses were implemented in this housing (Figures 170, 171 and 172)

.....
127 Teige, *The minimum dwelling*, p. 208.



Figure 169: Praunheim Housing
Source: By author

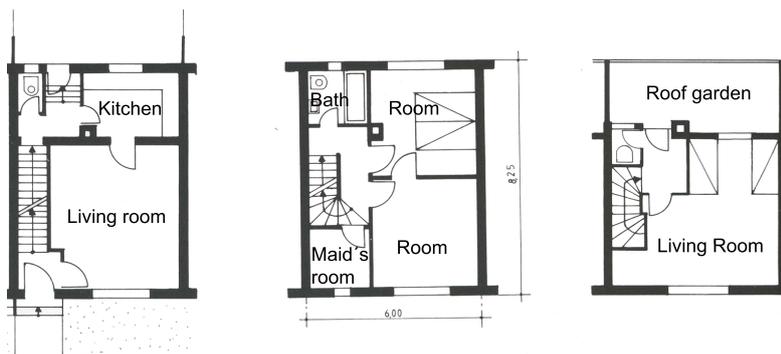


Figure 170: Three storey one family house with 54,5 m² in the terrace housing (Praunheim)

Source: Dietrich W. Dreyse, May-Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930, Köln, 2001, p. 8.

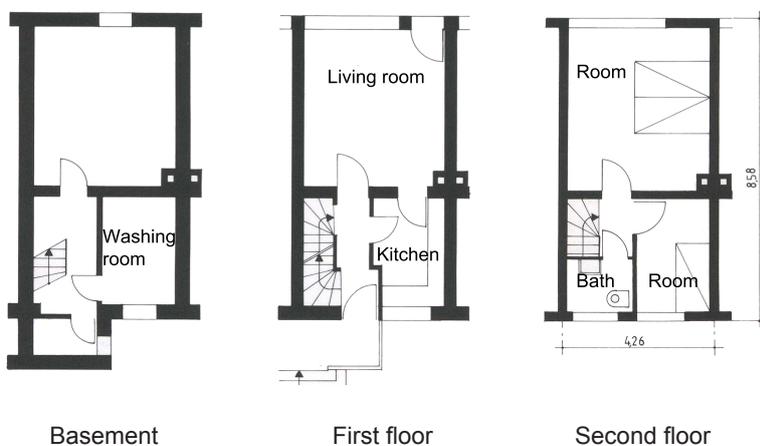


Figure 171: Three storey one family house with basement with 75 m² and 29 m² in the terrace housing (Praunheim)

Source: Dietrich W. Dreyse, May-Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930, Köln, 2001, p. 9.

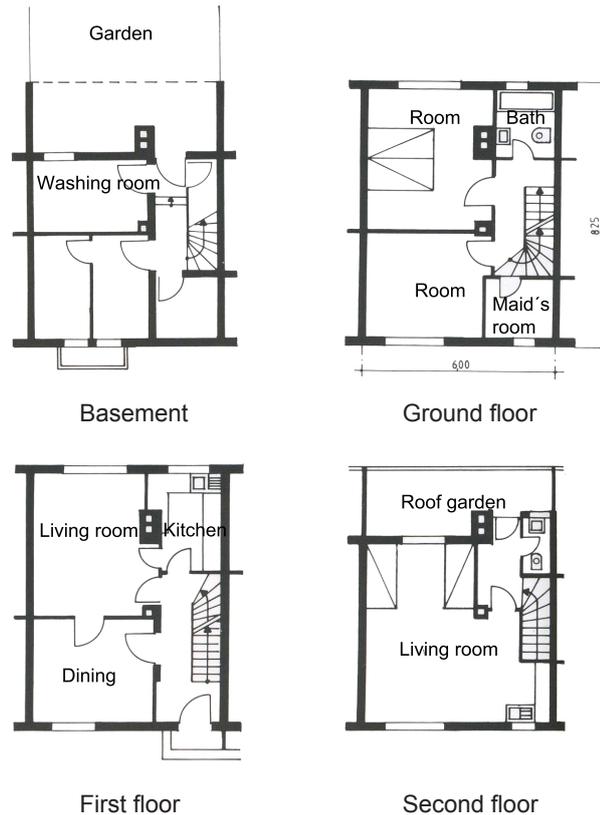


Figure 172: Three storey one family house with 75 m² and 28 m² in the terrace housing (Praunheim)

Source: Dietrich W. Dreyse, *May-Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930*, Köln, 2001, p. 8.

The Frankfurt kitchen was supplied in all houses. Moreover, flexible furniture as well as foldable beds were provided in each apartment.¹²⁸ (Figure 173) The idea of modern housing as a standardized unit designed according to the functional and economic aspects. It is apparent in the development of Ernst May's housing in Frankfurt. The housing planning is completely standardized with small and well functioning spaces. The other important component in the Frankfurt housing is that it is opened to the green spaces. They are the gardens at the front of the houses and the path way behind of the house in order to transport the vegetables as well as to communicate with neighbours.

128 Dietrich W. Dreyse, *May-Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930*, Köln, 2001, p. 10. (translated by the author)

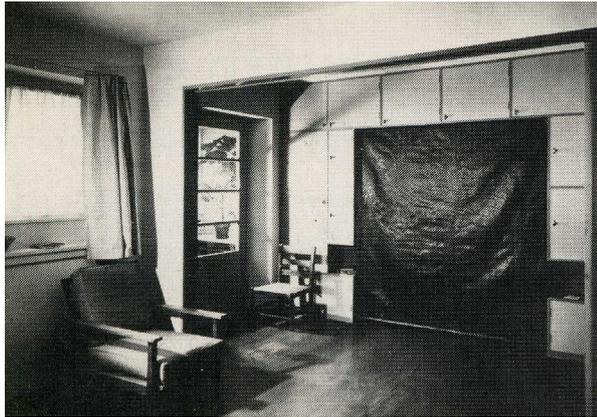
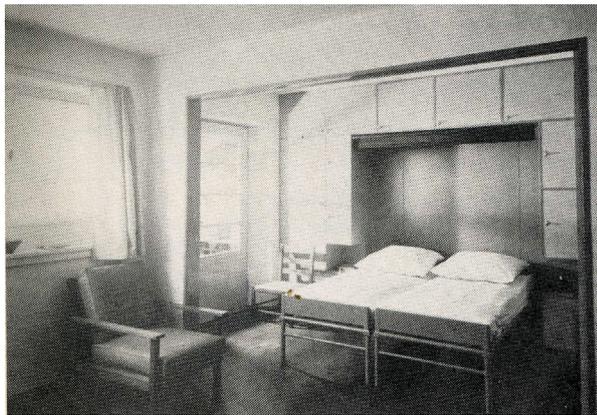


Figure 173: Foldable beds (Praunheim)

Source: Ernst May and Heinrich Klotz, Ernst May und das Neue Frankfurt, 1925-1930 Berlin, 1986, p. 88.



The floor plan of the apartment provided specialized functions, such as sleeping, cooking, eating, washing etc. The areas are determined according to their special functions and are spatially separated. The tight calculation of the functional area should decrease the floor area, such that the construction cost can be cheap. The average 3 room apartment has 65 m² compared to 75 m² (Figure 174). The location of the rooms allowed as much as possible to do the daily activities in a short distance and circulation. The granny apartments afford 3 generations to live together.

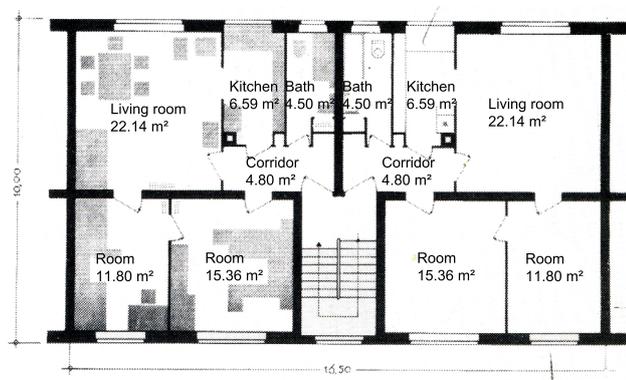


Figure 174: Floor plan of 3 rooms apartment with 65 m² in 1926 (Zick-Zackhausen)

Source: Ernst May and Heinrich Klotz, Ernst May und das Neue Frankfurt, 1925-1930, Berlin, 1986, p. 73.

If one tries to judge on the performance of this type of functional dwelling plans, there are two sides. It makes possible that many families are able to afford housing free from overcrowding and daily conflicts. On the other hand, the housing appears as a straitjacket because it hinders different forms of living together. Since the economic crisis in 1929, 3 rooms dwelling with 48 m² was reduced to the area of 42 m².¹²⁹

Römerstadt housing

Römerstadt housing (Figure 175) was implemented together with Praunheim, Westhausen and Höhenblick housing. The main form is a two storey single family row house with a basement (Figure 176). Public functions such as living, dining and cooking located on the ground floor. Private rooms such as bed rooms are located on the first floor. All rooms get enough ventilation and lighting. However, there is small congestion problem at the circulation path, if the furniture is added at the circulation path as well as in the kitchen (Figure 177). Moreover, the housewives disagreed with the location of the ironing board in the kitchen, because it disturbs entering the cooking area. The bed rooms get morning sun and the living room gets evening sun because each room has one exterior wall (Figure 178).

In the dwelling of Römerstadt, 1220 houses with 1182 rent houses were planned. 581 one family houses were mostly planned with 4 rooms. 50 two-family houses were with 3 to 4 rooms and 551 apartments were provided with 2-3 rooms. Central heating system, bath, Frankfurt kitchen, radio connection, electricity for lighting, warm water and stoves for cooking have been provided in the houses. An apartment for a four-member family includes a bed room for wife and husband, as well as separate rooms for the children.



Figure 175: Römerstadt housing

Source: By author

129 May and Klotz, Ernst May und das Neue Frankfurt, 1925-1930, p. 73-74.

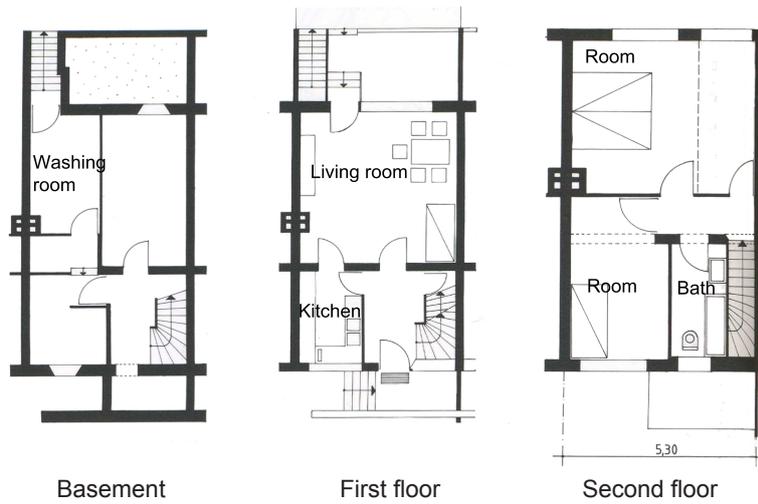


Figure 176: Floor plan of Römerstadt housing

Source: Dreyse, Dietrich-Wilhelm., May-Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930, Köln, 2001, p. 14.



Figure 177: Circulation path

Source: By author

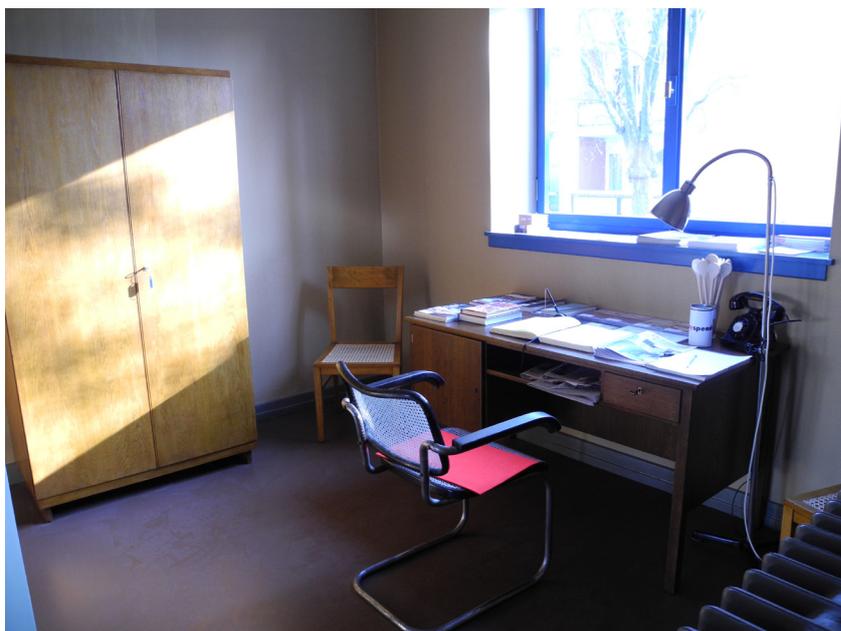


Figure 178: Living room

Source: By author

Westhausen housing

Westhausen housing is the last housing of Ernst May. Compared to the Römertadt and Praunheim housing, more open and green space as well as social communication space such as front corridor was provided. Westhausen housing was considered as a mark between traditional and functional planning. It shows the most radical in uniformity and economy. At the east along the Ludwig Landmann road, three storey apartment houses with an open access system are located (Figure 179).



Figure 179: Front long corridor housing (type 1)

Source: By author

There is another type of apartment in Westhausen housing with front corridor public access and verandah at the back of the unit (Figures 180 and 181).

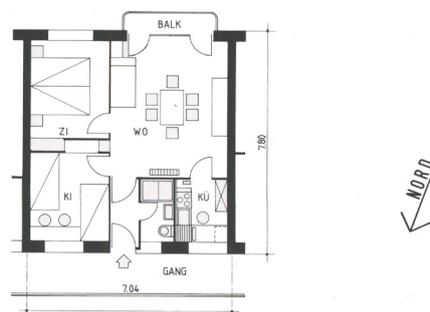


Figure 180: Front long corridor housing (type 2)

Source: Dietrich W. Dreyse, *May- Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930*, Köln, 2001, p. 22.

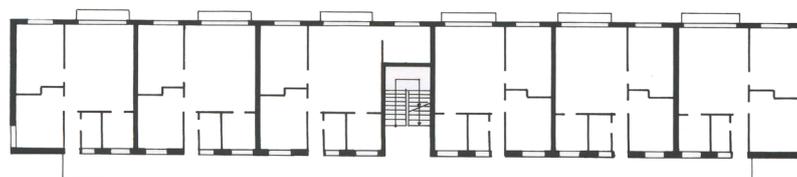




Figure 181: Front corridor type housing

Source: By author

Public space

In the development of housing by Ernst May, there is no homogeneous concept in the opened space. In general, there are three main situations:

1) The development plans are situated in the outskirts of the city. The roads are planned in a traditional and functional way.

2) The new planning of Römerstadt city and the housing planning balance between being schematic and being picturesque.¹³⁰ The southern row houses are located closely to the road in Römerstadt housing. The grass stripe with floral bushes at the northern side supports the shading of the houses. The north-south roads have front gardens. Also there are provided tree covered spaces at the front of the housing. The intention of different functions within the areas and zones was considered.

Aesthetic principles

Although a multiplicity of the architects with different sketches and designs was involved in the development of New Frankfurt housing, there are some basic elements of the architecture. They are:

- The simple cube made of concrete for canopies, walls and balconies.
- The flat roof
- The rectilinear line of apartments
- The suspense proportions from closed to opened walls
- The horizontal windows¹³¹

130 May and Klotz, Ernst May und das Neue Frankfurt, 1925-1930, p. 76.

131 Dietrich W. Dreysse, May-Siedlungen, Architekturführer durch acht Siedlungen des neuen Frankfurt 1926-1930, Köln, 2001, p. 5. (translated by the author)

5.3. Summary

Summarizing the study of '*New Frankfurt*' housing, the following facts are concluded:

- The floor plans of apartments and town houses are designed under the functional point of view as well as the economical point of view providing minimal spaces.
- Rooms have good ventilation and lighting due to the consideration of length and width of the building.
- A front garden at each house is provided as an open green space as well as a space for social communication with neighbours.
- Foldable beds are provided for a double-used function in the living area.
- However, there are some problems of circulation space due to the minimization.
- A sliding door is installed between dining and cooking area. From the dining area, there is a direct access to the garden at the back of the house. The composition of spaces is functionally well designed.
- Seeing the open access system with the front corridor and open common staircase in the Westhausen project, apparently the ongoing design of the Frankfurt housing to a certain degree was developed with regard to the possibilities of social communication.

5.4. Consideration about input for Yangon housing

In the previous sections (5.1), (5.2) and (5.3), cases of German housing after the First World War are taken which can be compared with the present situations of Yangon housing with respect to the high demand for housing and rare economic resources. Some hints can be extracted out in order to apply them as potential inputs for the development of housing in Yangon.

(1) Plans of minimum apartments

Due to the shortage of housing and poor economic resources after the First World War, the architects developed designs of minimal apartments. These ideas can be applied for the current problems of Yangon housing. The following facts can be learned from the minimum apartments in the CIAM conference:

- Using folding beds to provide double functions in the small apartments.

- A very compact arrangement of functional spaces without long circulation pattern.
- Open long corridor with semi-open space was provided where the people could communicate with each other and with neighbours.
- Foldable partitions which could extend the space in the day time for multi- functions and support the sleeping function at the night time.

(2) Frankfurt kitchen

Frankfurt kitchen was implemented with the aim of minimizing the circulation area for the housework for women, who had to balance their household chores and jobs outside the house. Although it is a small room with the area of 6.5 m², it supports a good quality of arranging the equipment for cooking function. It fulfills two objectives: to optimize kitchen work and to be cheaper in buildings with equipped kitchens. The following factors are observed as potential input for the kitchen in Yangon.

- Minimum space is provided.
- Well arrangement of equipment can support a well function for a house wife, who can save time for cooking.
- Good ventilation and lighting are provided from a wide window and the door from the entrance.
- A sliding door is installed in between cooking and dining area which is also used as children studying area. It is a positive fact when the mother is cooking, she can look after the children's activities (e.g. playing, studying, etc.).
- For a housewife, who has a job outside the house and can't spend much time in cooking, this kitchen is optimal design for quick preparation of foods.

(3) Frankfurt housing

Frankfurt housings were carried out regarding the working families. The apartments have a kitchen, one or two rooms, a bath and a toilet. There are some features which can be used as inputs for the recommendations of the housing development in Yangon.

- The central and tight circulation pattern was decided regarding a cheap construction cost.
- Open access system with front corridor and open common staircase system supports the social communication.

- Rooms have good ventilation and lighting due to the consideration of length and width of the building.
- In the apartment, the flexible usages of foldable beds, sliding doors and foldable partitions are applied. By such measures, double functions are implemented in Frankfurt housing and the required space is minimized.

6.

RECOMMENDATION AND PROPOSALS



CHAPTER 6: Recommendations and Proposals

The reason to analyze the deficiencies in chapter 4 and to look for transferable solutions in Germany was to provide improvements for Yangon housing planning. Therefore, in this last chapter it is tried to draw consequences out of the deficiencies and hints in the previous works.

The recommendations are presented partially in written form, and partially, also to specify them in an exemplary way, in form of graphic proposals. The better consciously are hold as abstract and schematic as possible. The elaborated solutions should be still task of architects or planning agencies, but if possible, on the basis of the results presented here. They are ordered according to the main sub-sections of chapter 4.

6.1. Recommendations with respect to functional performance

With respect to the functional performance, there are mainly two factors:

- Adequacy of functional area and
- Sufficiency of area.

6.1.1. Adequacy of functional area

Deficiencies and recommendations with respect to the adequacy of functional area is described in Table 24.

Aspect	Deficiency	Recommendation
- Adequacy of functional area	<p>In the case of hall type</p> <ul style="list-style-type: none"> - Access area is used not only for accessing, but also for communication and service area - The multi-functional hall has not an ordered mixture of private and public functions. 	<ul style="list-style-type: none"> - Access should enable to reach each function easily. - Public / private function should be clearly defined.

To continue -

Aspect	Deficiency	Recommendation
<p>- Adequacy of functional area</p>	<p>- There are some difficulties to see while the guest comes into the house when housewife cooks in the kitchen which is at the back of the house.</p> <p>In the case of room type</p> <p>- A mixture of public and private functions can happen due to the composition of space.</p>	<p>- The kitchen should be located near by the primary entrance door of the apartment.</p> <p>- Dining area should be located in a combined living/dining room or dining/kitchen room or living/ dining and kitchen room.</p> <p>- Living area should be accessible from the main entrance door without passing through private areas.</p> <p>- Sleeping area of the unit should be located away from the living & working area for its privacy.</p> <p>- Bathroom should be conveniently accessible from all rooms of the apartments. For the units where two baths are provided, one bath may open directly from the master bed room and another bath may be used for the public.</p> <p>- Stairway should be located in close proximity to the primary entrance door of the unit.</p> <p>- Circulation should be centralized to provide access to the spaces without disturbing by passing through other spaces.</p>

Table 24: Recommendations with respect to the adequacy of area

Source: By author

6.1.1.1. Schematic proposals with respect to the adequacy of functional area

In this part, possibilities of zoning and functional relation as well as proposals for multi-functional hall, sleeping and service areas are developed.

(I) Possibilities of zoning diagram

Three alternatives of zoning diagrams are proposed. There are differentiated three main zones. They are access zone, public zone and private zone. The access zone is found as the entrance area or shoe leaving area. In the public area, there are living, dining, kitchen, bath and WC, and veranda. In the private area, the private functions such as sleeping, praying and working area are included.

Possibility (I.a)

The zones are clearly defined as a vertical linear pattern.

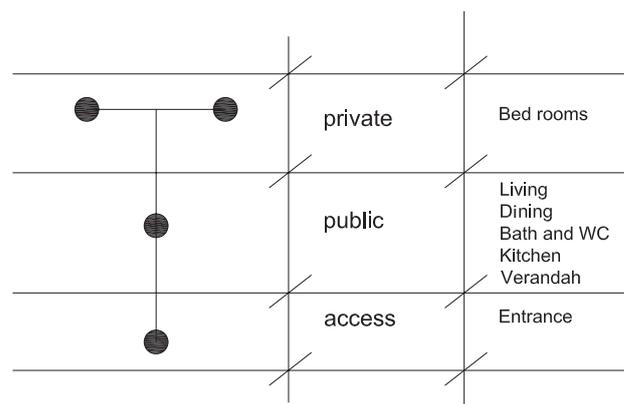


Figure 182: Possibility (I.a)

Source: By author

Advantages:

- Due to the clear classification of the public and private zones, the residents can do their daily activities without distortions by the mixture of private and public functions.
- By locating the public area near by the entrance, the residents can know easily when the guest comes into the house.

Disadvantages:

- This diagram forms linear zoning diagram. Due to this diagram, the access system might be the corridor long way access system. Although this access system is good for social communication, there can be some disturbances.

Possibility (I.b)

Access, public and private zones are clearly defined.

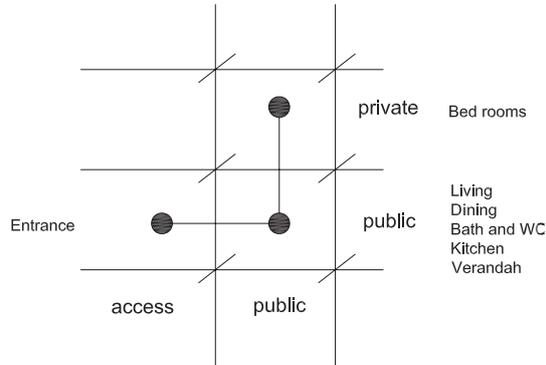


Figure 183: Possibility (I.b)

Source: By author

Advantage: There is no mixed function in between public and private zone.

Possibility (I.c)

The circulation path is centralized between public and private areas.

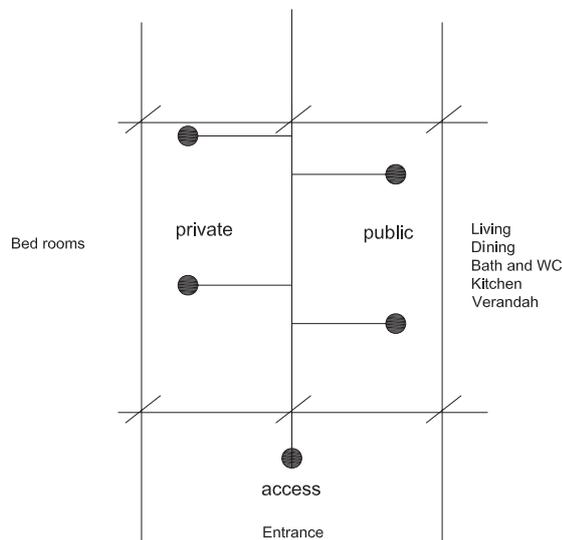


Figure 184: Possibility (I.c)

Source: By author

Advantage: Public and private zones are defined clearly. Access system which is the central circulation pattern between public and private areas is clearly located.

(II) Possibilities of multi-functional hall

In the case of multi-functional hall, 6 possibilities can be accepted.

Possibility (II.a)

Combination of living and dining, separation with kitchen

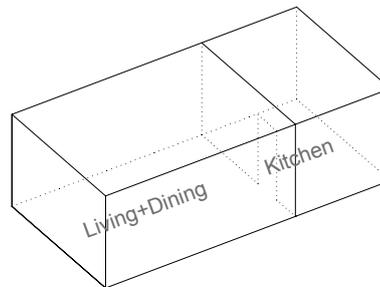


Figure 185: Possibility (II.a)

Source: By author

Advantage: Separation between living/dining hall and cooking is good when someone has to cook strong smelled curries in the kitchen. The people can close the door in order to avoid it from the kitchen.

Disadvantage: When the residents need more space for their activities, the fixed walls may be disturbing.

Possibility (II.b)

Separation with sliding door between living area and dining, kitchen area.

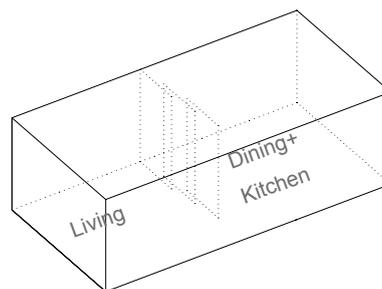


Figure 186: Possibility (II.b)

Source: By author

Advantage: The sliding door can support the flexible use of functions.

Disadvantage: When the people need some private activities such as praying or studying, there may be a weakness of acoustic because of the sliding partitions.

Possibility (II.c)

Separation with furniture between living area and dining, kitchen area

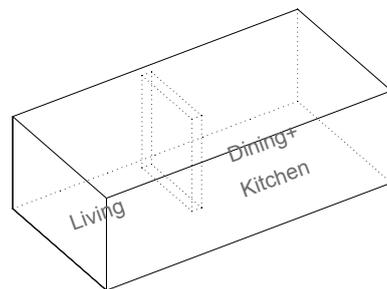


Figure 187: Possibility (II.c)

Source: By author

Advantage: Due to the movable furniture, the space can be used as a hall when the people need more space for the activities.

Disadvantage: There can be partially visual & acoustical problems.

Possibility (II.d)

Combination of dining and kitchen separation with living

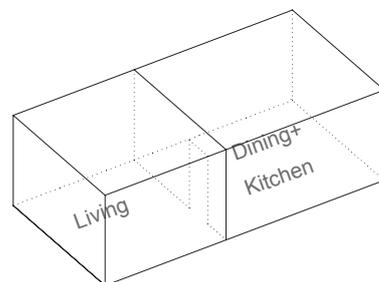


Figure 188: Possibility (II.d)

Source: By author

Advantage: Due to the separation between living area and dining, kitchen area, the residents can do their activities in two different places. When someone receives the guests in the living area, the children or another one can do other activities in the dining area.

Disadvantage: For the social activities in the house such as donation the monks or some celebration, there may be the lack of more space because of fixed space defined by walls.

Possibility (II.e)

Separation between living, dining and kitchen area by folding partitions

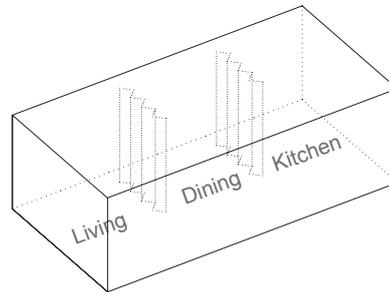


Figure 189: Possibility (II.e)

Source: By author

Advantage: The folding partitions can supply a wide and flexible space for the activities.

Disadvantage: There can be visual and acoustical problems due to the material of partitions.

(III) Possibilities of sleeping area

Four schemas are possible for the sleeping area. Each possibility can be decided depending on the residents' desire and their needs.

Possibility (III.a)

Fixed walls separation in between the multi-functional hall and sleeping area.

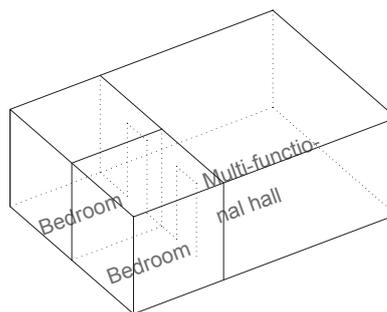


Figure 190: Possibility (III.a)

Source: By author

Advantage: Sleeping area is clearly separated from multi-functional hall. There is no disturbance between public and private area.

Disadvantage: For the small apartments which have less total floor area, the fixed 2 bed room area may have problem for the public activities.

Possibility (III.b)

One bed room with fixed wall, and another sleeping area is defined by sliding partition.

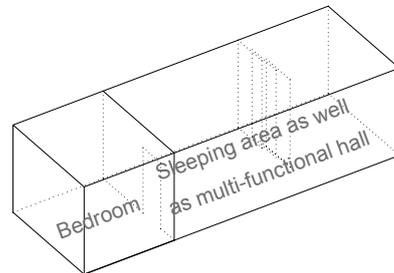


Figure 191: Possibility (III.b)

Source: By author

Advantage: One bedroom which is supplied with the sliding partition can be double used function at the day and night time. When the people need more space for their activities at the day time, one bedroom area can be used by sliding the partitions.

Disadvantage: Sleeping area with sliding walls can have acoustic problem.

Possibility (III.c)

Sleeping space is defined by folding partitions.

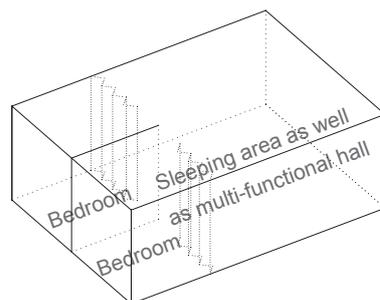


Figure 192: Possibility (III.c)

Source: By author

Advantage: Flexible space can be provided when the people need more space.

Disadvantage: There can be acoustic problems when the residents need private time and space.

Possibility (III.d)

Sleeping areas are defined by the sliding doors.

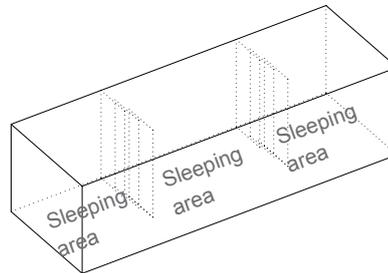


Figure 193: Possibility (III.d)

Source: By author

Advantage: Flexible space can be provided when the people need more space.

Disadvantage: There can be acoustic problems when the residents need private time and space.

(IV) Possibilities of service area

The following possibilities are considered for the service area.

Possibility (IV.a)

Service area is between multi-functional hall and bed rooms

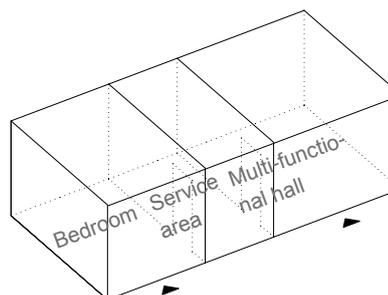


Figure 194: Possibility (IV.a)

Source: By author

Advantage: Service area can be accessed easily from the both public and private area.

Disadvantage: The location of service area can bring disturbance to the private area.

Possibility (IV.b)

Service area is accessible easily from the multi-functional hall and bedrooms.

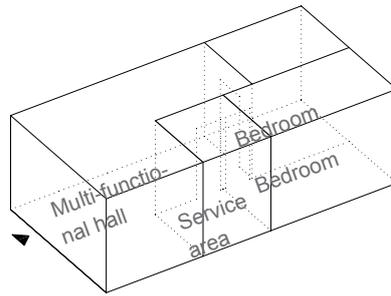


Figure 195: Possibility (IV.b)

Source: By author

Advantage: It is easy accessible from private and public area.

Possibility (IV.c)

Service area is near by living and dining area. Also it is near by the sleeping area

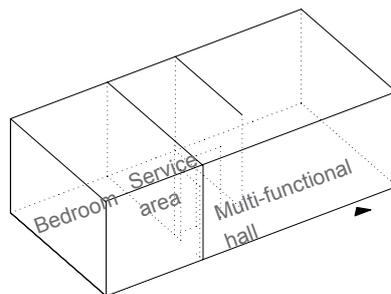


Figure 196: Possibility (IV.c)

Source: By author

Advantage: It is easy accessible from private and public area.

Disadvantage: The location of service area can sometimes bring disturbance to the private area.

Possibility (IV.d)

One private service area is supplied in the master bed room. The other service area is easily accessible from the living hall. Also it is near by the bedrooms.

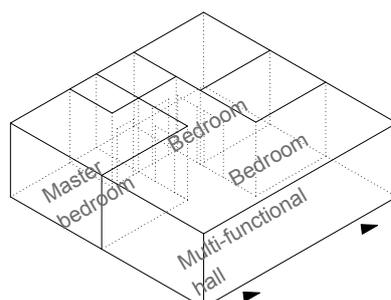


Figure 197: Possibility (IV.d)

Source: By author

Advantage: The service area is easily accessible from the bed rooms as well as from the living area. By providing the two service areas side by side, the cost for the water supply system can be more economical than providing them at different places.

6.1.2. Sufficiency of area

The following table presents the deficiencies and recommendations regarding the sufficiency of area.

Aspect	Deficiency	Recommendation
- Comparative study of occupancy rate in the selected cases.	- 4 to 7 members family are mostly found in the apartments which are designed for maximum 4 person.	- Sleeping area should be designed for 5 to 7 person families.
- Sufficiency investigation by the minimum space standard of selected cases and UN.	- More than 4 person families have a shortage of bed room.	- Double used functional area should be decided.
- Sufficiency investigation by person/ room.	- In two bed rooms apartment, more than one person use the bed rooms when the bedroom 1 has 8.4 m ² , and bedroom 2 has 9.3 m ² .	
- Sufficiency area by comparison: Time Saver Standard with factual states	- In the hall type apartments, there are space shortage problems in the hall room for more than 4 person families. - Kitchen / dining area is less than the standard. - In two bedrooms apartment, the public area such as living, dining and cooking area are less than the standard, while sleeping areas are more than the standard.	- The area of multi functional hall should be larger or flexible for the residents' activities. - The service area as well as the multi-functional area should be planned for the people's activities in the hall type apartment. Public area should be larger or flexible used for multi- purposes.

To continue -

Aspect	Deficiency	Recommendation
- Sufficiency of area by the comparison of combined functional area: Time Saver Standard and the factual states	<p>- In three bedroom apartment, the semi - opened and communicative area are less than the standard. even though all the public area & private area in the apartment reach the standard.</p> <p>-The combined area living / dining and living / dining / kitchen in two bed rooms apartments as well as 3 bed rooms apartments are less than the standard.</p>	<p>- Semi-opened area such as foyer, balcony or landing area should be planned larger for the social communication of residents.</p> <p>- The public and semi-public area such as living / dining, living / dining / kitchen and dining / kitchen areas should have enough area.</p>

Table 25: Recommendations with respect to the sufficiency of area

Source: By author

(V) Proposed area requirements for activities and functional spaces

The required areas for each space are proposed based on the peoples' activities, kinds of furniture and their sizes, and circulation area. The proposed area of each function is shown in the following table. The proposed area is calculated for at least 4 people for the group activities, and for one person for individual activity. To propose area requirements for people's activities, it is required to state the minimum area for each activity. The proposed areas in table 26 represent the single functions. These proposed areas can be overlapped according to the time and activities.

Space	Activities	Proposed minimum area requirements (approximately)
Living	Family gathering	~ 80 ft ² (7.4 m ²)
	Receiving guests	
	Family social activities	
	Dining (individual, with family)	~ 79 ft ² (7.3 m ²)
	Sleeping (for one or two person)	~ 80 ft ² (7.4 m ²)
	Worshipping	~ 72 ft ² (6.7 m ²)
	Reading or studying	~ 49 ft ² (4.6 m ²)

To continue -

Space	Activities	Proposed minimum area requirements (approximately)
Dining / Kitchen	Dining function (for 4 person) Cooking, dining and food preparation	~ 68 ft ² (6.3 m ²) ~ 92 ft ² (8.5 m ²)
Bedroom	Sleeping and relaxing Working Family gathering Wearing make up (by chair sitting style) (by floor sitting style) Dressing	~ 75 ft ² (two person) (7 m ²) ~ 35 ft ² (one person) (3.3 m ²) ~ 25 ft ² (2.3 m ²) ~ 50 ft ² (4.6 m ²) ~ 15 ft ² (1.4 m ²) ~ 16 ft ² (1.5 m ²) ~ 9.5 ft (2.9 m)
Front verandah	Reading Guest receiving Clothing	~ 18 ft ² (1.7 m ²) ~ 65 ft ² (6 m ²) ~ 12 ft ² (1.1 m ²)
Back verandah	Cooking Clothing	~ 20 ft ² (1.9 m ²) ~ 12 ft ² (1.1 m ²)
Bath and water closet	Bathing Cleaning Wasting Washing	~ 35 ft ² (3.3 m ²)

Table 26: Proposed area requirements for activities and functional spaces

Source: By author

(VI) Proposed area for each space

The required area is proposed for each space. Standards for residential areas are proposed on the basis of analysis of sufficiency of areas. The following spaces are recommended by evaluating the analyses of sufficiency areas.

Space	Household Number			
	4 person	5 person	6 person	7 person
Living	140 ~ 150 ft ² (13 ~ 14 m ²)	150 ~ 160 ft ² (14 ~ 15 m ²)	160 ~ 170 ft ² (15 ~ 16 m ²)	165 ~ 175 ft ² (15.3 ~ 16.2 m ²)
Dining	60 ~ 68 ft ² (5.6 ~ 6.3 m ²)	70 ~ 75 ft ² (6.5 ~ 7 m ²)	80 ~ 85 ft ² (7.4 ~ 7.9 m ²)	85 ~ 90 ft ² (7.9 ~ 8.4 m ²)
Kitchen	45 ~ 50 ft ² (4.2 ~ 4.6 m ²)	60 ~ 75 ft ² (5.6 ~ 7 m ²)	75 ~ 85 ft ² (7 ~ 7.9 m ²)	85 ~ 95 ft ² (7.9 ~ 8.8 m ²)
Master bedroom	120 ~ 130 ft ² (11 ~ 12 m ²)	130 ~ 140 ft ² (12 ~ 13 m ²)	140 ~ 150 ft ² (13 ~ 14 m ²)	150 ~ 160 ft ² (14 ~ 15 m ²)
Bedroom (Single)	100 ~ 110 ft ² (9.3 ~ 10.2 m ²)	110 ~ 120 ft ² (10.2 ~ 11 m ²)	120 ~ 130 ft ² (11 ~ 12 m ²)	130 ~ 140 ft ² (12 ~ 13 m ²)
Shrine	30 ~ 35 ft ² (2.8 ~ 3.3 m ²)	40 ~ 50 ft ² (3.7 ~ 4.6 m ²)	50 ~ 60 ft ² (4.6 ~ 5.6 m ²)	60 ~ 70 ft ² (5.6 ~ 6.5 m ²)
Bath & WC	35 ~ 40 ft ² (3.3 ~ 3.7 m ²)	40 ~ 50 ft ² (3.7 ~ 4.6 m ²)	50 ~ 65 ft ² (4.6 ~ 6 m ²)	65 ~ 75 ft ² (6 ~ 7 m ²)
Foyer (Entrance space)	9 ~ 12 ft ² (0.8 ~ 1.1 m ²)	9 ~ 12 ft ² (0.8 ~ 1.1 m ²)	12 ~ 15 ft ² (1.1 ~ 1.4 m ²)	12 ~ 15 ft ² (6 ~ 7 m ²)
Back Verandah	16 ~ 20 ft ² (1.5 ~ 1.8 m ²)	30 ~ 42 ft ² (2.8 ~ 3.9 m ²)	40 ~ 45 ft ² (3.7 ~ 4.2 m ²)	40 ~ 45 ft ² (3.7 ~ 4.2 m ²)
Front Verandah	40 ~ 50 ft ² (3.8 ~ 4.6 m ²)	60 ~ 75 ft ² (5.6 ~ 7 m ²)	75 ~ 80 ft ² (7 ~ 7.4 m ²)	80 ~ 85 ft ² (7.4 ~ 7.9 m ²)
Landing	30 ~ 40 ft ² (2.8 ~ 3.7 m ²)	50 ~ 60 ft ² (4.6 ~ 5.6 m ²)	60 ~ 70 ft ² (5.6 ~ 6.5 m ²)	70 ~ 80 ft ² (6.5 ~ 7.4 m ²)
Fire Escape	20 ~ 30 ft ² (1.9 ~ 2.8 m ²)	35 ~ 45 ft ² (3.3 ~ 4.2 m ²)	45 ~ 50 ft ² (4.2 ~ 4.6 m ²)	50 ~ 55 ft ² (4.6 ~ 5.1 m ²)
Total	645 ~ 735 ft ² (60 ~ 68.3 m ²)	785 ~ 900 ft ² (73 ~ 84 m ²)	925 ~ 1065 ft ² (86 ~ 99 m ²)	990 ~ 1085 ft ² (92 ~ 101 m ²)

Table 27: Proposed area for each space

Source: By author

(VII) Proposed area for combined space

As shown by the analyses of selected cases, combinations of spaces are possible. The proposed minimum area of combined space is shown in the following table. The areas are considered for 4 to 7 person families according to the findings in the selected cases. The numbers represent the areas of rooms. The proposed functional areas (Table 28) can be overlapped at the proposed combined spaces.

Combined spaces	Minimum room size for combined spaces			
	4 person	5 person	6 person	7 person
Living + Dining	180 ~ 200 ft ² (16.7 ~ 18.6 m ²)	200 ~ 220 ft ² (18.6 ~ 20.4 m ²)	220 ~ 240 ft ² (20.4 ~ 22.3 m ²)	240 ~ 260 ft ² (22.3 ~ 24 m ²)
Dining + Kitchen	100 ~ 120 ft ² (9.3 ~ 11 m ²)	120 ~ 140 ft ² (11 ~ 13 m ²)	140 ~ 160 ft ² (13 ~ 15 m ²)	160 ~ 180 ft ² (15 ~ 16.7 m ²)
Living+Dining+Kitchen	240 ~ 260 ft ² (22.3 ~ 24 m ²)	260 ~ 280 ft ² (24 ~ 26 m ²)	280 ~ 300 ft ² (26 ~ 27.9 m ²)	300 ~ 320 ft ² (27.8 ~ 29.7 m ²)
Living+Dining+Sleeping	320 ~ 340 ft ² (29.7 ~ 31.5 m ²)	340 ~ 370 ft ² (31.5 ~ 34.4 m ²)	360 ~ 390 ft ² (34.4 ~ 36.2 m ²)	380 ~ 400 ft ² (35.3 ~ 37.2 m ²)
Living+Sleeping	240 ~ 260 ft ² (22.3 ~ 24 m ²)	260 ~ 280 ft ² (24 ~ 26 m ²)	280 ~ 310 ft ² (26 ~ 28.8 m ²)	300 ~ 320 ft ² (27.8 ~ 29.7 m ²)

Table 28: Proposed area for combined spaces

Source: By author

6.2. Recommendations with respect to social performance

The deficiencies of social performance and the respective recommendation present in the following table.

Aspect	Deficiency	Recommendation
<p>Social activities and spaces</p> <p>The suitability of available space for social contact between members of family.</p>	<p>In hall type apartment</p> <p>- Hall way has not enough privacy for some activities (especially, sleeping and studying)</p>	<p>- Public & private space should be clearly defined for social and individual activities.</p> <p>In this case, possibility (II.a) and (II.d) in the possibility of multi-functional area, and possibility (III.a) and (III.b) in the possibility of sleeping area can be accepted.</p>

To continue -

Aspect	Deficiency	Recommendation
<p>Social activities and spaces</p> <p>- The suitability of available space for social contact between members of family and visitors.</p>	<p>In room type apartment</p> <p>- Residents have to use sometimes staircase area for their social communication</p> <p>- The mixture of public and private spaces disturbs people's individual needs.</p> <p>- Fire escape, stair case and verandah have to be used for social communication between the residents and neighbours as well as the visitors.</p>	<p>- Public & private space should be clearly defined for social and individual activities. In this case, possibility (II.a) and (II.d) in the possibility of multi-functional area, and possibility (III.a) and (III.b) in the possibility of sleeping area can be accepted.</p> <p>- Living area needs to be provided by reducing the sleeping area. In fact, it doesn't mean that the private area should be reduced. However, it should be planned for double used functions by providing flexible partitions. (see possibility (II.b) (II.c) and (II.e) in the possibility of multi-functional hall, and possibility (III.b), (III.c) and (III.d) in the possibility of sleeping area)</p> <p>- More open and semi-open spaces such as verandah, balcony or open corridor way should be provided sufficient area relevant to the communication activities.</p>

Table 29: Recommendations with respect to social performance

Source: By author

6.3. Recommendations with respect to cultural performance

The deficiencies of cultural performance and the respective recommendation shows in the following table.

Aspect	Deficiency	Recommendation
- Providing space for praying (shrine space)	<p>Hall type apartment</p> <ul style="list-style-type: none"> - There is no planned space for shrine in hall type apartment. - The residents try to place the shrine in the living room or sleeping area or sometimes, at verandah. <p>Room type apartment</p> <ul style="list-style-type: none"> - The mixture of entertainment and praying function is found in the living room. 	<ul style="list-style-type: none"> - Shrine should be planned in multi-functional hall such that the people can use this area when they want to pray or invite and donate the monks, as the budhism activities. In this case, the possibility (II.b), (II.c), (II.e), (III.b), (III.e), (III.d) can be accepted. - Shrine space should be specified near by the public area such as living and dining , however it should be separated partially when someone wants to pray.
- Providing space for leaving shoes and slippers	<ul style="list-style-type: none"> - People try to serve the shoe leaving space near by the entrance by themselves even though Myanmar has a strong culture of leaving shoes before entering the house. 	<ul style="list-style-type: none"> - Entrance space should be provided before entering the main house, such that the shoes and slippers can be placed there.

To continue -

Aspect	Deficiency	Recommendation
- Providing space for donating activities	- There can be some disturbance by the mixture of cultural activities and private activities in the hall type apartment.	- This space should be considered to better function for the residents' cultural activities.

Table 30: Recommendations with respect to cultural performance

Source: By author

6.4. Recommendations with respect to indoor environmental quality

6.4.1. Natural ventilation

The following table shows the deficiencies of indoor environmental quality and the respective recommendations with respect to natural ventilation.

Aspect	Deficiency	Recommendation
- Window location and air flow through system	<p>Hall type apartment</p> <p>- Due to the narrow and long form of the apartment, there is some disturbance for the airflow system, if the partitions are added for the private functions.</p>	- The narrow and long proportion of the apartment should be avoided.
- Orientation of building	<p>- East - west orientation with the wind from south-east is bad.</p> <p>- West orientation is bad for this type of building.</p>	- The building should be oriented properly according to the wind direction.

To continue -

Aspect	Deficiency	Recommendation
- Orientation of building	<p>Room type apartment Duplex apartment</p> <p>- Only the apartment at south edge of the building can get very good ventilation. The other apartments can only have a minor one by oblique wind.</p> <p>- Only one apartment of the south part of the building can get good ventilation when the building orients to the west.</p>	- The building should be oriented properly according to the wind direction.
- Window location and air flow through system	<p>Four unit central stair type</p> <p>- Poor air flow at the living area due to the location of windows.</p> <p>- Living area has a weak ventilation.</p>	- Location of window should be considered in the living area.
- Floor area and opening area	- Wind shadow happens at the back side of the apartments	- Spatial composition of living area should be decided with respect to the adequate ventilation.
- Form of building	- Due to the form of building, one apartment has always wind shadow.	- Form of building and unit combination should be planned with respect to a good ventilation in the units.

To continue -

Aspect	Deficiency	Recommendation
- Orientation of building	<ul style="list-style-type: none"> - The apartments at the north-west of the building will get wind shadow. - Due to the building position and perpendicular wind direction, two apartments behind the two front apartments cannot get enough ventilation. - Poor ventilation in the kitchen and dining room because there is only one window on the external wall, which faces to the neighbour's apartment. <p>Central corridor type</p>	- An adequate opening area should be decided in such a ratio of each room's floor area.
- Window location and air flow through system	<ul style="list-style-type: none"> - Cooking and dining can have only a little ventilation from the central corridor. - Master bedroom has only one small external opening. - The rooms at the side of the deep and narrow void ,which is in between two apartments, can get only poor ventilation. 	- An adequate opening area should be decided in such a ratio of each room's floor area.
- Orientation of building and wind direction	- Because of the form and orientation of building, only one half of the building can get good ventilation in every wind direction.	- The combination of unit and form of building should be decided according to the wind direction.

Table 31: Recommendations with respect to natural ventilation

Source: By author

6.4.2. Natural lighting

The following table shows the deficiencies of indoor environmental quality and the respective recommendations with respect to natural lighting.

Aspect	Deficiency	Recommendation
	Hall type apartment	
- Relation of floor area to opening area	- By the minimum day lighting standard, living hall has not enough lighting.	- Size and number of opening according to the floor area of each room should be planned.
- Relation window size and width to room area	- One third of living hall is dark.	
- Room depth	- Only 4.6 m length in the living hall which has 9 m length can get good lighting.	
- Orientation of building	- When the building orients to the South, and due to the amount of sun in Yangon, it is a bad point that the building can receive only almost 3 hours a day in June.	
	Room type apartment	
- Relation of floor area to opening area	- Master bedroom has poor lighting. It is less than the standard. - master bedroom hasn't enough lighting.	- Size and number of opening according to the floor area of each room should be planned.

Table 32: Recommendations with respect to natural lighting

Source: By author

6.4.2.1. Schematic proposals with respect to natural lighting

In this section, possibilities of orientation of spaces in apartment and composition of building with respect to natural lighting are developed as schematic proposals.

VIII. Schematic proposals for the orientation of spaces

There are 3 possibilities to recommend the orientation of spaces in the apartments. They are decided according to function and the need of lighting and ventilation. However, the advantage and disadvantage of each proposal such as being attainable of lighting and being available of ventilation can depend on the form of building.

Possibility (VIII.a)

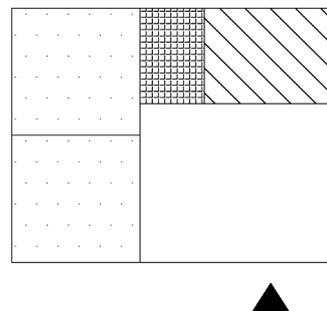
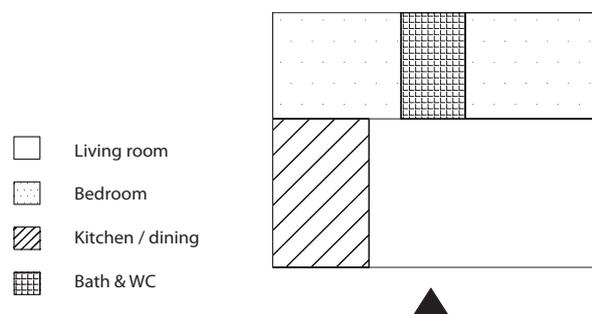


Figure 198: Possibility (VIII.a)

Source: By author

- Living room orients to the south. Bedrooms are at the east. Service areas such as kitchen / dining and bath & WC are at the north of the apartment.

Possibility (VIII.b)



-  Living room
-  Bedroom
-  Kitchen / dining
-  Bath & WC

Figure 199: Possibility (VIII.b)

Source: By author

- Living room locates at the south, service areas are separated in two places: kitchen and dining orients to the south, and bath room orients to the north. Two bedrooms orients to the north.

Possibility (VIII.c)

- The position of living area is determined to the east and north. Bed rooms are in different places, one is at the south and another one is at the north. Service areas such as kitchen, and Bath & WC are placed at the west and south - west of the apartment. The location of kitchen and toilet are easy accessible from the entrance.

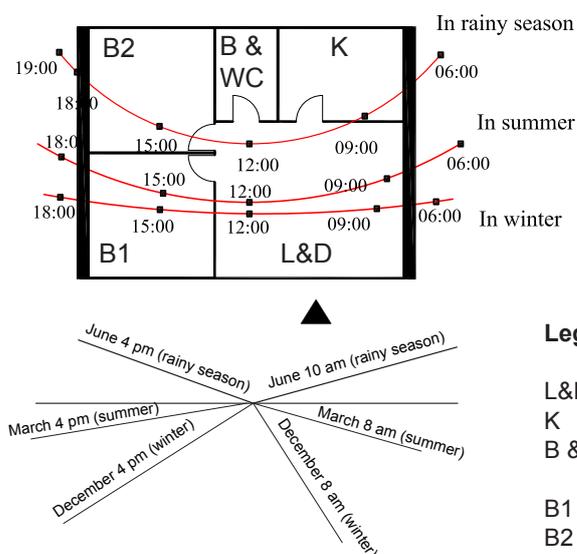
(IX) Possibilities of orientation of spaces due to the composition of building

Based on 3 possibilities of orientation of spaces, four types of combination in building are considered. The form of building can be generally point type and row type.

The unit combination can take 4 possibilities.

- Two attached walls at the both sides
- One attached wall at the left side
- One attached wall at the right side and
- No attached wall

The advantages and disadvantages of the orientation of rooms are stated in accordance with the composition of building's form. The availability of natural lighting of the rooms is decided due to the amount of sun shine in each seasons, and sun shine angles. (The amount of sun shine and sun shine angles are shown in Figure 58 in Chapter 2). Three curves on each possibility are represented the sun path directions in summer, rainy season and winter. The numbers on each curve show the time.

Possibility (IX.a.1): case of two walls at the both sides**Legend:**

L&D	= Living and dining
K	= Kitchen
B & WC	= Bath and water closet
B1	= Bedroom 1
B2	= Bedroom 2

Figure 201: Possibility (VIII.a.1)

Source: By author

In summer

L & D	= around 09:00 to 17:00
B1	= around 09:00 to 17:00
B2	= no direct sun light
K, B & WC	= no direct sun light

In rainy season

L & D	= no direct sun light
B 1	= no direct sun light
B 2	= around 09:00 to 17:00
K, B & WC	= around 09:00 to 17:00

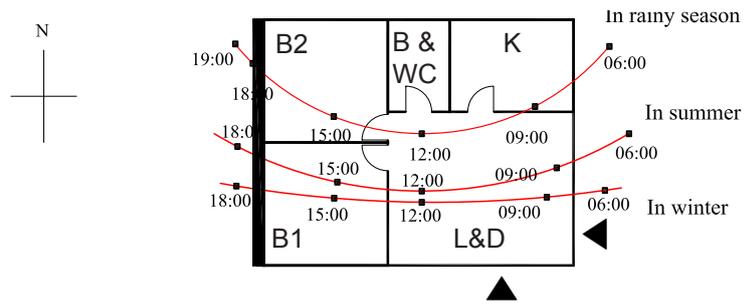
In winter

L & D	= around 06:00 to 19:00
B1	= around 06:00 to 19:00
B 2	= no direct sun light
K, B & WC	= no direct sun light

Advantage: The orientation of living room as well as of bedroom 1 supports the sun lighting in 3 seasons although there is less sun shining hours in June which is in rainy season.

Disadvantage: Bedroom 2 and service area such as kitchen, dining and bath room have no sun lighting.

Possibility (IX.a.2): case of wall at the left side

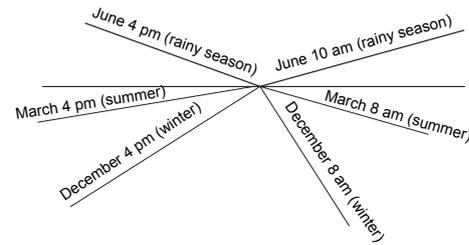


Legend:

- L&D = Living and dining
- K = Kitchen
- B & WC = Bath and water closet
- B1 = Bedroom 1
- B2 = Bedroom 2

Figure 202: Possibility (VIII.a.2)

Source: By author



In summer

- L & D = around 06:00 to 17:00
- B1 = around 09:00 to 16:00
- B2 = no direct sun light
- K, B & WC = around 06:00 to 09:00

In rainy season

- L & D = no direct sun light
- B1 = no direct sun light
- B2 = around 15:00 to 17:00
- K, B & WC = around 09:00 to 11:00

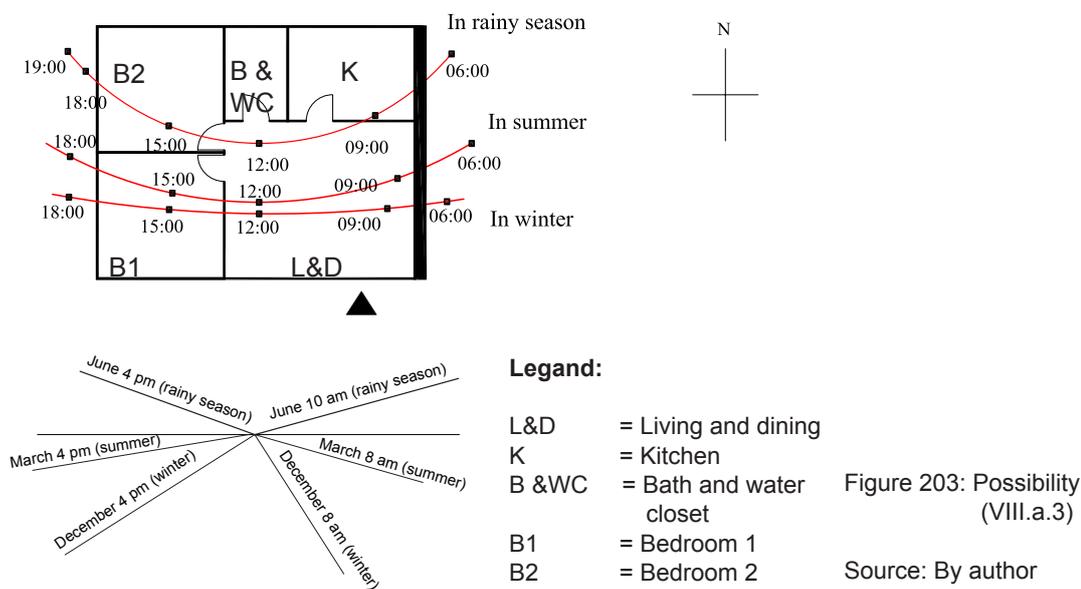
In winter

- L & D = around 06:00 to 19:00
- B1 = around 06:00 to 19:00
- B2 = no direct sun light
- K, B & WC = around 06:00 to 11:00

Advantage: The orientation of living room as well as of bedroom 1 supports the natural lighting in 3 seasons although there is less sun shining hours in June which is in rainy season.

Disadvantage: Bedroom 2 has less sun, but receives lighting from the north.

Possibility (IX.a.3.) : case of attached wall at the right side



In summer

L & D = around 06:00 to 17:00
 B1 = around 06:00 to 19:00
 B2 = around 15:00 to 19:00
 K, B & WC = no direct sun light

In rainy season

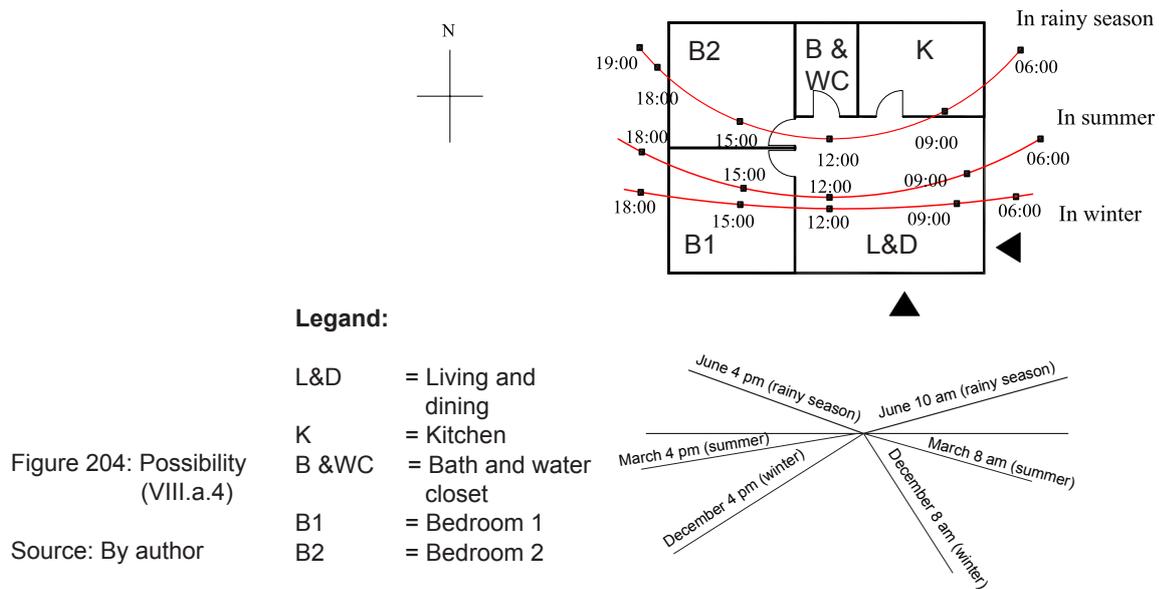
L & D = no direct sun light
 B1 = around 13:00 to 18:00
 B2 = around 09:00 to 11:00 and 15:00 to 19:00
 K, B & WC = around 09:00 to 11:00 and 15:00 to 19:00

In winter

L & D = around 06:00 to 19:00
 B1 = around 06:00 am to 18:00
 B2 = around 13:00 to 19:00
 K, B & WC = no direct sun light

Advantage: Living and bedrooms have enough sun lighting.

Disadvantage: Kitchen has no sun light in summer and winter seasons.

Possibility (IX.a.4.) : case of no attached wall**In summer**

L & D = around 06:00 to 19:00
 B1 = around 09:00 to 19:00
 B2 = around 13:00 to 19:00
 K, B & WC = around 06:00 to 12:00

In rainy season

L & D = no direct sun light
 B1 = no direct sun light
 B2 = around 15:00 to 17:00
 K, B & WC = around 09:00 to 11:00

In winter

L & D = around 06:00 to 19:00
 B1 = around 06:00 to 19:00
 B2 = no direct sun light
 K, B & WC = around 06:00 to 11:00

Advantage: The orientation of living room as well as of bedroom 1 supports the sun lighting in 3 seasons although there is less amount of sun in June which is in the rainy season.

Disadvantage: Kitchen has less natural lighting.

Possibility (IX .b.1): case of two attached walls at the both sides

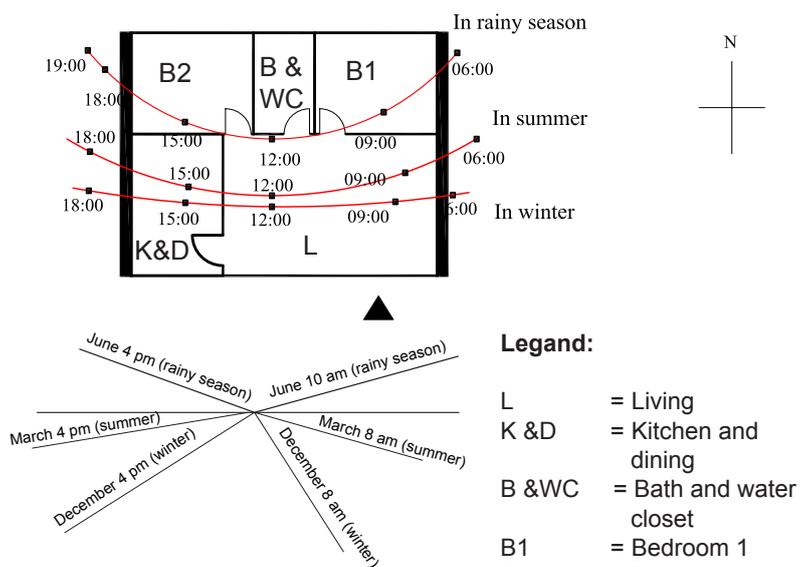


Figure 205: Possibility (VIII.b.1)

Source: By author

In summer

- L = around 06:00 to 17:00
- B1 = no direct sun light
- B2 = no direct sun light
- K & D = around 06:00 to 17:00
- B & WC = no direct sun light

In rainy season

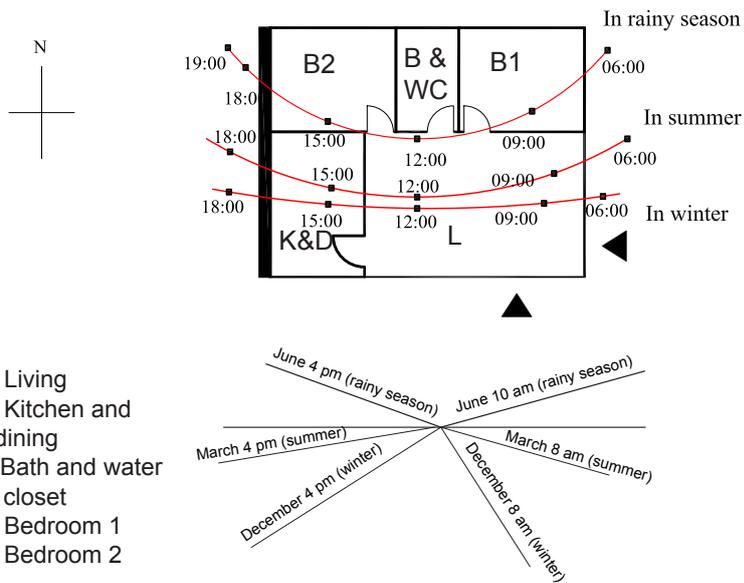
- L = no direct sun light
- B1 = around 09:00 to 17:00
- B2 = around 09:00 to 17:00 and 15:00 to 19:00
- K & D = no direct sun light
- B & WC = around 09:00 to 17:00

In winter

- L = around 06:00 to 19:00
- B1 = no direct sun light
- B2 = no direct sun light
- K & D = around 06:00 to 19:00
- B & WC = no direct sun light

Advantage: The orientation of living room as well as kitchen and dining area is good, even there is less amount of sun in the rainy season.

Disadvantage: Bedrooms have no direct sun light in the summer and winter seasons. They receive the direct sun shine about 4 hours a day in the rainy season if the residents use these rooms for reading or working activities.

Possibility (IX.b.2.) : case of attached wall at the left side**Legend:**

- L = Living
 K & D = Kitchen and dining
 B & WC = Bath and water closet
 B1 = Bedroom 1
 B2 = Bedroom 2

Figure 206: Possibility (VIII.b.2)

Source: By author

In summer

- L = around 06:00 to 17:00
 B1 = around 06:00 to 11:00
 B2 = no direct sun light
 B & WC = no direct sun light
 K & D = around 09:00 to 17:00

In rainy season

- L = around 06:00 to 11:00
 B1 = around 09:00 to 18:00
 B2 = around 09:00 to 18:00
 K & D = no direct sun light
 B & WC = around 06:00 to 18:00

In winter

- L = around 06:00 to 19:00
 B1 = around 06:00 to 11:00
 B2 = around 09:00 to 18:00
 K & D = around 06:00 to 19:00
 B & WC = around 06:00 to 11:00

Advantage: The orientation of living room as well as kitchen and dining area is good even there is less sun shine hours in the rainy season.

Disadvantage: Bedroom 2 has no direct sun light in the summer and winter seasons. It receives the direct sun shine about 4 hours a day in the rainy season if the residents use that room for reading or working activities.

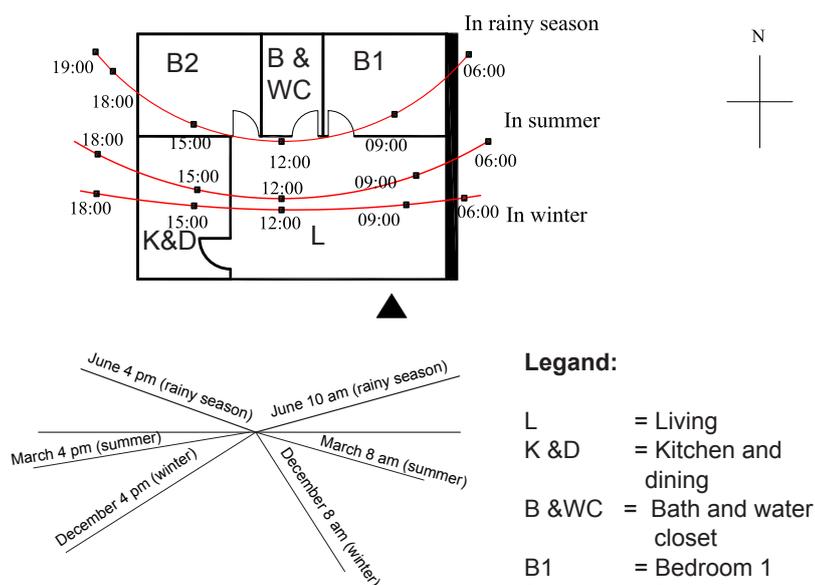
Possibility (IX. b.3.) : case of attached wall at the right side

Figure 207: Possibility (VIII.b.3)

Source: By author

In summer

L = around 06:00 to 16:00
 B1 = around 15:00 to 19:00
 B2 = around 13:00 to 19:00
 K & D = around 09:00 to 19:00
 B & WC = around 15:00 to 19:00

In rainy season

L = no direct sun light
 B1 = around 09:00 to 11:00 and 16:00 to 19:00
 B2 = around 09:00 to 11:00 and 13:00 to 19:00
 K & D = around 15:00 to 17:00
 B & WC = around 09:00 to 11:00 and 16:00 to 19:00

In winter

L = around 06:00 to 19:00
 B1 = no direct sun light
 B2 = around 13:00 to 19:00
 K & D = around 15:00 to 17:00
 B & WC = no direct sun light

Advantage: Living room, kitchen and dining area have enough sun light in summer and winter.

Disadvantage: Bedroom 1 at the north receives only evening sun in the summer.

Possibility (IX.b.4.) :case of no attached wall

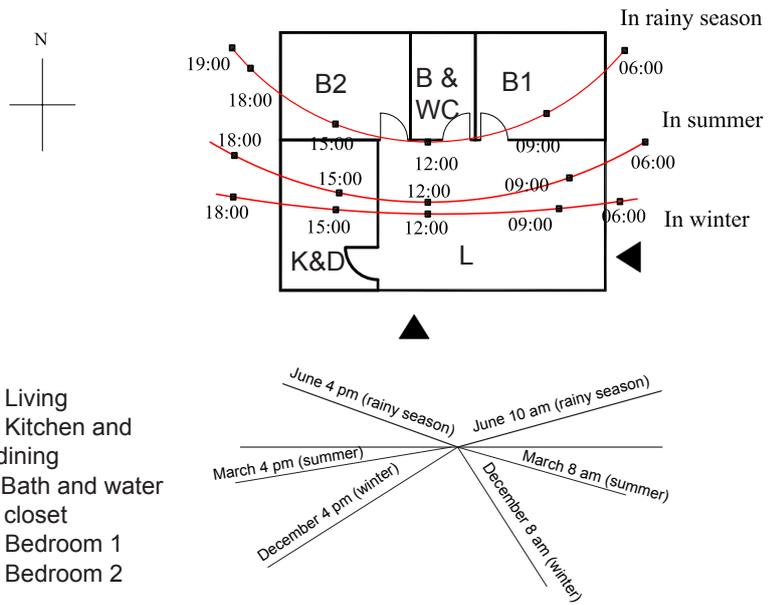


Figure 208: Possibility (VIII.b.4)

Source: By author

In summer

- L = around 05:00 to 19:00
- B1 = around 05:00 to 14:00
- B2 = around 13:00 to 19:00
- B & WC = around 06:00 to 14:00
- K & D = around 09:00 to 19:00

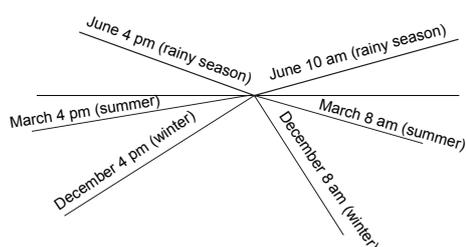
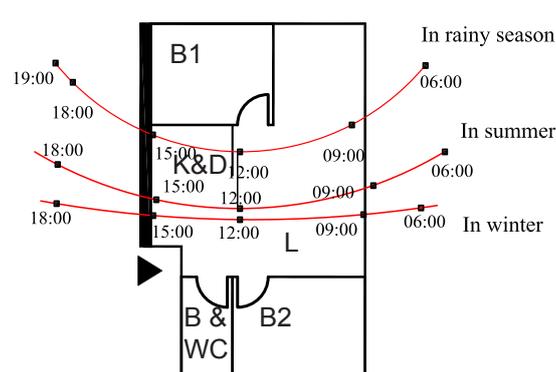
In rainy season

- L = around 09:00 to 14:00
- B1 = around 16:00 to 18:00
- B2 = around 13:00 to 18:00
- K & D = around 13:00 to 18:00
- B & WC = around 16:00 to 18:00

In winter

- L = around 06:00 to 19:00
- B1 = around 06:00 to 11:00 and 16:00 to 19:00
- B2 = around 13:00 to 19:00
- K & D = around 09:00 to 19:00
- B & WC = around 06:00 to 11:00 and 16:00 to 19:00

Advantage: The orientation of living room as well as of kitchen and dining supports enough sun lighting in 3 seasons although there is less sun shining hours in rainy season.

Possibility (IX.c.2.)**In the case of attached wall at the right side****Legend:**

L	= Living
K & D	= Kitchen and dining
B & WC	= Bath and water closet
B1	= Bedroom 1
B2	= Bedroom 2

Figure 209: Possibility (VIII.c.2)

Source: By author

In summer

L	= around 06:00 to 11:00
B1	= around 06:00 to 09:00 and 16:00 to 19:00
B2	= around 06:00 to 11:00
B & WC	= around 10:00 to 18:00
K & D	= no direct sun light

In rainy season

L	= around 06:00 to 14:00
B1	= around 09:00 to 11:00 and 16:00 to 19:00
B2	= around 09:00 to 18:00
K & D	= no direct sun light
B & WC	= around 09:00 to 14:00

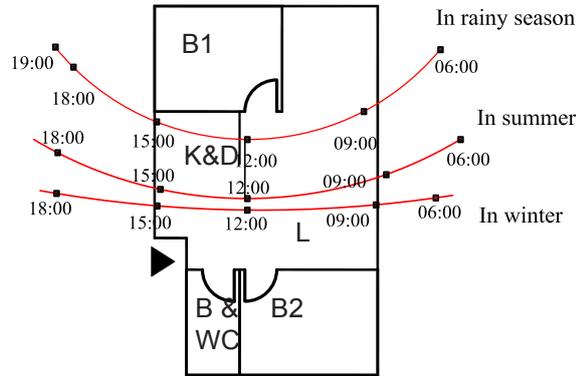
In winter

L	= around 06:00 to 11:00
B1	= around 16:00 to 19:00
B2	= around 06:00 to 18:00
K & D	= no direct sun light
B & WC	= around 11:00 to 19:00

Advantage: Living room as well as bed room 2 can receive morning sun in three seasons.

Disadvantage: Kitchen and dining area cannot get direct sun light in three seasons.

Possibility (IX.c.3.)
In the case of no attached wall

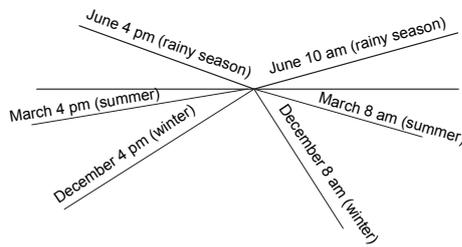


Legend:

- L = Living
- K & D = Kitchen and dining
- B & WC = Bath and water closet
- B1 = Bedroom 1
- B2 = Bedroom 2

Figure 210: Possibility (VIII.c.3)

Source: By author



In summer

- L = around 06:00 to 11:00
- B1 = around 13:00 to 19:00
- B2 = around 06:00 to 17:00
- B & WC = around 06:00 to 19:00
- K & D = around 13:00 to 19:00

In rainy season

- L = around 06:00 to 11:00
- B1 = around 06:00 to 10:00 and 13:00 to 19:00
- B2 = around 06:00 to 17:00
- K & D = around 13:00 to 19:00
- B & WC = around 13:00 to 19:00

In winter

- L = around 06:00 to 11:00
- B1 = around 14:00 to 19:00,
- B2 = around 06:00 to 17:00
- K & D = around 13:00 to 19:00
- B & WC = around 06:00 to 19:00

Advantage: Every room has quite good natural lighting.

6.5. Recommendations with respect to economic efficiency

The economic condition is a very important aspect because the players of the economic interests are the most powerful ones. If one wants to reduce costs, there are some possibilities:

- The less facade area per apartment, the cheaper the cost of external wall and decoration.
- A span of about “3.6 m”¹³² between column is cost efficient.
- The more stories and the more attached units per access elements, the more cost effective.

Economic considerations are more or less related with the recommendations for other performance aspects. If we increase the performance of other aspects like functional, social and cultural ones, then the cost will be more.

In general it must be seen that in most cases the recommendations regarding sufficiency of area, lighting, ventilation increase the cost. Normally there are conflicts. Less m² in high density, more storeys, and more attached units in poor quality is cheaper than more m² with better condition for lighting and ventilation. Possibilities of saving costs, while holding the same standard, are in prefabrication, in the intelligent arrangement of zones, in material, in providing internal flexibility and may be self-help in building construction, mainly finishing.

6.6. Overall view of recommendations

The following section provides a short overview of the previous recommendations from the section 6.1, 6.2, 6.3, 6.4, and 6.5. The main 16 items of recommendations are shown in figure 209. The figure also shows how single items are related to different subsystems, and sub aspects. There is a network of relations. The recommendations relate to the deficiencies of each aspect.

These recommendations can be differentiated due to the user’s requirements. Some items refer to common needs and some to individual needs. These recommendations can be carried out according to the user’s need and kind of development system. For example: If we prefer to give favour to the functional aspect, we can refer to the items which are linked to the functional performance. However, in real situation planning, there will be always a conflict between the recommendations of economical conditions and other performances.

132 The costs per different area of the building is affected by span between columns is simulated by Moe Thae Phyu in her master thesis.

Overall view of recommendations

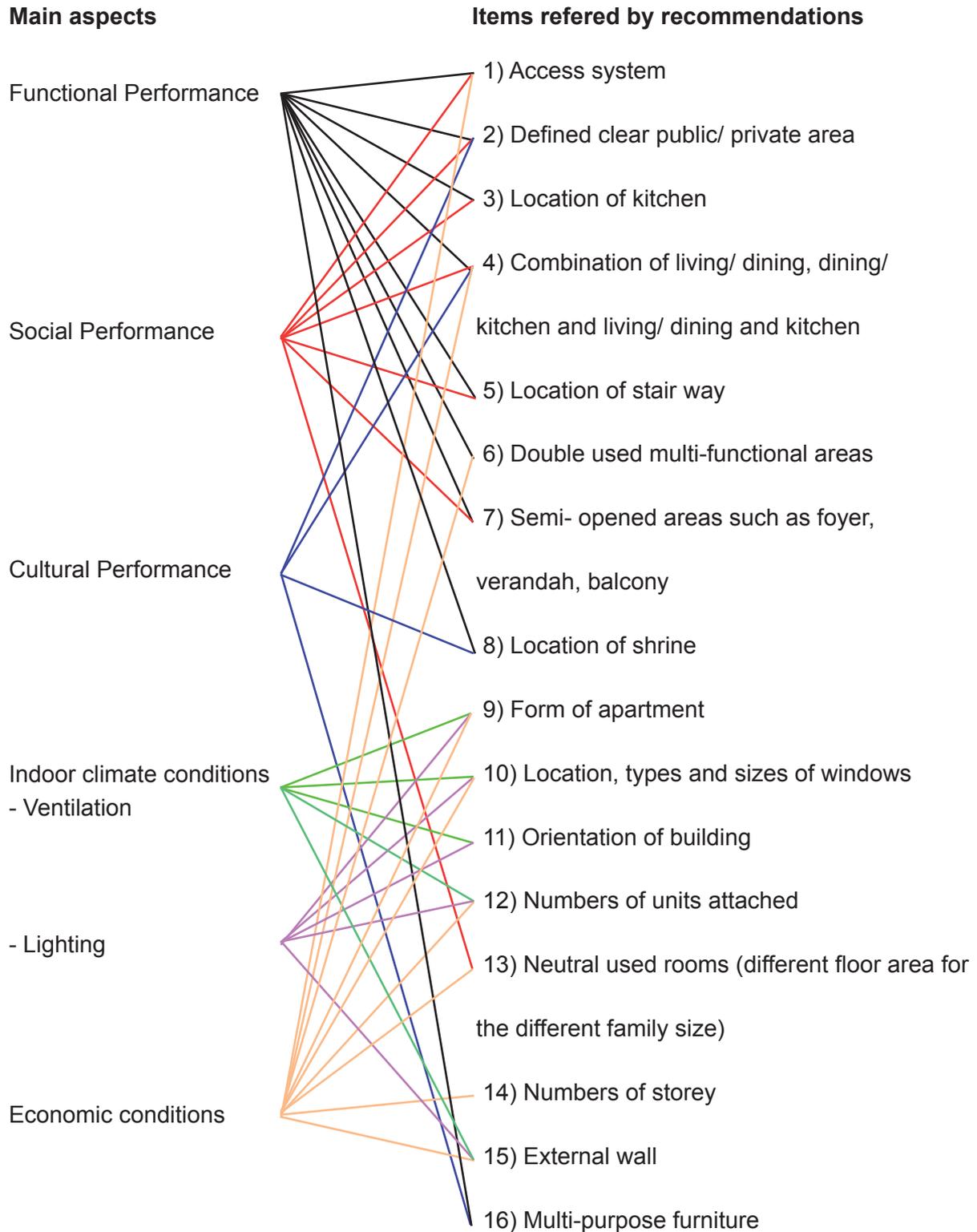


Figure (211): Overall view of recommendations
Source: By author

7.

CONCLUSIONS



CHAPTER 7: Conclusions

The central motives driving people to move from rural to urban area are:

- 1) The opportunity of jobs
- 2) The education system and
- 3) The quality of life style

Due to the development of migration to Yangon after 1980, the Department of Housing Settlement and Housing Development (DHSHD) and private sectors tried to deal with the rapid growth rate of urban population as well as the needs of residents.

In Yangon, high density living is increasingly adopted in order to catch up with the growth of city's population and to fulfill the annual housing demand. Thus, walk-up apartment housings became the preferable solution to provide adequate dwellings for the people living in Yangon housing. In face of various deficiencies, which have been analyzed, this thesis intends to support the development of better solutions with respect to the different aspects of housing like functional, social, climatic and cultural requirements in Yangon walk-up apartments.

The supplied housings have some weaknesses in different respect from the user's point of view. Therefore this research exhibits the deficiencies of current solutions in the housing in Yangon in order to improve design decisions in the future.

This section is structured in three major parts. The first part presents an executive summary of the major findings of the previous analyses. These findings are the results of the analyses which are the discoveries of various deficiencies regarding the different aspects of housing quality. The second part describes a summary of possibilities to resolve the deficiencies and to formulate the propositions of improvement in forms of recommendations. The third part opens the door for the better design of future housing in Yangon.

7.1. Summary of the results of the deficiency analysis

The following section presents the synopsis of overall results of analyses which assessed the findings on the selected cases by the deficiency criteria. To improve the spatial configuration, the arrangement of spatial zones in Yangon apartments was analyzed in order to find out, whether there are suitable spatial conditions for the residents. Since most of the residents migrated from rural area to urban area after 1980, the spatial composition of rural area houses is one of the references to evaluate the adequacy of functional areas of urban apartments in Yangon even if there are some changes. The zones in rural areas houses can be categorized in four major areas: living / sleeping, cooking / dining, working, and outdoor activities areas. Those differentiations of zoning arrangement also happen in

the urban apartments. The central courtyard as well as the semi-opened multi-functional hall in the rural area houses is transformed to a living and dining hall in the urban apartment. However, the enclosure of the composition of zones has the problem with the mixture of uses in both hall and room type apartments, when there is not enough space for the domestic activities. Moreover, semi-opened areas such as balcony and verandah are needed as a social communication space.

According to the statistical surveys, 4 to 7 members are living in the selected cases. As found by the investigation regarding the adequacy of functional arrangement and sufficiency of area, there are congestion problems and conflicts because of mixed use functions if the family members are more than 4 to 7 persons. The investigation of areas of space has shown that the provided spaces are less than the space standard of DHSHD, when the family is more than 5 members. It was furthermore found that hall and two bed room apartments have congestion problems with sleeping, when the family is more than 5 persons. Besides, more than 6 person families do not have enough space for habitable rooms. Additionally, the results indicate that more area for semi-opened spaces like verandah, open corridor or balcony area is needed in the hall and room type apartment.

The discussion of the social quality in housing design concentrates on the space for social communication of residents. The surveys are focused on how family members communicate with each other and how they interact with neighbours and visitors.

The examination of the suitability of available space for social activities in the hall and room type apartments indicates that the hall way in the hall type apartment and living / dining hall in the room type apartment are the most important areas for most of the social activities of residents. Moreover verandah and corridor space are necessary for social communication of residents as well as with neighbours. However, in the analyzed cases, the space at verandah, the landing and the corridor is not sufficient for communication.

Most of the verandah spaces in the Yangon apartments are congested with the function of drying the clothes. Sometimes, they are used as the place for the shrine. The provided area of landing is not enough for the social communication with neighbours. According to the examination of the spatial composition, the mixture of praying activities and public activities in the both hall and room type apartments is found. By the floor plan organization, there is no specific area for shrine and praying. However, the residents try to provide that area by themselves. In some apartments, the residents install a specific shrine space, which is divided from the sleeping area. In some apartments, a praying area is defined by the movable partitions like curtains, or showcases.

It still belongs to Myanmar culture to provide the entrance space for taking off the slippers before entering the house. In most analyzed cases in Yangon, there is no provided entrance space where the people can take off their shoes and slippers. Furthermore, unsatisfying situations occur in the selected cases relating the donating activities. The people use mostly the hall way or living / dining hall for the donating to the daily monks or for celebrating the ritual concerning the donating activities.

Dividing the rooms to create an additional small room for the particular purpose, for praying, or providing movable partitions for multi-functional purposes are some of the examples of problem solving tools of the residents.

Regarding the natural ventilation, the form of apartment as well as its location, the sizes of openings, the number of units attached, and the form and orientation of building are the most important variables. Among the four considered types of building, the duplex type is the best apartment type. Moreover, the orientation of building with respect to the wind direction is an important condition for good natural ventilation. The central corridor and central stair types have strong deficiencies, because they produce much wind shadow for some apartments.

With respect to the lighting quality, opening area as well as window height and width is seen in relation to the room depth and floor area. The central stair type is the best type concerning the ratio of opening area to the floor area. There is poor lighting penetration in the long rectangular forms of apartments. The rooms should be accommodated at the sunny or shady side according to their functions. To provide solutions for shading, the orientation of the building with respect to the sun angles is important. Also shading devices such as overhangs or verandah are helpful.

Concerning the economic conditions, the cost per floor area is largely influenced by the architectural form. The hall type apartment with corridor access system providing two stairs at each side is economically more effective than other types. The number of stairs and their location mainly influence the costs. Furthermore, the numbers of storey as well as the numbers of unit attached are influencing factors for affordable design.

With the purpose of providing some hints for the Yangon housing, some German housing designs after the First World have been analyzed. Using folding beds, foldable partitions, and sliding doors can serve double functions in the small apartments. Open access corridor systems as well as the consideration of an effective ratio of length and depth of an apartment are also important potential inputs for the design of Yangon housing.

7.2. Summary of recommendations

The supplied housings have some weaknesses in different respect from the user's point of view. Therefore this research exhibits the deficiencies of current solutions in the housing in Yangon in order to improve design decisions in the future.

From the functional, as well as from the social, cultural and indoor environmental qualitative point of view, the main requirements are found by the deficiency analysis (Chapter 4), which is the basis to give the recommendations. The recommendations regarding each aspect (Chapter 6) are meant to influence the guidelines for the suitable and better solutions for the walk up apartments in Yangon.

They are likely to be important for different individuals, social groups and household types according to their life styles and affordable situation. The developers, architects and urban planners can identify users' needs at decision making stage. Nevertheless, to meet the needs of different users is difficult. The recommendations are meant to support the problem solving process for architects and urban planners. It is possible to state general recommendations which are common for all residents.

The following list describes the recommendations:

- 1) Access system
- 2) Defined clear public / private area in the apartment
- 3) Location of kitchen
- 4) Combination of public activity spaces
- 5) Location of stair way
- 6) Double used multi-functional areas
- 7) Semi-opened areas such as foyer, verandah, balcony
- 8) Location of shrine
- 9) Form of apartment
- 10) Location, types and sizes of windows
- 11) Orientation of building
- 12) Numbers of unit attached
- 13) Neutral used rooms (for different floor area for the different family size)
- 14) Numbers of storey
- 15) Facade area
- 16) Multi-purposed furniture

7.3. For better future design

There are five main issues on the design agenda regarding the future better housing design in Yangon. These issues are related by the respective recommendations.

- (A). Providing semi-opened space regarding the social communication
- (B). Maximizing the functional capacity in the minimum existing space
- (C). Mixture of different size apartments regarding the different demand in the context of changing family size
- (D). Negotiations between users, designers and developers in relation to the economical aspect
- (E). Considering design adapted to the climate

(A). Providing semi-opened area regarding the social communication

“Every culture has its particular expectations of its dwellings, and arranges domestic spaces in ways that relate to its social structure, to its traditions and to the organization of the daily lives of its members.”¹³³

Looking backwards to the composition of traditional living style in Myanmar traditional houses as well as in rural area houses, three zones can be defined clearly. They are: opened zone, semi-opened zone, and private zone. However, there can be stated a weakness with regard to the semi-opened and opened area in modern buildings in the urban area. If semi-opened areas are provided in the apartment, it is at a verandah, at landing areas or corridors. In the real situation, there are some disturbances by mixed use and unsuitable functions in these areas.

In order to solve that problem, the spaces for verandah, common corridor and landing areas are to be planned considering the questions: how to provide sufficient social communication space for the residents among themselves and with neighbors. To provide semi-opened area, the access system, the location of stairs and the placement of verandahs are important factors for the recommendations. Indeed, the form of semi-opened space is depended on these factors. For example, one can design a wider common long corridor access system, or a wider landing area as part of the common stairs, or an alternate location of the verandahs, which allows vertical social communication. The social communication space for the family members as well as with neighbors can be improved by these ways.

.....
133 Paul Oliver, *Dwelling*, (London, 2003), p. 166.

(B). Maximizing the functional capacity in the minimum existing space

In general, a multi-functional hall is the dominant space in a typical Myanmar house. That allows various public functions and semi-public functions in the existing space. According to the statistical surveys regarding the household sizes in the selected cases, 4 to 7 member's households are the most common ones. The investigation of in and out migrants in Yangon division indicated that the population of in migrants is more than that of out migrants. By the investigation of the age of the in migrant population, 15 to 34 years old ages are found as the most frequent number. These ages are normally the school going age, and the age of parents of young families with 2-4 children.

Taking into account the family size, there is not enough space in the most selected apartments. Even though there is the space for the public and private functions, there happens a mixture of function in the living / dining hall area. By investigating the daily activities of family members, there is not enough space for every specialized function. Therefore a neutral functional space is recommended in form of double used space which means flexibility.

*"In architectural terms, 'flexibility' can be interpreted in several different ways. Flexible space is often taken to mean simply a space that can be used for a variety of purpose, or it might relate to a relationship between rooms that allows them to connect to each other."*¹³⁴

*"Change is a reliable constant. Constant change calls for appropriate strategies and a high level of flexibility. The architect Richard Buckminster Fuller claimed that 'a room should not be fixed, should not create a static mood, but should lead itself to change so that its occupants may play upon it.'"*¹³⁵

Rooms sizes can be changed to a limited extent by means of movable inserts. Beisi described a situation in a flexible space: *"the spatial configuration readily changed whenever demanded. Furniture arrangement remains location free. The children can use the entire space as a play field by moving the partitions. When privacy needs demanded a change of environment, the flexible partitions function effectively. The relative advantages or disadvantages caused by flexible spatial arrangements are experienced differently by different families."*¹³⁶

"As Myanmar is a rich country with natural resources, we found in the rural area houses that most of the furniture and household things are made by timber, bamboo and rattan which are very flexible to use and to fold up when we need to have more spaces. However most of the spaces

134 Hilary French, *New urban housing*, (Great Britain, 2006), p. 100.

135 Peter Schwehr, *Evolutionary algorithms in Architecture*, *Proceeding of 16 International Conference on Open and Sustainable Building*, (May, 2010, Spain), p. 284.

136 Jia Beisi, *Operable infill in housing renovations, A practice in urban density*, *open house international journal*, vol.29, No.2, 2004.

*are fixed with concrete walls in the urban apartments. There has some mixed used function and spaces because of the fixed spaces. So that, some spaces as bed rooms should have double used function according to the day and night time by using foldable curtains or partitions. Also there should be a storage area in the apartment in which we can store furniture and the things easily which will use according to the space function and the time.*¹³⁷

An advantage of using neutral functional space to a certain degree is that it can be used according to the user's desire anytime. When the people are getting old and the children moved out to live with their own family, the large space is not needed. Then, the owners can make partitions in the neutral functional space as they wish. They also can sell out or rent out the rest of the apartment to other people. Moreover, kinds of material for movable partitions, and kinds of furniture should be decided due to the development of technological systems for creating flexible spaces in order to solve the problem of different daily activities in the existing rare space.

(C) Mixture of different size apartments regarding the different demand in the context of changing of family sizes

The population pyramid (1973-2000) shows that there will be a large amount of older people in the coming decade (Figure 30). Therefore, long term use for apartments should be considered additionally. In order to provide suitable space according to the changing family size, the apartments should be implemented as modular form. The large family (2 parents with 3 children or 2 parents, 2 children and 2 grand parents, or 2 parents, 2 children and brother or sister of parents) may need 2 or 3 attached units. The users should be able to divide the space and rent it to others, when they don't need the large space.

*"Housing has to be flexible enough to deal with two conditions. The first is the need to adapt to the changing needs of individuals as they grow old or physically less able. The second is housing than can respond to the changing constitution of a family as it grows and then contracts."*¹³⁸

In the selected cases in Yangon, there is provided the same floor area in all apartments. Instead of providing the same area, different areas for different family sizes should be planned in one building.

"There should be different ranges of floor plan with modules (for example: from one room apartment to three room apartments in one building). One room apartment is proposed one module. It can develop to the two room apartment with two modules and three room apartment with three

¹³⁷ Khin Lin Nwe, Development of flexible open spaces in housing concepts for Yangon regarding social and cultural conditions in Myanmar, proceedings of 16 International Conference on Open and Sustainable Building, (May, Spain, 2010), p. 418.

¹³⁸ Tatjana Schneider, Jeremy Till, Flexible Housing, (UK, 2007), p. 41.

modules. In each module, only the access area and service and supplying function, and private function should be in the fixed rooms and other spaces should be movable and flexible spaces with the movable furniture and household utensils."¹³⁹ The mixture has the additional effect of different social communication patterns.

(D) Negotiations between users, designers and developers in relation to the economical aspect

The development of housing is not only based on the social, functional and technical factors, but is also related to the economical ones. There are different views on a planning or a design concerning the economical factor. They are user's point of view, developer's point of view and designer's point of view. There are several factors in relation to the economical condition in a building or housing project. For example, providing a larger open verandah, or a wider corridor, more windows and doors, a wider landing area or a larger multi-functional hall are factors of increasing the costs. More units attached as well as multi-storey buildings without elevators would save costs. However, inconvenient living can be the consequence of saving money. The cheaper the building for the developer is, the less convenience the living may be. Therefore, there is normally a conflict in between developer's and user's point of view. However, the users could balance their actual needs with their resources. For example: some families may not need an area for playing. In this case, developers and users should discuss the possibilities of saving costs in relation to their desire, and what they can afford.

Especially if one takes into account that the economic conditions of Myanmar will improve, there is as one effect that the resources and needs of the people will change, inclusive their life style and housing demands. Therefore, to deal with changing needs, a good possibility is that the involved persons start to negotiate. The role of the designers should be to organize it.

(E) Adaptive design in relation to the climate

*"Dwellings are built to serve a variety of functions, but one of the most important case is to create living conditions that are acceptable to their occupiers, particularly in relation to the prevailing climates."*¹⁴⁰

In order to adapt to the climate, it is to be decided which rooms should be located at the sunny side and shady side according to their functions. Also it is important to design buildings and apartments, such that they allow natural ventilation and lighting without any technical support.

139 Khin Lin Nwe, Development of flexible open spaces in housing concepts for Yangon regarding social and cultural conditions in Myanmar, p. 418.

140 Paul Oliver, Dwellings, (London, 2003), p.130.

The arrangement of the apartments in the building is a strong factor for ventilation. The building type with an open long corridor system can provide good cross ventilation. Also the building accessed with one staircase for two units which have two external walls, is the best condition for natural ventilation and lighting. Shading devices and overhangs are decisive for preventing overheating. The depth of the apartment and the size and place of the windows are important factors for natural lighting.

There are many factors in order to provide a design adapted to the climatic condition, including insulation, double windows, using earth cooling etc, which may belong to a future generation of housing design.

7.4. General final statement

These results at the same time lead to the conclusion, that in the future quality of housing design can be improved by giving attention to the special recommendations of this thesis. But furthermore it shows that the methodological aspect is important. It is the generally recommended step of looking for and analyzing users' needs as an input for any further design and planning. Even if needs change due to changing urban life style, planners will react adequately if they assess users' needs.

The special recommendations and the method to link analysis with design measurements are the results of the thesis. Also they are input and basis for the improvement of the design and planning of housing facilities in Yangon.

LIST OF REFERENCES



List of References

Beisi, Jia. *Operable Infill in Housing Renovations, a Practical in Urban Design*. Open House International Journal, Vol 29, No.2, 2004.

Central Statistical Organization (CSO). *Household Income and Expenditure Survey*. Yangon, Myanmar, 1997.

Chiara, Joseph D., Panero, Julius and Zelnik, Martin. *Housing and Residential Development*. Singapore, 1995.

Department of Human Settlement and Housing Development, Ministry of Construction. *A Report on Construction Activities*. Yangon, Myanmar, 2000.

Dreyse, Dietrich W., *May Siedlungen Architekturführer durch acht Siedlungen des neuen Frankfurt 1925-1930*. Köln, Germany, 2001.

Evans, Benjamin H., *Daylight in Architecture*. AIA, New York, 1981.

Fassbinder, Helga and Jos V. Eldonk. Flexibilität im Niederländischen Wohnungsbau. Arch+, Zeitschrift für Architektur und Städtebau, vol 100/101, October 1989.

Feriadi, Henry. *Thermal Comfort for Naturally Ventilated Residential Buildings in the Tropical Climate*. Journal of Energy and Buildings, Vol 36, Issue 7, 2007.

French, Hilary. *New Urban Housing*. Great Britain. 2005.

Frink, Dieter. *The Quality of Urban Life, Social, Psychological, and Physical Conditions*. Berlin, Germany, 1986.

Givoni, Baruch. *Climate Consideration in Building and Urban Design*. New York, 1998.

Hertzberger, Herman. *Lessons for Students in Architecture*. Nijmegen, Netherland. 1991.

Hindrichs, Dirk U., Berthold, Sonja. *Plusminus 20°/40° latitude*. Bielefeld, 2007.

Htay Htay Myint. *Analysis on recently Built Housing Estate in Yangon*. M.Arch thesis, Yangon Technological University, Yangon, Myanmar, 2002.

IDEA International Institute, IHLCA Project Technical Unit. *Integrated Household Living Condition Survey in Myanmar, Poverty Profile*. Yangon, Myanmar, 2007.

Institute Sultan Iskandr of Urban Habitat and Highrise (ISI) and Malaysian Industry Government Group for High Technology. *Interim Report (Executive Summary), Yangon Strategic Development Plan*. Yangon, Myanmar, April, 2005.

Khin Lin Nwe. *To the Development of Flexible Spaces in Housing Concepts for Yangon Regarding the Flexible Spaces of Myanmar Rural Houses*. Paper presented at 25 years of Trialog journal conference, Darmstadt, Germany, January 2010.

Khin Lin Nwe. *Development of Flexible Open Spaces in Housing Concepts for Yangon Regarding Social and Cultural Conditions in Myanmar*. Proceedings of 16 International Conference an Open and Sustainable Buildings, Spain, May 2010.

Khin Wynn. *Housing Delivery System in Yangon*. Powerpoint presentation to 4th Asean Forum Conference, Tokyo, Japan, December 2004.

Knapp, Ronald G., *Asia's Old Dwellings, Tradition, Resilience, and Chance*. Oxford, 2003.

Kuhn, Gerd. *Die Frankfurter Küche*. In T. Harlander (Ed.), *Sozialwissenschaftliche Planungsgrundlagen*, Institute Housing and Design, University of Stuttgart, Stuttgart, Germany, 2001.

Kuhn, Gerd. *Die Frankfurter Küche. Wohnkultur und Kommunal Wohnungspolitik in Frankfurt am Main 1880-1930*. Bonn, Germany, 1998.

Lauber, Wolfgang, et al. *Tropical Architecture, Sustainable and Humane Building in Africa, Latin America and South-East Asia*. Munich, Germany, 2005.

Lechner, Norbert. *Heating, Cooling, Lighting, Design Methods for Architects*. New York, 2001.

Lewis, Sally. *Front to Back, a design agenda for urban housing*. Oxford, 2005.

May, Ernst and Franz Roedcke. *Ernst May und das neue Frankfurt, 1925-1930*. Berlin, Germany, 1986.

Mira, Ricardo G., et al. *Housing, Space and Quality of Life*. Antony Rowe Ltd., Great Britain, 2005.

Moe Thae Phyu. *Analysis on Housing for Low Income Community in Yangon*. M.Arch thesis, Yangon Technological University, Yangon, Myanmar, 2005.

National Housing, Town and Country Development Board. *Housing in Burma*. Yangon, Myanmar, 1980.

- Neufert, Ernst. *Architect's Data*. London, 1988.
- Noever, Peter. *Die Frankfurter Küche von Margerete Schütte-Lihotzky*. Berlin, Germany, 1992.
- Oliver, Paul. *Dwellings*. London, 2003.
- Pearn, B. Reginald. *History of Yangon*. Gregg International Limited Westmead, England, 1939.
- Saw Myat Yin. *Cultural Shock (Burma)*. Time Books International an Imprint of Times Editions Pte Ltd, Singapore, 1996.
- San San Moe. *Norms and Space Standard for Multi-Storeyed Residential Buildings in Yangon City*. M.Arch thesis, Yangon Technological University, Yangon, Myanmar, 1998.
- Schneider, Tatjana and Till, Jeremy. *Flexible Housing*. Oxford, USA, 2007.
- Schwehr, Peter. *Evolutionary Algorithm in Architecture*. O&SB 2010, Open and Sustainable Building Conference, Spain, May 2010.
- Schütte, L. Margarete. *Warum ich Architektin wurde*. Satzberg, Germany, 2004.
- Statistical Department. *Household Income and Expenditure Survey (HIES)*. Yangon, Myanmar, 2001.
- Städtischen Hochbauamt in Frankfurt am Main, *Die Wohnung für das Existenzminimum*, Frankfurt am Main, 1929, p.106.
- Su Su and Swe Swe Aye, *Conflicts between Development and Conservation in Yangon Central Business District*, Proceedings of the Gulf First Urban Planning and Development Conference and Exhibition , Kuwait, February , 2006.
- Swe Swe Aye. *Proposal for Improvement in Walk-Up Apartment in Yangon*. Ph.D. Preliminary Research Report, Yangon Technological University, Yangon, Myanmar, 1997.
- Swe Swe Aye, *Formulation of Guidelines for Urban Design in Yangon City Residential Areas*, Ph.D Diss., Yangon Technological University, Yangon, 2000.
- Swe Swe Aye and Maung Hlaing. *Research on Architectural Fenestration for Sustainable Building Designs*. World housing congress, Terengganu, Malaysia, July 2007.

Teige, Karel. *The Minimum Dwelling*. Prague, 1932.

Than Than Thwe. *Regionalized Population Forecast for the Union of Myanmar*. Ph.D diss., University of Stuttgart, Stuttgart, Germany, 2004.

Than Htay Oo, *Modern Trend in Traditional Houses within the Myanmar Context in Central Myanmar*, Proceeding of first international conference on science and engineering, Yangon, Myanmar, 2009.

Von Hauff, Michael. *Economic and Social Development in Burma/ Myanmar*. Marburg, 2007.

Yuzana Lwin. *Correlation between Health and Housing for Walk-Up Apartments in Yangon*. M.Arch thesis, Yangon Technological University, Yangon, Myanmar, 2004.

List of Internet Sites

Climatic condition in Yangon. <http://www.wetter.com/reise/klimadatenbank?type=humid&continent=AS&country=MM&station=480970>>. accessed 12.12.2009.

Central Intelligence Agency. *The World Factbook: Burma*. <http://www.cia.gov/library/publications/the-world-factbook/goes/bm.html>. accessed 13.01.2007.

Falam, *Solar diagram of Myanmar*. <http://www.gaisma.com/en/location/falam.html>. accessed on 03.09.2010.

Feradi, Henry. *Thermal Comfort for Natural Ventilated Buildings*. National University of Singapore, Singapore, 2004. <http://scholarbank.nus.edu.sg/bitstream/handle/10635/13922/Chapter%202%20-%20Literature%20Review.pdf?sequence=4>. accessed 20.12.2010.

Google Map, Yangon Map. <http://maps.google.de>. accessed on 20.08.2009.

Gems and the environment: *Mining in Burma*. <http://www.uvm.edu/rsenr/gemecology/index.html>. accessed 03.11.2010.

HM Government. *The Building Regulation 2000-2010*. Ventilation. http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADF_2010.pdf. accessed 12.09.2010.

- Jerram, Leif. *Kitchen sink dramas, women, modernity and space in weimer Germany*. Journal of cultural geographics, 2006. <http://cgj.sagepub.com/content/13/4/538>. accessed 9.01.2010.
- Manas Informatics Pvt. Ltd., Yangon, Myanmar. <http://www.topnews.in/files/Yangon-map.gif>. accessed on 20.08.2009.
- May, Ernst and Franz, Roeckle. *Das neue Frankfurt, vergessene Moderne die Heimarsiedlung*. <http://www.may-siedlung.de/architektur.html>. accessed 10.01.2011.
- Melching, Karen. *Frankfurt Kitchen: Patina follows function*. V&A Journal, no. 53. http://www.vam.ac.uk/res_cons/conservation/journal/number_53/frankfurt/index.html. accessed on 10.01.2011.
- Myanmar Religion*. <http://asiarecipe.com/burreligion.html>. accessed on 03.11.2010.
- Nyunt Shein, Hla Hla Myint. *The Poverty Ratio in Myanmar*. UNSD Workshop on Development Indicators, Manila, Phillipines. <http://www.nscb.gov.ph/events/ASEAN/papers/country/Myanmar%20.pdf>. accessed 20.09.2010.
- Shan Yoma. *Myanmar Travel Agency. Geography and Climate in Myanmar*. <http://www.myanmartraveltour.net/geography-climate-in-myanmar>. accessed 08.09.2010.
- Steiner, Susie. *Frankfurter Küche*. The guardian online newspaper. <http://www.guardian.co.uk/lifeandstyle/2006/apr/01/homes1>. accessed 09.01.2011.
- UN Economic Commission for Europe Information Service. *Utilization of Space in Dwelling*. <http://www.unece.org/>. accessed on 12.12.2009.
- Yangon Housing*. <http://www.spiritus-temporis.com/yangon/history.html>. accessed 8.12.2009.
- Yangon Map*. <http://www.rubyland.net/map/yangon-l.jpg>. accessed on 10.05.2009.

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Abbreviations

DHSHD	= Department of Human Settlement and Housing Development
CBD	= Central Business District
ICA	= Inner City Area
ISI	= Institute Sultan Iskandar of Urban Habitat and Highrise
UNFPA	= United Nations Population Fund
PD	= Population Department
HD	= Health Department
GDP	= Gross Domestic Product
CSO	= Central Statistical Organization
PAE	= Plinth Area Estimate
UNCCD	= United Nations Conversation to Combat Desertification
ASEAN	= Association of Southeast Asian Nations
DF	= Daylight Factor
YCDC	= Yangon City Development Committee
UN	= United Nations
CIAM	= International Congress of Modern Architecture
RFG	= Reichforschungsgesellschaft

