

The Typologies of Block and Unit Plan in Malaysian Apartments - Focused on Middle Cost Houses Supplied by the Private Sector -

Seo Ryeong Ju*¹, Lina Lee² and So-Young Jeon²

¹ Professor, Department of Housing and Interior Design, Kyung Hee University, Korea

² Master, Department of Housing and Interior Design, Kyung Hee University, Korea

Abstract

Most Southeast Asian countries, including Malaysia, have experienced rapid industrialization, after which their people started to acquire high standards of living and began to pay attention to the quality of housing. Apartments are a housing typology imported from Western culture, and this housing type has had a strong impact on the people who were very familiar with the landed properties such as terrace houses, detached houses and semi-detached houses. This type has also affected their urban lifestyle. In Malaysia, apartments are supplied by the public and private sectors. Apartment planning supplied by the public sector is very simple and uniform. However, apartment planning supplied by the private sector has demonstrated an improvement in residents' living conditions and better response to their housing needs and requirements. For these reasons, this study focuses on the apartments supplied by the private sector. The authors selected 34 housing precincts in Kuala Lumpur for this study, and analyzed their site plans, block plans, and unit plans in order to extract their representative typologies.

As a result, the authors could understand the unique characteristics of apartment planning in Malaysia, and ultimately, were able to grasp its essential housing needs and the regional characteristics of Malaysian apartment planning.

Keywords: apartment planning; block plan; unit plan; size of house; typology

1. Introduction

1.1 Background and Aim of Study

After World War II, as Malaysia experienced rapid industrialization, cities came to expand dramatically due to the concentration of the population. In this process, many housing problems began to surface, including urban slums and insufficient housing. Such problems appeared in Kuala Lumpur, the capital city of Malaysia, as well. Apartments, a western housing typology with high population density, were imported and transformed to resolve these housing problems.

In Malaysia, housing is basically classified by its price: low-cost, low-medium-cost, medium-cost, and high-cost housing.¹ According to Ju & Saari (2010), representative housing types in Malaysia were classified in terms of their forms into shophouses,

bungalows, terrace houses, semi-detached houses, cluster houses, and apartments. The apartments examined in this study can be defined as flats, walk-up four story housing blocks and high-rise housing blocks equipped with lifts for medium-cost housing.

Apartments supplied by the public sector were essentially simple and uniform units (Ju and Jeon, 2011). However, with the recent increasing interest in living standard in Malaysia and the rise in resident expectation concerning dwellings, problems began to arise such as residents refusing to move into public apartments that do not reflect their housing needs.

As a follow-up on the author's previous study on Malaysian public apartments, this study aims to examine the planning principles of apartments supplied by the private sector, which demonstrate a better response to residents' housing needs and are designed to be more appropriate for regional housing culture and environmental conditions.

This study has the following detailed objectives: first, to understand the basic status of the site plan, such as density, size, public facilities, and parking types, and the key points of its design trend, in order to better understand the block and unit plan; second, to pick out the representative typologies of block plans and analyze their planning principles; third, to

*Contact Author: Seo Ryeong Ju, Professor,
Department of Housing and Interior Design,
Kyung Hee University, 522 College of Human Ecology,
1 Hoegi-dong, Dongdaemun-Gu, Seoul, 130-701, Korea
Tel: +82-2-961-0256 Fax: +82-2-961-0256
E-mail: jcl@khu.ac.kr

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select representative typologies of unit plans in terms of space organization, and analyze the sizes of each of the house spaces to understand the basic guidelines in designing a unit; and finally, to identify unique and regional characteristics of apartment planning supplied by the private sector in Malaysia.

1.2 Scope and Methodology of Study

This study focuses on medium-cost apartments to understand the general life styles of Malaysians.²

The initial intention was to investigate all the apartments supplied by the private sector in Kuala Lumpur, the capital city of Malaysia since the 1970s when the construction of apartments started. Because the DBKL (Dewan Bandaraya Kuala Lumpur, City Hall of Kuala Lumpur)³ has not kept full record of apartments built in Kuala Lumpur to date, this study includes only a total of 34 precincts acquired through a number of stages and using the available data from DBKL.⁴

Typically, the components required to develop housing precincts include site, housing blocks, and units, and the framework of this study is based on these components. Detailed elements were developed and selected according to the framework shown in Table 1. Based on this framework and the documents obtained from DBKL, the study employs field surveys for the exact understanding of the precincts. Field surveys included photographing, observation and measurements that were conducted during the period of July 24 to August 6, 2011.

Table 1. Framework of Analysis

Site Plan	Block Plan	Unit Plan
Density	Block Layout	No of Rooms
Site Size	Air Well	No of Bays
Site Layout	Pocket Space	Unit Layout
Public Facilities	Core	Size of Unit
Parking Type	(EV, Stairs)	Size of Spaces
	Corridor	

2. Housing Supply of Malaysia

In Malaysia, housing is supplied by two sectors, public and private. The housing supply of each sector is shown in Fig.1. While the public sector supplies mainly low-cost housing, the private sector supplies

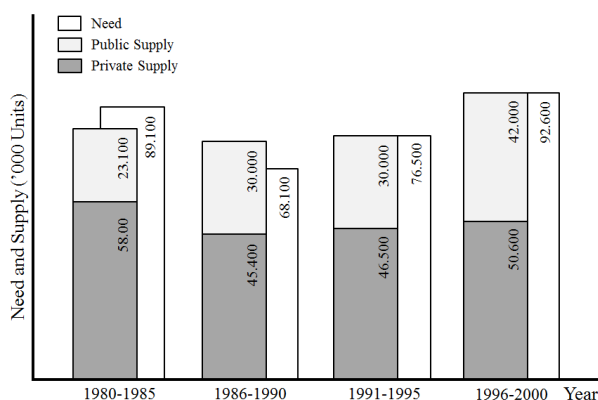


Fig.1. Summary of Housing Need and Supply (Source: Kuala Lumpur Structure Plan, p. 39)

housing for all income groups. Thus, as can be seen, the private sector supply occupies a large percentage of the total housing supply. However, the private supply amounted to 58,700 (71.8%) during 1980-1985, and decreased to 50,600 (54.6%) during 1996-2000. This may be because the public sector has implemented a housing policy for all income groups (Fig.1.).

3. Case Analysis

3.1 Overview of the Objects

Table 2. shows a list of the apartments examined in this study. The average number of units per precinct is 179.71 (1980s), 432.47 (1990s), and 371.13 (2000s). The average unit density (units/acre) in the 1980s is 84.42, and it increased to 122.41 (1990s) and changed again to 91.88 (2000s). All the numbers of the blocks in a precinct are below 6 except for one case (00-5C). Stories got higher and higher over time, aided by the technical development. Units have 2-4 bedrooms, however, this study focused on 3 bedroom units to concentrate on middle-cost housing.

Table 2. The Overview of Surveyed Apartments

Project No.	Built Year	Block Type	Site Size (acre)	No. of Unit	Density (unit/acre)	No. of Block	Storey	No. of Bedroom	Unit Size (m ²)	No. of Unit Type
70-1C	1975	A	0.87	64	73.56	2	4	3	78-91	2
80-1C	1984	D-4	6.69	356	53.21	5	5	3	87	1
80-2C	1984	D-4	8.21	288	35.08	4	5	3	87	1
80-3C	1985	S	0.70	90	128.57	1	10	2-3	86-137	3
80-4C	1986	S	2.52	142	56.35	4	3.5-6	3	83-89	2
80-5C	1988	D-3	1.39	198	142.45	1	13	2	78	1
80-6C	1989	D-2	1.18	120	101.69	2	12	2	95-127	3
90-1C	1990	D-S/D-2	10.50	448	42.67	5	12-15	3-4	78-145	5
90-2C	1992	S	7.20	592	82.22	3	16-22	3	75-86	4
90-3C	1993	S/ D-4	2.83	118	41.70	4	9-10	3	85	1
90-4C	1993	D-3	6.54	329	50.30	3	8-9	2-3	69-80	3
90-5C	1994	D-4	9.30	659	70.86	3	16-22	3	75	1
90-6C	1994	T	15.6	1245	79.80	1	27	3	121-134	4
90-8C	1994	D-2	0.37	37	100.00	1	6	2-3	64-110	3
90-9C	1995	D-2	3.82	205	53.66	2	14	2-3	107-130	2
90-10C	1996	T	5.58	150	26.88	2	12	3	93-137	3
90-11C	1996	D-2/D-4	2.35	140	59.57	3	8	3	79	2
90-12C	1997	S	5.99	720	120.20	5	15	3	56	1
90-13C	1998	D-3/D-4	3.13	212	67.73	2		2-4	77-170	6
90-14C	1999	D-S	2.98	344	115.44	2	13	3	63-70	4
90-15C	1999	D-S		1240		3	10	2-3	55-82	5
00-1C	2000	D-2	6.70	577	86.12	5	15	3	85	1
00-2C	2000	D-2/D-3	5.22	540	103.45	3	16	3	54-129	3
00-3C	2001	T	5.58	419	75.09	3	16	3	102-142	3
00-4C	2001	D-2/1	3.13	202	64.54	1	19	2-3	81-94	10
00-5C	2001	D-2	3.52	246	69.89	1	16	3-4	101-163	5
00-6C	2002	D-S	8.21	757	92.20	6	16	3	53	1
00-7C	2003	D-2	29.20	852	29.18	3	27	3	86	2
00-8C	2003	D-S	2.36	316	133.90	1	22	3	70	2
00-9C	2003	S	3.13	156	49.92	3	5-10	3	77-108	3
00-10C	2003	T	0.90	215	238.89	1	33	2		4
00-12C	2005	D-4	6.79	270	39.76	2	14	3	79-82	2
00-13C	2005	D-2/1	1.63	252	154.60	1	25	3	82-119	4
00-14C	2005	T	9.16	480	52.40	3	35	3	139-176	4
Total 34 precincts										101

S: Single-loaded Corridor Type, D-S: Double-loaded Corridor Type-Standard, D-2: Double-loaded Corridor Type-2 Units, D-3: Double-loaded Corridor Type-3 Units, D-2/1: Double-loaded Corridor Type-2&1 Units, T: Tower Type, A: Atrium Type

3.2 Analysis of Site Plan

Regarding site planning, there are many small precincts with only one to two block buildings (44.1%). Excluding single block precincts, blocks were found to be arranged in semi-courtyard I-shapes in most cases (26.3%) and arranged in square courtyards in some cases. Compared to public housing, the most noteworthy

characteristic is the strong security in the form of gated communities. All the surveyed precincts have security offices at the gate, and security guards control visitors.

In Malaysian residential communities, religious facilities are very important elements. They are allocated in the neighborhood taking into great consideration the different ethnic and religious groups of the community.

An Islamic prayer room called '*surau*' is to be arranged within sites. In public housing, *suraus* are often arranged as separate buildings, however, in private housing, *suraus* are arranged on the first floors of the individual blocks in most cases. In addition, precincts are well equipped with convenient public facilities including a gym, playground, community center, management office, and mini market. Among these, swimming pools are arranged within all sites, as if mandatory. Some have Jacuzzis and barbecue tables beside them. Because there are many convenient facilities to be managed, management services are outsourced to professional management companies.

Outdoor parking or combinations of piloti parking and outdoor parking is the most common type of parking and amounted to 21 cases (61.8%). However, there are also cases where the lower floors (2-4 floors) are used as parking lots (nine cases; 26.5%). This seems to be an attempt to use the lower floors as parking lots instead of living spaces because they are comparatively disadvantaged in lighting and ventilation and where privacy is difficult to secure. The latter form has been prevalent since the second half of the 1990s. In addition, there were seven cases (20.6%) of separate parking buildings.

Though the authors do not have the exact data, they note the trend that in recent projects, 30~40% of total land use was allocated for an open space (and green space). This shows the strong preference for a sustainable environment. The term sustainable development first appeared in the Eighth Malaysian Plan (2000-2005) and then continued to be emphasized in the Ninth Malaysian Plan (2006-2010).

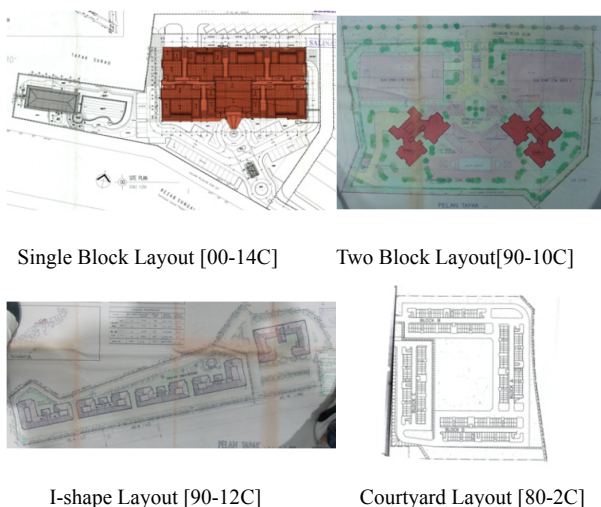


Fig.2. Site Plan Layout

3.3 Analysis of Block Plans

3.3.1 Typologies of Block Plans

The block plans⁵ examined are classified into mainly four types: single-loaded corridor-type, double-loaded corridor-type, and tower type and atrium type (Table 3.).

Among the total 34 cases, the double-loaded corridor-type (26 cases) is the most frequently found type, followed by the single-loaded corridor-type (eight cases), followed by the tower type (five cases) and then the atrium type (one case).

The single-loaded corridor-type (20%) constitutes a form where units are arranged only on one side of the common corridor. Although they are comparatively of more advantage than the double-loaded corridor-type in terms of lighting and ventilation, the standard units in the middle of the block are relatively disadvantaged compared to the units at the ends. In cases of 80-3C, 00-9C, 90-12C, air wells are located to improve the privacy and ventilation of the units.

The double-loaded corridor-type (65%) constitutes a form where units are arranged in rows on both sides of a corridor. Although this is disadvantageous for lighting and ventilation, there is the advantage that a relatively dense population can be accommodated.

Table 3. Typologies of Block Plans

Type	Basic Unit	Sub Type		
Single-Loaded Corridor Type		 80-3C, 80-4C, 90-2C, 90-3C	 80-4C	 90-2C, 00-90C, 90-12C
Double-Loaded Corridor Type	D-S Standard	 90-1C, 90-14C, 90-15C, 00-8C, 00-6C		
		D-2 	D-2-a 80-6C	D-2-b 90-8C
	D-2 	D-2-c 00-5C	D-2-d 00-7C, 90-9C, 90-11C, 00-1C, 90-1C, 00-2C	
		D-3 	D-3-a 90-4C, 90-13C, 00-2C	D-3-b 80-5C
	D-4 	D-4-a 00-12C, 90-11C	D-4-b 80-1C, 80-2C	
		D-4-c 90-5C	D-4-d 90-3C	
	D-2/1 	D-2/1 00-4C		D-2/1 00-13C
		Other	Tower 90-6C, 90-10C, 00-3C, 00-10 C, 00-14C	Atrium 70-1C

Within this type, there have been various attempts to overcome poor lighting and ventilation.

Double-loaded corridor-types can be sub-classified in detail into various types including D-S, D-2, D-3, D-4 and D-2/1, based on the rules of grouping the units, i.e., how many single units were grouped as a basic group and how the basic groups are organized within themselves, pockets and corridors.

The D-S type (five cases) is a standard type where a number of units are arranged in a line. The length of a block is usually long. Therefore, by locating the elevator core and staircases or bending the corridor, blocks are broken into several clusters.

In the D-2 type (nine cases), a basic group consists of two single units. The advantage of this basic two unit group is that one side of a unit can face the outside, and the rooms can easily have windows compared to the units where both sides of a unit have shared walls with other units.

Within the D-2 type (nine cases), D-2-d (six cases) is a representative type where two unit groups are coupled with different two unit groups at opposite sides of a corridor, then this four unit cluster is doubled at both sides of the elevator core. This type has a similar effect as the tower type regarding privacy, daylight, and ventilation.

In the D-4 type (six cases), the basic group consists of four single units where the two units at the end are of the corner type, and the two units in the middle are standard types.

Similar to D-2-d, D-4-a consists of four clusters of four unit groupings with a core in the center. In D-4-b and D-4-c, 6 unit groupings or two unit groupings were mixed with four major unit groupings.

D-2/1 is similar to D-2-d and D-4-a, but D-2/1 adopts three odd units instead of two or four even units.

The tower-type (12.5%) constitutes a form where several units cluster around the central core. Among the three types above, it is the most advantageous in terms of lighting and ventilation. This type first emerged in the 1990s and also later in the 2000s.

The atrium type is only found in the 70-1C case, the only case built in the 1970s. At the same time this type is pretty similar to the block plan of public apartments of DBKL.

As a result, the authors found that in recent years, to increase the density of projects, double-loaded corridor-types have been adopted more often than other types. Also, various trials of grouping units in double-loaded corridor-types to provide a better residential environment have been developed in recent years.

3.3.2 Relationship of Air Wells and Pockets to Corridors and Units

One interesting finding from the analysis of block plans is the relationship of the air well⁶, the corridor, and the pocket between two or several coupled units.

In a typical layout of a block plan, two side separating walls of a unit are blocked, and the front width of a unit is limited; therefore, providing

windows to all rooms in a unit including bathrooms is impossible. However, according to Malaysian regulations, more than 10% of the total space should be allocated for windows, and each room should contain a window to allow for natural ventilation. Therefore, to provide windows to all rooms in a unit, air wells and pockets between units are essential elements in Malaysian apartment planning.

Generally, adjacent units share an air well located at the back of the unit and which faces the corridor, and they have a pocket between the two units at the front. Both the air well and pocket space function as openings for ventilation and day lighting, and also as a device to protect the privacy of the units.

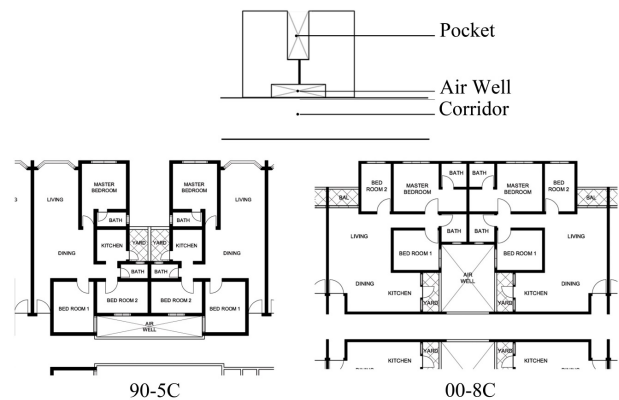


Fig. 3. Representative Types of Air Wells and Pockets

3.4 Analysis of Unit Plan

3.4.1 Typologies of Unit Plans

A house can be understood as a series of orderly relationships among spaces and people, i.e., these relationships have patterns. Space organization in houses is, in fact, a more fundamental aspect of the designed environment than shape, material, and the like (Rapport, 1977). Space organization is a useful tool for analyzing housing design and uncovering the underlying compositional principles of unit plans.

According to Cho *et al.*'s (1987) study, the important factors to formulate the space organization of apartment units are unit sizes, number of rooms, number of bays, and entrances. Therefore, in this study, to classify the space organization of units, the authors adopted the number of bays in the front as a basic reference. The units analyzed were found to comprise three types: the 2-bay, 3-bay, and 4-bay-types (Table 5.).

2-bay-types are the most simple and general types with the bedroom and living room in the front in all types of area. The reason why 2-bay-types are adopted more often than other types is the economic rationale to accommodate more units in a same size block plan.

2-bay-types are categorized into six sub-types, which can be re-grouped into two: a kitchen located in the middle of a unit (2b-C, 2b-D, 2b-E) and kitchen located in the back of a unit (2b-A, 2b-B, 2b-F). There were seven units out of 29 analyzed that had types with a kitchen in the middle of the unit, while there were 22

units that had a kitchen located in the back of the unit. The authors found a trend that in recent years the norm has been to have a kitchen in the back of the unit, i.e., the corridor side. This finding proves that the ventilation of kitchens is more important than that of bedrooms.⁷

In cases where the kitchen is located between bedrooms, it is difficult to expose the kitchen to the outside for ventilation unless the unit is a corner type where the kitchen and the bathroom located between bedrooms can have a window.

An apparent phenomenon is the diverse attempts to improve the day lighting and ventilation condition for every room in a unit. For example, locating air wells and pockets between units by resetting the front facade are the common attempts found in unit plans.

3-bay-types appeared more in the 1990s than before. In 3-bay-types, bedrooms and living rooms are located in the front. They can be re-grouped into units with one bedroom in the front (3b-A; 8 units) or units with two bedrooms in the front (3b-B, 3b-C, 3b-D; total of 14 units). Therefore, units with two bedrooms in the front are more popular than units with one bedroom in the front. The authors can understand that bedrooms are more important than a living room.

3b-B, 3b-C, and 3b-E, all have two bedrooms in the front. As mentioned above, Malaysian housing is characterized by a clear distinction between private space and public space within units. However, as an exception, the 3b-C-type is a rare case, where the bedrooms are planned on both sides of the living room.

In 4-bay-types, the configuration is such that all two or three bedrooms are located in the front, where the bedrooms can be arranged in a row or in an L-shape. 4-bay-types mainly appeared in the 1990s, with the understanding that they reflect the trend of a comfortable living environment.

The difference between Southeast Asian and East Asian countries with regards to unit plans is the arrangement of air wells and bathrooms. In East Asia, South orientation and a view of the outside are important issues, when choosing a house. Therefore, generally, the master bedroom and living room are first located in the front, and the bathroom is located in the middle without an opening but with mechanical ventilation. Because of the hot and humid climate, however, in Southeast Asian countries, bathrooms are legally required to be exposed to outside air.

Also for economical design, the width of the front is limited, so that units are generally designed in a narrow and long configuration. Besides the corner type, it is important to decide which room should be located in the front or in the back that has access to natural light and fresh air. Generally, the priority is the living room, then the master bedroom. The spaces in the middle of a unit that have no access to the outside generally have a pocket space or air well to obtain fresh air and light.

In addition, apartments supplied by the private sector have their unique characteristics compared to public

housing. Even within the same precincts, diverse types of units were supplied. As for public housing, while mostly one to two types of unit were supplied, as for those apartments supplied by the private sector, a maximum of 10 types were supplied within the same precinct (00-4C), with an average of three types of unit plans supplied within the same block. Experimental trials of unit plans were also found, such as mezzanine floor units and three floor units, both of which were excluded in this study.

3.4.2 Relations between Rooms and Air Well/Pockets in Units

As discussed in 4.3.2, providing windows to all rooms in a unit where the width of a unit is limited is impossible.

Various attempts have been made to allow all spaces to be exposed to the outside air such as providing a pocket space and/or air wells in the middle or in the back. These diverse attempts define the unique characteristics of Malaysia apartment planning.

The authors examined the configuration of air wells and pocket spaces, and spaces adjacent to them. When designing an air well or pocket space, a space named as a yard (which is a utility space for washing and drying clothes and which is also used as a wet kitchen) serves as an open space to provide fresh air for kitchens and toilets located at the back of a yard. Generally, the yard is adjacent to the air well or pocket space.

Since the 1990s and more often in the 2000s, long narrow air wells appeared between corridors and rooms at the back of a unit. This phenomenon may suggest an increased importance of privacy and also natural lighting and ventilation.

3.4.3 Size Analysis

The authors categorized the surveyed units into six groups according to the unit size⁸ and measured the size of each of the unit spaces.⁹ They then came up with an average size of each space and its percentage to gross area.

Table 4. and Fig.4. show the size of each space (L+D, K, MB, B and BT) in a unit, ranging from small gross areas (S1) to large gross areas (S6). Fig.6. shows each space in terms of its percentage relative to the gross area of the unit.

According to Table 4., the area of L+D increases as the unit size increases from 22 m² (S1) to 60 m² (S6), with an average of 37.25 m². The kitchen area (K) also increases as unit size increases. The average size of K is 7.98 m², while its size varies from 5.98 m² to 11.25 m². The master bedroom area also increases as the unit size increases from 10.63 m² (S1) to 20.63 m² (S6) with an average of 14.69 m².

The number of rooms is typically three (including a master bedroom) up to S4 (89-93 m²), while the number of rooms increases to four, as the unit size is larger than S5 or above. The number of BT is typically two up to S4 (89-93 m²), where the smallest size is only 1 m² and the largest size is 4 m². The number of BT increases to four in S5 and five or higher in S6. S5 has 4 bathrooms, and their sizes range from 2.00 m² to 4.27 m².

The smallest bedroom (B) exists in the S1 category with an area of only 6.25 m². On the other hand, the largest room is in the S6 category with an area of 14.88 m².

S1 is the only category which has no utility rooms. In other categories, it ranges from 3.00 m² to 5.20 m². Yards are found in all categories, which range from 2.50 m² to 6.33 m², while balconies range from 3.00 m² to 6.88 m². The S5 category, which is not the largest size group, consists of the most diverse room functions, including functions such as storage rooms and study rooms.

Table 4. Size of Each Space by Unit Size (m²)

	Low		Low Med	Med	Med High	High	Total	
	S1 <65	S2 65-74	S3 75-88	S4 89-93	S5 94-139	S6 >139	ST (aver.)	%
L+D	22.0	26.3	32.5	37.3	45.4	60.0	37.2	37.1
K	6.5	5.9	7.5	8.0	8.8	11.3	8.0	8.0
MB	10.6	11.9	13.1	14.3	17.6	20.6	14.7	14.7
B1	8.3	8.8	9.9	10.1	11.8	14.9	10.6	10.6
B2	6.3	6.3	8.3	8.8	10.0	12.8	8.7	8.7
B3	-	-	-	-	8.0	11.0	3.2	3.2
BT1	2.1	3.0	3.1	4.0	4.3	5.3	3.6	3.6
BT2	1.8	2.7	3.2	3.9	3.6	4.5	3.3	3.3
BT3	-	-	1.0	-	2.8	2.6	1.1	1.1
BT4	-	-	-	-	2.0	2.8	0.8	0.8
BT5	-	-	-	-	-	1.0	0.2	0.2
ER	5.5	6.6	6.4	6.0	12.7	15.5	8.8	8.8
Total	63.1	71.5	84.9	92.4	126.9	162.2	100.2	100.0

B: bedroom, K: kitchen, L+D: living + dining room, MB: master bedroom, BT: bathroom, ER: extra room, balcony, utility, yard, study room and storage

According to Fig. 4., the average percentage of each space to the gross area of a unit is as follows: MB+B (37.2%), L+D (37.1%), K (8.0%), BT (8.9%), ER (8.8%). Bedroom (MB+B) space dominantly contributes to the largest area among others. The second largest is the living room and dining space (L+D).

While L+D and MB+B as percentages to the gross area remain largely stable regardless of gross area, the absolute L+D and MB+B spaces increase sharply as shown in Fig. 4. This result shows the steady preference for a bigger size of L+D and MB+B spaces.

The percentage of K to the gross area declines as gross area increases as shown in Fig. 4. Absolute K areas, however, increase moderately as in Fig. 4. This

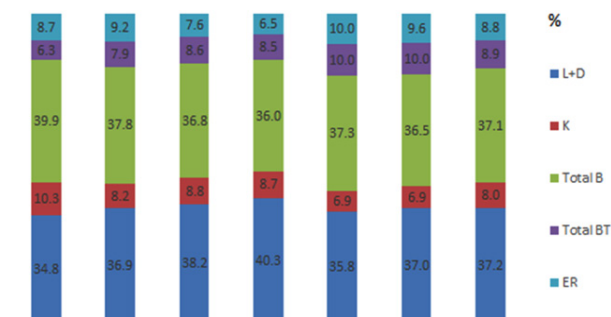


Fig. 4. Space as Percentage to Gross Area by Unit Size

is because a bigger unit has a large sized U that is used for cooking and housekeeping, thus supplementing the K space.

BT is the only area which increases in terms of its percentage relative to the gross area with the increase in gross area, as shown in Fig. 4. This is because the number of BT increases as gross area increases as mentioned above although the absolute single bathroom size remains stable regardless of gross area. This means that residents think the number of bathrooms is more important than their size.

4. Conclusion

This study examined the characteristics of apartments constructed by the private sector in Malaysia through case studies analyzed in terms of site plans, block plans, and unit plans.

Based on the overall examined characteristics, precincts are planned as small sites that mainly consist of only one to two blocks. Even when precincts are large, the layout of the block buildings is simple, as in single rows or courtyard types.

The typologies of block plans can be classified into four major types: single-loaded corridor-types, double-loaded corridor-types, tower types, and atrium types. The double-loaded corridor-type is the most prevalent. However, there are many attempts in this type to make it advantageous for lighting and ventilation by locating air wells between units and corridors or pockets between units. Recently, the tower-type has emerged which is the most advantageous for lighting and ventilation.

The unit plan can be classified into three typologies including the 2-bay, 3-bay, and 4-bay-type. The 2b-A-type is the most typical typology in the 2-bay-type. Within this typology, there are many attempts to locate the bathroom, bedroom, air wells, and pockets in different ways to improve day lighting, ventilation and privacy for a unit. Within the 3-bay-type, 3b-A-type is the most general type, and it is almost similar to the 2b-A-type. In the 4b-A-type, three bedrooms are located at the front and take 3 bays. The 4-bay-type appeared in the 1990s as an attempt to enhance the quality of the living environment. Because of the hot and humid climate in Malaysia, bathrooms are legally required to be exposed to the outside. For this reason, there are many cases where the bathroom is located in the front, even though it may disturb the front view of a room, or beside an air well to bring air into the bathroom.

This study could only examine some limited cases in Kuala Lumpur; therefore, it is difficult to generalize the findings of this study to all other apartments in Malaysia. Nevertheless, it is worthwhile to try to collect data and organize it systematically according to typologies. Finally, the authors were able to understand the unique regional design factors to be considered for medium-cost apartment planning in Malaysia.

Table 5. Typologies of Unit Plans

S1 (<65m ²)	2b-A 	90-15C-d 	2b-B 	90-15C-a 	00-06C 	3b-A 	90-8C-a 	00-02C-c 	3b-B 	90-12C-a 	90-14C-a 		
S2 (65-74m ²)	2b-A 	90-4C-b' 	90-10C-b 	90-13C-b 	00-04C 	3b-B 	90-14C 	90-15C 	00-08C 				
S3 (75-88m ²)	2b-A 	00-12C1-a 	00-07C-a 	2b-B 	90-2C 	2b-C 	90-1C-a 	90-1C-b 	2b-D 	90-5C 	80-4C-b 	90-3C 	
	3b-A 	90-13C-b 	00-09C-b 	3b-B 	80-5C 	3b-E 	70-1C-a 	3b-C 	90-1C 	90-15C-b 	4b-A 	90-11C 00-01C 	
S4 (89-93m ²)	2b-A 	90-10-b 	2b-E 	80-4C-a 	2b-F 	90-13C-c 	00-04C 	3b-B 	70-1C-b 	S5 (94-139m ²) 	2b-A 	00-02C-b 	00-09C-a
		00-13C 	0-03C 	00-04C-a 	80-6C-a 	90-10C-c 	2b-F 	80-6C-b 	3b-A 	90-10C-a 	90-13C 	00-02C-a 	
S5 (94-139m ²)		00-5C 	90-6C 	3b-D 	90-8C-b 	90-9C-b 	3b-E 	00-14C-b 	4b-A 	80-3C-b 			
		00-03C-a 	00-14C-b 	3b-A 	80-3c-a 	3b-B 	00-05C-c 	4b-D 	90-13C-d 				
S6 (≥139m ²)	2b-A 	00-03C-a 	2b-D 	00-14C-b 	3b-A 	80-3c-a 	3b-B 	00-05C-c 	4b-D 	90-13C-d 			

B: bedroom, K: kitchen, L: living room, MB: master bedroom, T: toilet, b: Balcony, u: utility, y: yard, : airwell, : entrance, : shearing wall

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Notes

¹ The Category of House Class is Decided According to House Price.

Category		House Price Per Unit (RM)	Target Group /Income per Month (RM)
Before June 1998	Low Cost	< 25,000	< 750
	Low Medium Cost	25,001- 60,000	750-1,500
	Medium Cost	60,001-100,000	1,501-2,500
	High Cost	> 100,001	> 2,501
After June 1998	Low Cost	< 42,000	< 1,500
	Low Medium Cost	42,001-60,000	1,501-2,500
	Medium Cost	60,001-100,000	Not Stated
	High Cost	> 100,001	Not Stated

(Source: SYAFIEE, S. (2004). Low Medium Cost Housing in Malaysia: Issues and Challenges, APNHR Conference.)

² As for low-cost housing, there were too many restrictions in terms of size and facilities so that basic and uniform units were supplied. Incidentally, in high-cost apartments, called condominiums, there were few restrictions in design because the area allowed is pretty spacious and many high-end condominiums are targeted at foreign residents. Therefore it was inappropriate to study low-cost or high-cost housing for understanding the typical and general housing lifestyle and needs of Malaysians. As for middle-cost housing, there was more freedom than low-cost housing in designing a house, but the idea remains to try to develop a design solution in a limited space and tight budget. Therefore many thoughtful design elements and devices have been seriously considered and invented throughout the years.

³ It was officially launched as the DBKL following the establishment of Kuala Lumpur as the official capital in 1972. Under the vision of making Kuala Lumpur a "World Classic City" by 2020, it performs duties and implements projects regarding urban hygiene, urban public health, urban beautification, social infrastructure construction, public transportation infrastructure construction, public housing supply, certificate issuance, and cultural projects.

⁴ The initial intention was to systemize the existing data of all apartments supplied by the private sector in Kuala Lumpur starting from the 1970s and to conduct field surveys on at least 10 selected representative cases according to their construction dates. However, the DBKL had yet to organize such accurate data. Obtained through numerous stages, the authors acquired a table of apartments existing in Kuala Lumpur with the most approximate data containing detailed information such as year designed and population. However, not all information was indicated in these data. The researchers requested documents regarding the 80 representative sites selected based on the data above from the City Planning Department (Jabatan Perancang Bandar). However, because the documents had not been systematically managed, it was difficult to find the data requested. Consequently, out of the collected data, only 34 sites possessing site plans, block plans, and unit plans were analyzed.

⁵ In some precincts, there exist different types of block plans; therefore the total number of block plans analyzed in this study is 40.

⁶ Air well is a space connected from the ground floor to top floor for natural ventilation purposes. The minimum size of an air well depends on the height of each building and is stipulated in Article 40 of the UBBL.

Height (Storeys)	Buildings (m ²)	Bathrooms (m ²)
2	7	3.5
4	9	4
6	11	4.5
8	13	5
> 8	15	5.5

(Source: Uniform Building By-Laws 1984)

⁷ In the 1980s, about half of the units had a kitchen in the middle and another half had a kitchen in the back, but in the 1990s, the majority (nine out of 13 units observed) had a kitchen in the back. In the 2000s, the norm became to have a kitchen in the back, comprising 18 out of 20.

⁸ In Malaysia, housing supply is determined according to housing price and the minimum size of housing is also suggested depending on housing price. According to this guideline, the authors classify unit plans collected into 6 categories.

Category of Housing Cost	Unit Size
Low Cost	700 sq. ft
Low Medium Cost	800 sq. ft
Medium Cost	950 sq. ft
Medium High Cost	1,000 sq. ft
High Cost	1,500 sq. ft

⁹ In each precinct, several types of unit were applied from 1 to 10 types. The authors analyzed all 104 units plans for size analysis excluding mezzanine types and 3 floor units.

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