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Living with Transformation

Self-Built Housing in the City of Dhaka

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To my parents

Preface

Self-built houses are inseparable parts of urban built environment. Mostly prevalent in the developing part of the world, they are often ignored by researchers. However, due to its bulk, they have been attracting recent researchers around the world. Often accused of creating unhealthy urban development, they catch the observers' eyes for the wrong reasons. However, a closer look and sensitive investigation can bring up a different picture. This book is such an attempt. Beginning with some contextual description of the neighborhoods with respect to the city of Dhaka, Bangladesh, it focused on a particular phenomenon of spontaneous transformation, which due to its particular nature can be regarded as a dominant identity of these houses. First, it tried to categorize the otherwise random looking incidents of transformation. Later, it explored the behavioral patterns of such categories. By doing so, it tried to represent these houses not only just as a static element, but also as a dynamic element in time, which passes through different stages of aging just as human beings. With the experience of living in these houses for a major part of my life, and using my professional knowledge as an architect as well as my lifelong experience in academics and research, I tried to unfold them as characters in human life; sensual and alive.

Skudai, Malaysia, 2013 Tareef Hayat Khan

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Finally, my passionate appreciation goes to my wife Dr. Naznin Sultana for her continuous support and inspiration during the whole time.

Contents

Abstract

This book describes and analyzes the phenomenon of spontaneous transformation in self-built houses in the context of developing countries. After describing briefly the history of self-built houses in the context of Dhaka City, it focused on the phenomenon of spontaneous transformation. Later, it explored the different categories of the transformation incidents inside these self-built houses. Finally it unfolded various explicit behavioral patterns associated with these transformations. The phenomenon of spontaneous transformation has been recognized in this book more as a behavior by not only looking at it from its physical aspects but also from the context-specific social, economic, and cultural aspects.

Keywords Spontaneous transformation · Self-built houses · Dhaka City

Chapter 1
Self-Built Houses (SBH) in Dhaka City

Abstract Self-built houses are defined in this study as those which are developed by the owners by using their own leisure time. They are in abundance especially in the developing countries where the public sectors are not resourceful enough to cater for the lower income group. In the particular context of Dhaka City, these self-built houses are found to be located in confused sprawls, a particular type of urban development evolving at urban fringes when agro lands are converted to urban residential quarters. This chapter describes the different morphological and non-morphological issues related to the self-built houses in confused sprawls in Dhaka City in order to familiarize the reader to the particular context.

Keywords Self-built houses · Confused sprawl · Dhaka city

1.1 The Concept of Self-Built Houses

Self-built houses have been defined in many ways by different scholars depending on different contexts. Looking at the history, vernacular housings were traditionally built by the owners literally by their own hand, and thus the definition of self-built house can be applicable to that context only. However, in the growing urban context, the scenario changed. Introduction to newer materials and technologies demanded specialized technicians or masons to offer professional help in constructing houses. Professionals have started to be involved in all the traditional phases of building process namely design, construction, management, and maintenance. The developers, public or private, have emerged as inseparable part of the huge construction industry, and the owners are often left to choose their house from the market.

However, in different parts of the world, especially in cities of developing countries, owners still play a substantial role in the building process. However, the degree of their involvement may vary from place to place. Therefore at the outset, it is important to operationally define self-built houses for the particular context of this book. The criteria to identify them as distinct from other categories are the location, ownership, material, design, construction, management, and investment.

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Rural vernacular has been excluded, and only urban context is considered. Though in some part of urban areas, slums or squatters are built literally by own hand, they were excluded considering two criteria namely ownership and materials. A more popular concept of self-help houses which are literally built by owners as part of rehabilitation program around the poorer settlements around the world, are also excluded from the definition of self-built houses, though they might include structures made of permanent building materials. A self-built house in this book, is considered to be owned by the person who has the ownership of the land, and the house has to be constructed with permanent building materials, which means they have a longer impact on the urban built environment. It would be more appropriate to include only those houses which have been designed by the owner themselves. However, in modern urban contexts, a house is usually required to be designed by a professional as building regulations needs to be abided by. Therefore, both of these options are included in the definition. Hiring a contractor for the whole process of construction, or hiring separate sub-contractors by the owners themselves seldom make any different impact as in both cases the project management remains within the control of the owner. Therefore, both of these options are also included in the definition. Controlling the project also involves controlling the flow of money, and it has been kept as one major criterion for the definition. Thus, self-built houses refer to an informal project management.

Houses by the comparatively richer segment of the society such as mansions, bungalows etc., which can also fulfill the criteria of such self-built houses are also excluded from this study. It is because of their big budget investment, they are likely to be smaller in number, and therefore likely to have less impact on the urban built environment. Thus, the self-built houses become limited to urban middle or low income group of people, constructing houses on their own land with permanent building materials whether by hiring professionals in design and construction phases or not, but controlling the management of the project borrowed from their leisure time using their limited investment.

Mass public housings also fall out of the category, so do the commercially developed apartments, as they are designed, constructed and managed throughout the whole process by public or private developers, therefore leaving no control of management or investment in any phases of the construction to the owners (Fig. 1.1).

Another clarification is needed at this point whether it is mandatory for the owners to be inhabitants of the house they built in order for a house to be recognized as Self-built houses. In fact there are three options for that. Either owners

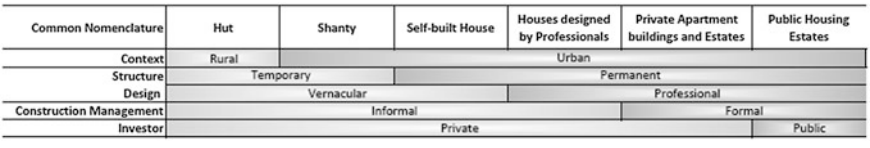


Fig. 1.1 Setting criteria to define Self-built houses. *Source* Author

solely live in their houses, or they are rented out completely, or owner(s) and tenant(s) cohabit in the same building. Ideally there is no conflict to recognize all of them as Self-built houses, but for the sake of simplicity, the owner-only situation, and the tenant-only situations are left out of the definition. The former is omitted because studies show they have less incidents of transformation as the needs grow only from the needs of the owners' family (Seek 1983). The latter is omitted because tenants cannot necessarily transform the buildings or the partitions simply because they do not have that authority (Habraken 1999), unless of course there are some exceptional situations, especially highlighted in the studies of Tipple (2000), where tenants exercised plenty of transformations to the houses they did not own. So, in this study, Self-built houses refer to only those where owner(s) cohabit with tenants. Thus the houses possess the possibility to transform both from the needs of the owners' family, and also from the issues related to tenancy, and consequently offer more variety in transformation.

1.2 Confused Sprawl: Abode of Self-Built Houses in Dhaka City

Urban sprawl, a widely explored field of research, refers to the expansion of urban area to its fringes, thus tuning a previously agro-land, empty or green area into part of the urban built environment. As Harvey and Clark (1965) writes, sprawl is rather an invasion of urban development at the urban fringe, which are scattered or strung out or surrounded by or adjacent to undeveloped sites or agricultural lands. It can be planned or unplanned, controlled or uncontrolled. If planned or controlled, it can be referred to formal sprawl, which offers less complicated issues of urban facilities such as traffic, infrastructure, pollution and such. However, if it is not controlled, as can be referred to as informal sprawls, it is likely to be associated with those issues. Whether desirable or not, urban sprawl is a feature of many cities in the world, and especially it draws a lot of concerns in the cities of developing world, where density is often very high. Informal sprawl is the more common types of sprawl in urban development, though urban areas around the world do not develop similarly at the fringe, nor are their scale similar. However, for cities like Dhaka, there is one more parameter to complicate the situation.

Dhaka city has been historically surrounded by agro land on the sides except on those parts that are bounded by the rivers. Talking about rivers, the whole Bangladesh is a country of rivers with more than seven hundreds of them plying around the whole delta region creating a complicated web (Banglapedia 2006). That is the major reason why the agro lands could not have bigger rectangular or regular shaped chunks one can see in many other countries. Moreover, when these irregular chunks are sub-divided because of hereditary obligation, the smaller chunks become even more irregular and even curvilinear. In most of the cities in Bangladesh, urban sprawl happened spontaneously but mostly as unplanned and

uncontrolled, and in small scales. Irregular shaped chunks of agro land turned into irregular shaped urban plots to create residential neighborhoods in the urban fringe. Inevitably there were needs for roads to give access to these plots. Some roads tended to follow some of the existing irregular paths in the agro land, while others had to be tailored out in a very unsystematic manner. Though these days many developers try to buy a bigger area and convert into regular shaped plots with well-designed road network, turning it into a formal or planned sprawl, most of the previous sprawls were due to individual efforts, and therefore the road network was not a result of a collective process nor was it with a futuristic vision that could foresee the issue of car access or other methods of transportation into consideration. To harmonize with the confusion the roads create inside these newly developed urban neighborhoods, they are contextually defined as 'Confused urban sprawl' in this study. Though physically similar, this is different from Chaotic Sprawl (USBCD 2007), which refers to a forced sprawl rather than a spontaneous one. Confused sprawl is essentially associated with the conversion of deltaic agro land into urban fringe.

Due to lack of a planned method, the plots inside these neighborhoods remained cheaper, and therefore they were occupied by the middle or low income groups, who were mostly the new migrants from rural to urban areas. In most cases, it could remain as the only piece of land they ever owned, and therefore, at some point in their lives, they invested their own money and time to build up their houses. Therefore, these confused sprawls became an abode of self-built houses in the cities of Bangladesh. Dhaka city as the capital, suffered this phenomenon to the most extent.

The confused sprawl in Dhaka, an agro based deltaic Asian City, can be best described from two broader perspectives namely from a morphological perspective and from a non-morphological issues.

1.2.1 Morphological Issues of Confused Sprawl in Dhaka City

1.2.1.1 Historical Development of Confused Sprawls in Dhaka City

A city, if it is let to grow spontaneously, will sprawl with time. Authorities may or may not be able to intervene, and the sprawl may or may not follow the intervention, depending on the degree of control from the authority. However, topographical characteristics can also set the patterns of the sprawl (Rossi 1982). Dhaka has experienced all of them. The whole country is a big deltaic agro land, the patterns of subdivisions correspond to the enormously complicated web like network of rivers around. However, the location of Dhaka was strategic because being in the flat alluvial delta near the Padma-Brahmaputra-Meghna river junction,

and to the north of Dhaleshwari river, it had comparatively less perforation, and hence had more strategic importance. Especially during colonial rules, it was developed as a major trading center in this region and as a consequence, experienced some imposed land use patterns.

However, that was not the only control. As the city needed to grow, the rivers at East, South, and West did not allow sprawling in those directions immediately. Therefore it started to devour agro lands at the North, and they were turned into confused sprawls. Today, bridges are helping the city to sprawl in other directions as well and confused sprawls are located at various corners of the city. Combined to the occasional intervention of the authority with some land use policies in order to control the urban sprawl, some planned developments grew beyond these confused sprawls, and the confused sprawls today are not only at current fringe, but some of them are also trapped as pockets inside the bigger boundary of the city corporation. The confused sprawl is characterized mainly by its organically developed street network, and comparatively smaller, and often non-identical shaped urban plots.

In Fig. 1.2, the curves show how natural waterways influences sub division in agro land.

Similar curvilinear natural waterways such as rivers and canals are in abundance in urban fringes around Dhaka, and the irrigation waterways are important for developing walkways. Moreover, the curbs (*aayl*) which marks the subdivisions, developed as a consequence of land subdivision, are also likely to play a role in land subdivision in the later settlements, as they become the boundaries of plots.

The curbs (*aayl*), be it non-linear or orthogonal, turns in short intervals shown in Fig. 1.2b. The arms are much smaller in scale comparing to the huge and regular shaped land divisions found in parts of Europe, Australia, or US, where it is non-deltaic land (Fig. 1.2c).

More population causes more sub-divisions, and it complicates the situation even more. It is what exactly happened in Bangladesh. When these small and irregular land divisions remain agro, more subdivision may not cause threat to access one's piece of land as one can walk on the curbs. But once they become a confused sprawl, and the small agro-land subdivisions become urban plots, the street network becomes complicated and they are not likely to support vehicular access immediately.

Moreover, while agro land becomes part of urban area, land price increases, and plots are more and more subdivided as they provide good source of income. These divisions do not necessarily follow any long term vision such as car access, fire trucks access. Often it is found that a rear part of certain plot is sold first, resulting in narrow access roads further deepening the problem.

A randomly selected confused sprawl of Dhaka City in Fig. 1.3 shows how complicated the street network can be in confused sprawl.

Tachakitkachorn and Shigemura (2005) discovered few patterns of street networks generated inside confused sprawl while studying the sprawl in the deltaic

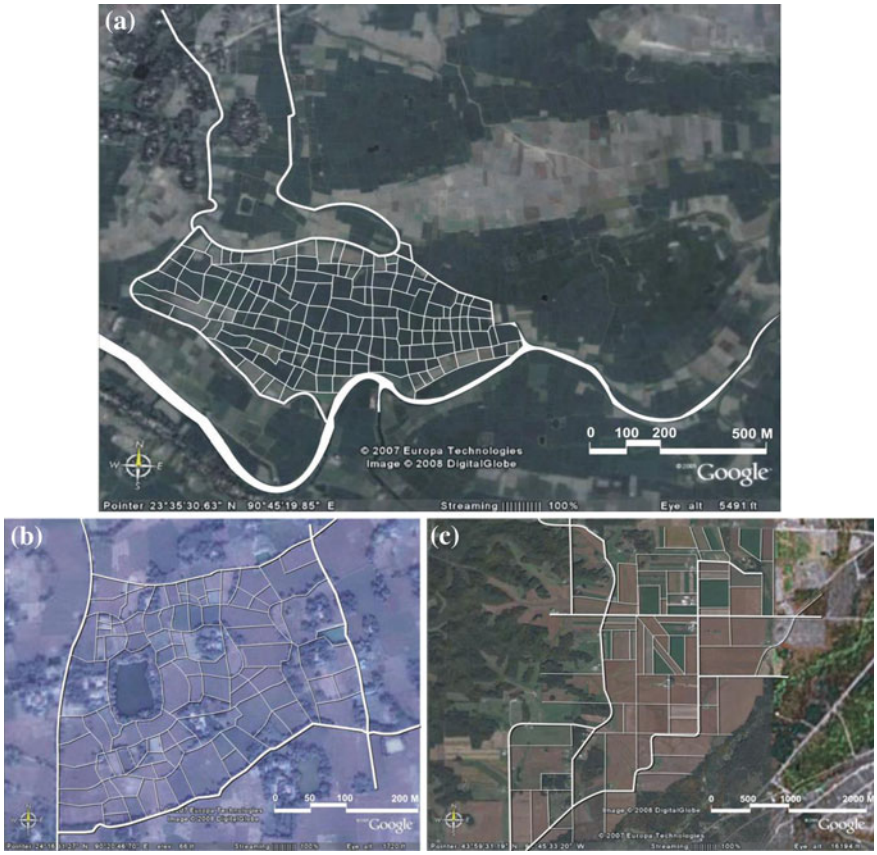


Fig. 1.2 Web of rivers resulting complicated agro land divisions. **a** The web of rivers influences irregular land divisions while curvilinear streets develop to connect one another. The thicker lines are rivers, and the fine lines are land divisions. **b** The land divisions are complicated, irregular, and numerous. This view is from 500 m altitude. **c** This view from 5,000 m shows how big chunks of agricultural land exist in countries with less web of waterways (in this case, US). Similar size viewed from 10 times away means the divisions are ten times bigger in this case. *Source* Google Earth, and author

City of Bangkok. The morphological patterns are of course important to identify particular physical characters, but they found that the governing reasons behind those patterns are more significant. This is because the particular patterns might be context specific, but the reasons behind them are almost the same as any other deltaic agro land settlements. For example, the irrigation waterways play significant role in the land development, which themselves depends on the natural waterways around. The topographical limitations such as the curvature of natural waterways play significant role in developing the land subdivisions as well.

Fig. 1.3 A particular part of confused sprawl in Dhaka City Satellite view showing examples of the urban sprawl, which resembles agricultural land division. *Source* Google Earth, author

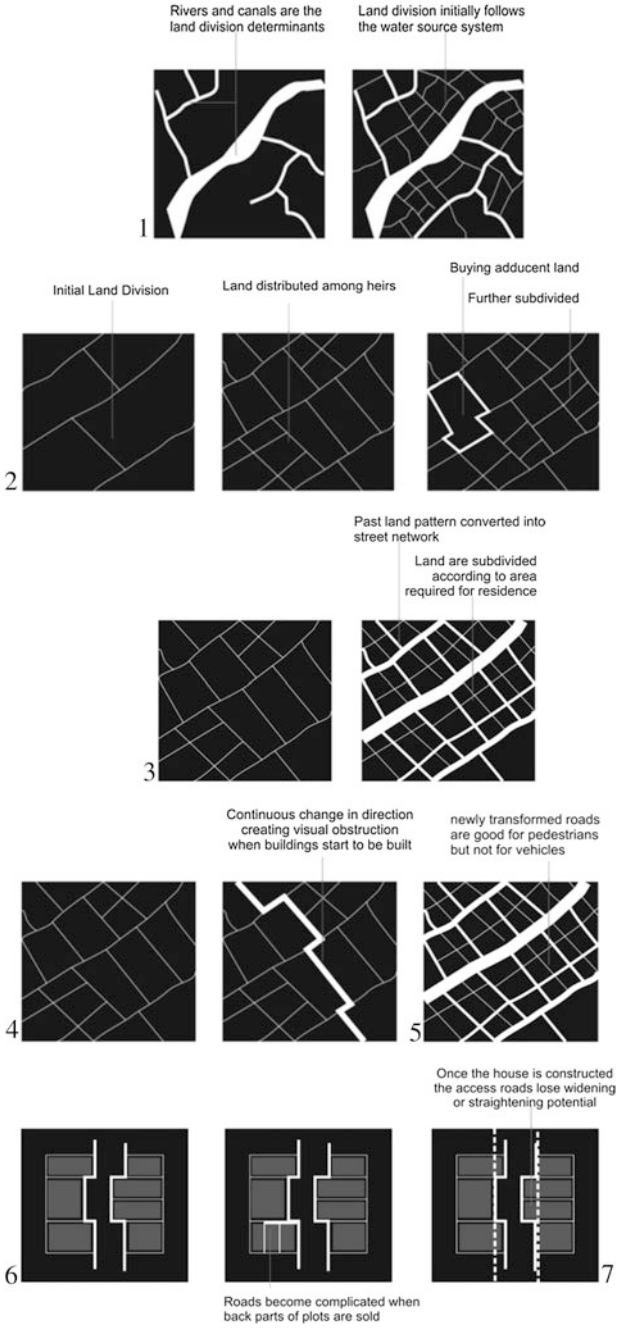
In the context of Dhaka, the conversion agro land into confused sprawl urban neighborhoods can be explained through the sequences shown in Fig. 1.4 below.

1.2.1.2 Location of Confused Sprawls in Dhaka City

The planned Dhaka Mega City was estimated to be around 1,600 sq. km, which would join Dhaka Metropolis with the satellite towns of Tongi, Gazipur, Savar and Narayanganj (Fig. 1.5).

However, the current border of Dhaka City as in 2010 (by Dhaka City Corporation) was around a quarter of it in size (around 400 sq. km) in the middle (diagonally hatched in Fig. 1.5), and the actual urban built-up area was around half of that area, and known as Dhaka Metropolis (around 200 sq. km) (Fig. 1.6b). The rest were still agro land, which are waiting to become part of the bigger metropolis (Fig. 1.6a) just as major parts of current metropolis have been transformed from agro-land in the past the same way.

The metropolis was divided into ten zones and 90 wards inside them (Fig. 1.6b), which were mainly political boundaries based mainly on number of population. Ignoring the development in zone 1, 2, and 3 (Old City of Dhaka), which had different morphological development due to their growth during British colonial period as more like a planned development (1757–1947), the other zones, excluding some extensive planned land-use areas (such as for universities, railways tracks, commercial centers, or formal housing zones), were exclusively residential. They all possessed this same kind of confused sprawl extending towards the North of the Old City. Due to the low income group of people dominating there, self-built houses were very quickly became the dominant type of house form there from its very outset (Fig. 1.7).


Rivers and canals are the land division determinants
Land division initially follows the water source system
1
Initial Land Division
Land distributed among heirs
Buying adducent land
Further subdivided
2
Past land pattern converted into street network
Land are subdivided according to area required for residence
3
Continuous change in direction creating visual obstruction when buildings start to be built
newly transformed roads are good for pedestrians but not for vehicles
4
5
Once the house is constructed the access roads lose widening or straightening potential
6
7
Roads become complicated when back parts of plots are sold

◀ **Fig. 1.4** Summary of historical development of confused sprawl. 1. The deltaic region influences agro land to be subdivided into irregular rectilinear divisions. 2. Furthermore, high number of offsprings in rural areas lead to smaller land divisions in those agro land in Asian rural areas. Additions can also add to more irregularity. 3. Like other Asian cities on deltaic land, street patterns in confused sprawl is directly linked with past agricultural land use patterns, which means these complicated shaped small agro lands become urban plots in the urban fringes. 4. Agro paths with their continuous orthogonal bends at small intervals due to land divisions do not pose threat to visual continuity to fields once they were agro land, but when retained so as neighborhood streets they create visual obstruction and vehicular inaccessibility. 5. These newly developed plots in the urban fringe area are cheaper and generally new rural migrants are tenants here. These tenants do not need motorized vehicles for their transport as they belong to poor and lower middle income groups, thus the complication of street network do not cause much problem for their access immediately. 6. Once within such sprawl, the land shapes are furthermore complicated when people start selling them. Usually they sell the back part of their plots, thus newer and narrower access roads need to be generated, adding the complication of the overall street network of the neighborhoods. 7. The neighborhoods mature quite comprehensively, i.e. houses in most of the plots reach their aspired plot coverage and thus there is less chance that road can be widened in future

1.2.1.3 Urban Façade of Confused Sprawls Compared to Other Parts of Dhaka City

There are some subtle differences in the built forms in old and new Dhaka. The old part mostly had row houses separated with one sharing partition wall. The historical urban façade usually reflected colonial influences in the zone 1 and 2, with classical influence in form or row houses creating European type street blocks (Imon 2006). Contemporary built forms represent shows use of contemporary building materials and facades consisting of eclectic style.

The newer Dhaka has two identifiable developments. The first one is ‘confused sprawl’, while the other one is the ‘formal sprawl’, where the land division and street network is done either by the city corporation or by private developers by occupying lands in the urban fringe. The following picture (Fig. 1.8) shows such two neighborhoods developing side-by side.

Regarding urban façade, there is little difference between confused sprawl, or formal sprawl, or newer developments in ‘old Dhaka’, with all representing eclectic style. In terms of street network, the formal sprawls fare much better than the confused sprawl due to the effort on planning.

1.2.1.4 Street Network Inside Confused Sprawls in Dhaka City

House forms usually correspond to particular plot sizes. As Moudon (1986) stated that this is especially true in middle or lower income housing where the cost of land is an important component, and the plot sizes are only large enough to accommodate the house just comfortably.

Again, plot forms are influenced by street patterns. In such tight situations, plots have no other option than to follow the street lines. Thus, streets, plots and houses

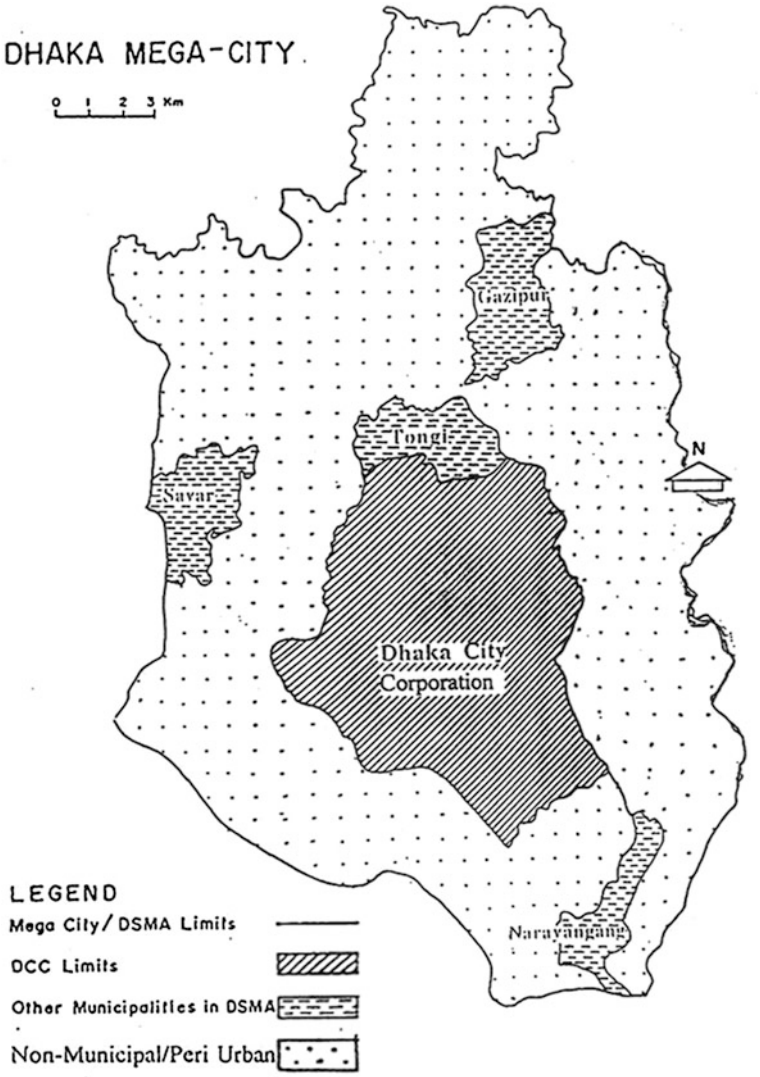


Fig. 1.5 Dhaka megacity. *Source* DCC (2002)

combine to form 'plan units', which are socio-architectural units of developed land which represents the social ideals as well as economic limitations of the first builders (Conzen and Whiteland 1981). Thus a brief study on street networks on the context can be pretty useful for the further investigation on house forms, before going deep into the issue of transformation of these built forms.

The confused sprawls in Dhaka city, where the agro land divisions play a significant role in this deltaic region, streets generate indigenously following the

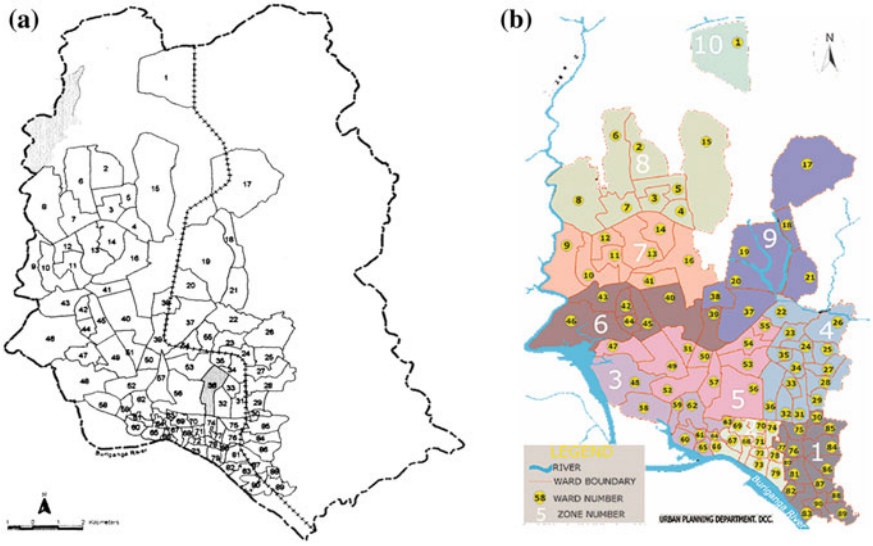


Fig. 1.6 Dhaka City and the actual built-up Metropolis area. **a**. Dhaka metropolis (appx. 400 sq. km) included built-up area as well as non-built-up agro land waiting to be part of the urban built environment through confused sprawl. **b**. The actual built up area so far (appx. 200 sq. km), included 10 zones, which comprised 90 Wards altogether. The boundaries were mainly based on population, though political and topographical factors also prevailed. *Source* DCC (2002)

topographical boundaries such as ditches, canals, irrigation waterways, local field pathways; or sometimes restriction from land-use plan, such as thoroughfares, reserved lands etc. The invasion of urban sprawl towards agro land in the urban fringe do not necessarily overwrites the existing rural streets, and in some way they give an impression of the hybrid continuous curvilinear and cul-de-sac combinations.

However, it seemed easier to use a nomenclature derived from hierarchy of width or connectivity.

For better conceptualization of the hierarchy of street network inside confused sprawl, the hierarchy and definition of residential quarters may be defined simultaneously.

1. For the city of Dhaka, a **Ward** is the biggest identifiable such group. The Ward boundary is often a result of political, topographic or demographic reasons. Therefore, a Ward may not have historical identity and its boundary is subject to change. A Ward can have one or more localities.
2. **Locality** refers to geographically localized community located within the Wards, which are separated by thoroughfares, and fed by a lower order of street network (defined as second order streets), which may or may not connect back to the thoroughfare. A locality may be too big for a resident to psychologically feel the sense of belonging.

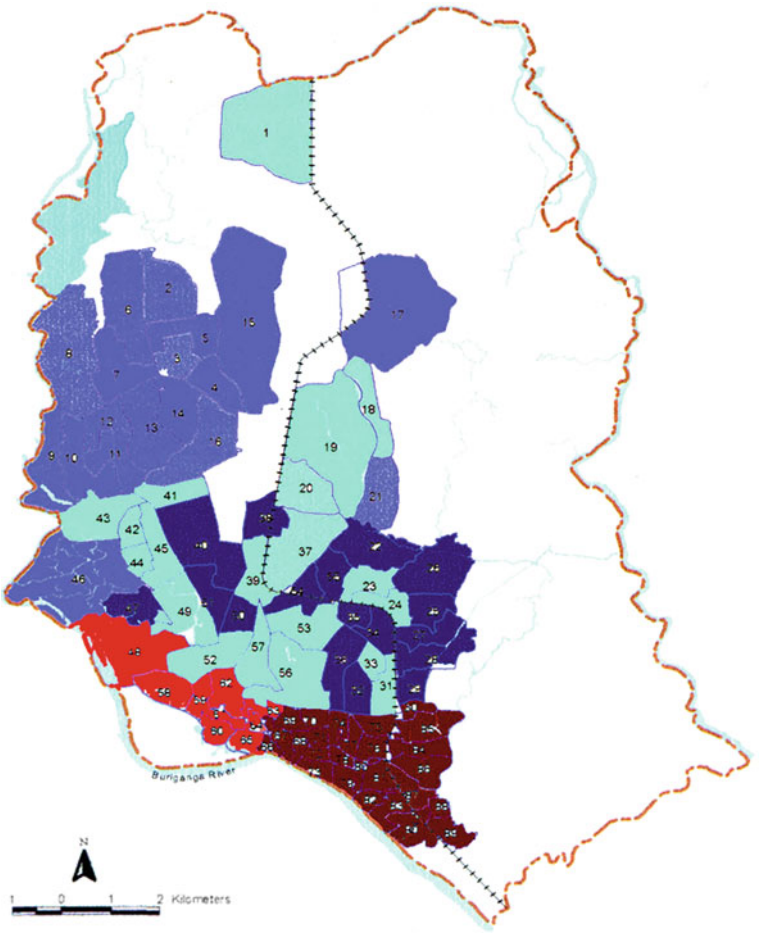


Fig. 1.7 Pattern of development inside Dhaka metropolitan city. *Source* DCC (2002) 'Old Dhaka'(Zone 1, 2, and 3), (in red and maroon) is a small part considering the size of Dhaka metropolis today. The rest are these confused sprawl (deep and light blue), except those areas reserved as land for government development (in Green)

3. The ***'Mahalla's***, or **Neighborhoods** are the biggest area of residential quarters defined by local people inside which they psychologically feel their sense of belonging following their everyday activities (Khan 2001). *Mahalla* boundary can be generated from topographical reasons too, though later land developments may connect them as well. Thus psychological cognition remains the main source of identity of a *Mahalla*. *Mahallas* can be connected in series or in parallel. In the first case, part of the feeder for the locality (second order street) itself serve as the main feeder of the *mahalla* as well, while for the latter, different second order streets feed different *Mahallas.* In the second case, these

Fig. 1.8 A co-existence of confused sprawl, formal sprawl, and agro land. *Source* Google Earth

feeders can also serve as connector, connecting back to the thoroughfare as some other point. Otherwise they end up at a topographical barrier such as water-body, agro land etc.

4. ***'Goli'*** or **'Clusters'** are quarters where the residents expect primary or face-to-face social interaction (shopping, mosque, schooling, daily route to get office transport etc.). They are also considered to be fed by a still lower level of street (third order street), which may be a connector that goes back to the second order street. Otherwise, they may also end up at a natural topographical barrier. Sometimes it is difficult to differentiate between these two levels if only width of the street is considered. In that case, Clusters lose their separate identity, as the hierarchy turns into a web.
5. ***'Kanagoli'*** or **Blocks** can be considered as the lowest level of residential quarters which are fed by a public **cul-de-sac** inside the clusters, or even *Mahallas*. Individual buildings (single or multistoried) on individual plots inside the blocks are fed by the cul-de-sacs which are usually not expected to run very long. Usually they are the results of ill-planned land divisions which were followed by subsequent sub-divisions. They are the fourth order streets.
6. The final level of residential quarters can be distinguished by a group of plots the owners of which are most likely to belong to one big family. They might have their own road inside the boundary of the original big plot, and most probably are gated for security purpose. They are also cul-de-sacs, but at a fifth level, and can be represented as **'Own Road'**, and can exist at any levels of residential quarters (Fig. 1.9).

A schematic diagram of a Ward shows how the streets work (Fig. 1.10). The first order street (1) divides the Ward into two localities. One of them is (a) as the upper hemisphere. The second order streets (2) are branched out from (1). They may terminate due to certain topographical constraints such as low land, canal etc.

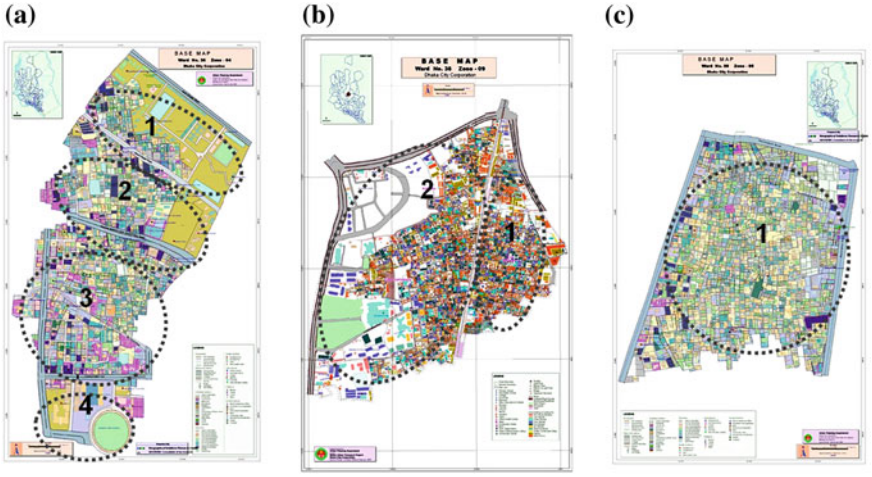


Fig. 1.9 Different kind of thoroughfares existing in Wards. **a** Ward no. 36 is divided into 4 localities by three thoroughfares (first order street) namely Rajarbag (1), Shantinagar (2), Paltan (3), and Stadium (4). **b** Ward no. 38 is bordered by two thoroughfares, but bisected by railway line, which is also a thoroughfare, and dividing it into 2 localities namely East (1) and West Nakhalparha (2). **c** Ward no. 50 is surrounded or bordered by three thoroughfares and no such road bisecting it, thus there is only 1 locality here namely Kathalbagan. *Source* DCC (2002), author

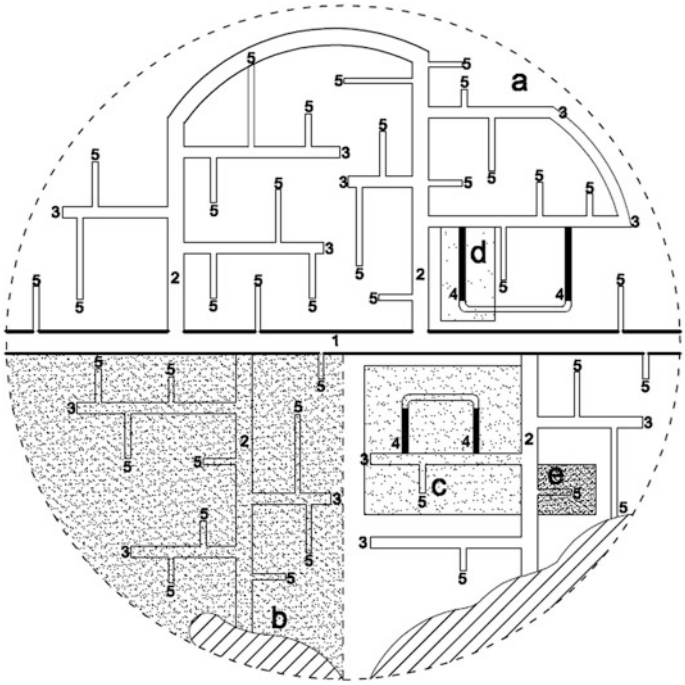


Fig. 1.10 A schematic diagram showing the hierarchy of street network in the Wards. *Source* Author

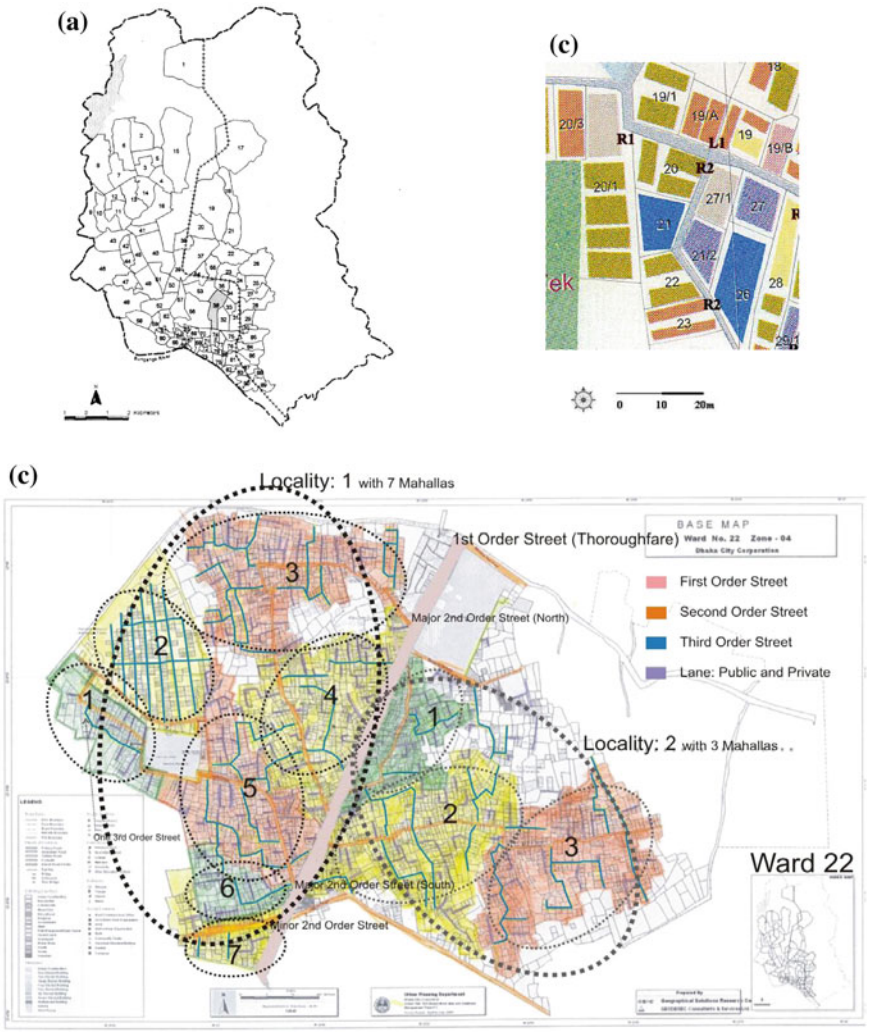


Fig. 1.11 Location of individual houses gradually explored within Wards. (**a**) Map of Dhaka city showing residential 'Ward's (smallest administrative unit of Dhaka City). (**b**) Ward no. 22 has two localities and cadastral map of this ward shows five different street levels with shaded areas marking self-built neighborhoods with *smaller circles* showing their informal boundaries. (**c**) detail of one block inside self-built neighborhood 1 fed by fourth order street or public cul-de-sac R2, and showing plot boundaries and roof plans. *Source* (DCC 2002) and author

or can be connected. One of the 'Mahalla's are highlighted as (b) at the bottom left corner. The third order streets (3) are branched out from (2) and serve the 'clusters', one of them (c) are highlighted in lighter shade at the bottom middle part. Again, the third order streets can be connected as well. Then comes the public and private lanes, branched out from third order streets and ends at certain plot. They

are not quite distinguishable from one another if only width is considered, but only can be identified if they are non-gated or gated. They serve the 'Block's. One of them (d) is shown at the bottom right corner. One important point to note is that cul-de-sacs can branch out from virtually any level of the network even from (1) depending on the original land division of the area as shown in figure.

A more specific example from Ward no. 22 shows its location within the metropolitan city (Fig. 1.11a). The detail of Ward 22 in Fig. 1.11b shows two localities existing within the Ward because of the bisection by a thoroughfare. Locality 1 (West Rampura) has 7 *mahallas*, and Locality 2 (East Rampura) has 2 *mahallas*. In West Rampura Locality, two major second order streets (Orange color) feed *mahallas.* The Southern one feeds three (no. 5, 1, and 2) on its way towards terminating into a ditch. Therefore, 5, 1, and 2 are connected in series. The Northern one is connected in parallel to the Southern one and feeds two (no. 4, and 3) *mahallas* while becoming a connector and meeting the main thoroughfare again. There is another minor second order further at South ending in ditch again, and it feeds two (no. 6, and 7) smaller *mahallas*. Second order streets are branched out by third order streets (yellow color), and they feed clusters (*goli),* some of them are connected in series, while some others in parallel. A detail of a cluster (*goli)* fed by third order street are shown in Fig. 2.17c, where R and L describes cul-de-sacs on Right and Left hand side respectively, and they feed the Blocks (*kanagoli*), the smallest of residential quarters inside the Wards. In the picture, R2 is a fourth order street, while L1 is an 'own road'. In the past, R2 itself was actually an own road as all the plots currently approached by R2 had only one owner. Thus, R2 has been upgraded from fifth to fourth order. While the feeding third order street itself was upgraded from fourth order (cul-de-sac) to become a connector at third order street in only in 2005.

1.2.2 Non-morphological Issues inside *Confused Sprawls in Dhaka City*

Besides the morphological characteristics of the urban tissue inside the confused sprawl, there are some other non-morphological issues which have their own power to describe a confused sprawl. They are the people who live in these buildings, as inhabitants play a big role in this study.

1.2.2.1 Demographic Information

A little history might be useful here. In an agro based rural economy like in Bangladesh, there is an average of 300,000 – 400,000 rural migrants flocking to Dhaka city every year, mostly in search of economic upgrading. Among them are homeless people who might start living in slums as destitute at the beginning.

Table 1.1 An overview of Bangladesh and the people

Area	144,000 sq. km
Land	133,910
Arable land	55.39 %
Irrigated land	47,250 sq. km
Population	144–159 million
Working age group (15 – 64 years)	63.4 %
Life expectancy	59 years
Fertility rate	3.09 children born/woman
GDP (purchasing power parity)	USD 2300 (world average is USD 10,200)
Unemployment rate	2.5 %
Labor force	69.4 million (agri 63 %, service 26 %, industry 11 %)
GDP (sector-wise)	(agri 19 %, service 52 %, industry 29 %)
Population below poverty line	45 % (Poverty line 5,000 Tk/month/household) Half of them are hardcore poor (less than 2,500 Tk/month/household)

Source CUS (2006)

Besides them a good number of these numbers who come for economic upgrading, start living in these confused sprawls as they offer cheap rent (Hossain 2001) (Table 1.1).

1.2.2.2 The Socio-Economic Class of the People in Self-Built Houses

It is difficult to identify or generalize the social or economic class of the people living in Self-built houses. According to the operational definition, there is an owner and several tenants in each house. Apparently they seem not to belong at the same economic group. In the context of the confused sprawl in the city of Dhaka, the tenants are most likely to be the new migrants looking for economic upgrading coming from rural or less developed urban areas. However, the owners do not automatically qualify for a higher economic group, as previously mentioned, they are likely to belong to the same category in recent past as well. The confused sprawls are one of the cheapest area in the city. Now, whether economic class is parallel to socials class is a debatable issue. If the 'horizontal cleavages' are concerned, based on three basic criteria such as education, economy, and profession, these owners are likely to belong to lower social class. However, there are still many other criteria to define a particular social class mostly if they are specifically described through 'vertical cleavages' such as religion, ethnicity, language, race etc. (Mattei 2004). However, the point is that the traditionally stronger vertical ones become less and less strong along time, and economy appears to be the strongest determinant among the three horizontal ones.

Table 1.2 Characteristics of households

Dwellings	
Average plot sizes (m^2) (median)	195
Average GF built area (m^2) (median)	139
Average No. of Story (median)	4
Dwelling type	Permanent construction with RCC foundation and roofing, with brick exterior and partition walls
Service provided	Piped water and gas supply, sanitary toilets, conventional electric supply
Tenure (median value)	Owner occupying a floor, and renting out the others
Occupants (owner's family)	
Median household size (median)	4
Monthly household income (median)	US$ 90 × 4 = 360 (= approximately 30,000 BD Taka)*
Income level**	Close to the lower threshold of Lower-middle income group
Employment of the household	Only on rent 51 % Other business 40 % Service 8 % Others 1 %
Educational level of the head of household	Below diploma 43 % Diploma 38 % Graduate or more 19 %
Household characteristics	Mature family (89 %) Post-mature family (11 %)#
Age of the head of household (median)	68
Age of head when constructed started (median)	46

* 1 US$ = 80 BD Taka (approximately)
**Monthly income threshold for low: 83 US$, lower-middle: 333, middle: 1,000 (WB 2011)
Mature family: at least one child is above 18 years old. Post-mature family: at least one children is married out

Therefore, social and economic classes become almost analogous in some situations. A random survey prior to this study on households (owners) in confused sprawl showed that they belong to the Lower-middle income group (Table 1.2).

1.3 Summary

Considering the morphological character, self-built houses in Dhaka City can be operationally defined as located in confused sprawl having heterogeneous sets of plot sizes and shapes, complicacy and dispute in land ownership, a very complicated, organic web-like pattern of road networks with limited or no car access at

the deepest ends of the webs, a three dimensional juggle of mid-rise (3–4 stories) residential buildings at their various stages of developments. With a comparatively high level of tolerance from authority when it comes to strictly abiding by building regulations, the inhabitants exercise more authority to practice spontaneous transformation.

Considering the non-morphological issues, *SBH*s in Dhaka City can be described as an abode of lower-middle-income people as owners as well as tenants. Usually for one house, the owner occupies a part, while several tenants occupy the rest. They are built with locally available materials and construction techniques, and very much unlikely to be demolished or upgraded by formal agencies (public or private) as their location are not suitable for real estate values, at least for the time being.

The following chapter concentrates on exiting literature those are related to spontaneous transformation as the study later on tried to unfold various aspects of this phenomenon in self-built houses.

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Chapter 2
Spontaneous Transformation as an Integral Phenomenon of Inhabitation

Abstract This chapter is a literature review on the phenomenon of Spontaneous Transformation, which is defined as any alteration, addition, extension or modification of a house. Spontaneous Transformation has been identified as an integral part of inhabitation. However, in large scale housing, users, even if they are owners, do not have much authority to transform. In the context of self-built houses, especially in the developing countries, studies show that there is abundance of transformation incidents. With the owners being the actors behind them, this chapter tried to relate this phenomenon of spontaneous transformation with human behavior.

Keywords Spontaneous transformation · Human behavior · Self-built housing

2.1 Introduction

At this point, the focus of this study moves to the particular phenomenon of spontaneous transformation. Spontaneous transformation can be operationally defined as alterations, addition, extensions, or modifications of a house, both in terms of the form and the interior spaces usage. Though it is regarded as an integral phenomenon of inhabitation irrespective of the type of housing, it is likely to occur more frequently and in bigger scale in self-built houses (Carmon 2002). In the specific case of self-built houses in the confused sprawl in the city of Dhaka, the study further looks for any existing physical patterns, and thereafter for the explicit behavioral patterns of such transform incidents. However, the phenomenon of spontaneous transformation is investigated by several notable researchers. A brief overview of those literatures would be useful here before moving on to the context specific issues.

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There have been attempts to relate human behavior with many issues such as food habit, choice of clothing, bias to pets, choice of furniture etc. Human behavior is a resultant of a complicated process, and there is always a risk to draw such straightforward or simplified relationships. However, spontaneous transformation is not a phenomenon that occurs suddenly. It involves a long process of thoughts between the members of the households. Therefore, it might show some reflection about the behavior of the household if not of the individual.

Outcome of human behavior can be expressed in different ways. More commonly known as control theory, as developed by Reckless (1973), human behavior is not caused by outside stimuli, but by one's internal needs. Caniggia (2001)'s theory of human actions for co-existence also highlights the role of one's own needs. These needs, however, can be shaped with or without the presence of the outside stimuli. Moreover, it also states that people tend to act rationally, but if there are given the chance to act deviant, they would. Therefore, be it rational or deviant, the first task would be to try to identify the internal needs. Then there could be an attempt to relate them with transformation issues.

Glasser (1998) identified five particular internal needs that shape our behavior. They are:

1. To survive
2. To belong
3. To have freedom
4. To have power and control
5. To have emotional fulfillment.

However, while translating them through transformation incidents, overlapping can be discovered between the needs to belong, to have freedom, and to have control. The following sub-sections try to relate these needs with the phenomenon of spontaneous transformation.

2.2 Transform to Survive

Few households are likely to remain completely satisfied with the same house indefinitely since the needs for survival of family life constantly change (Seek 1983). This endless and ever-changing list of 'housing needs' creates a 'housing gap' between current level and preferred level of 'housing consumption'. Demographic issues are considered as one major contributor which brings in this gap (Tipple 1999). However, other issues such as changes in household's socio-economic circumstances or changes in tastes and preferences, changes in housing prices, changes in the need for rental income and other external influences such as decisions related to land use, transportation etc., all contribute to increase this gap (Khan et al. 2010), and therefore disturbs the household's equilibrium state. Like any other state of disequilibrium, the stakeholders, in this case the households, constantly search for solution to stabilize the state. But the housing gap can seldom

be covered up immediately. Seek (1983) argues that the actions to be taken for housing adjustment is unlikely to be immediate and prompt. Therefore it leads to 'Housing stress' along time.

2.2.1 Housing Stress

Housing stress mounts gradually, and gathers momentum over a fairly long period of time, at least over some stages of the family cycle. Almost every reaction to housing stress is likely to involve considerable amount of money. Therefore, affluence might hold a key role on the amount of work initiated to overcome that stress. As progression through life also brings in career advancement and increase in wealth, most households become ready to respond to the housing stress as they approach their middle ages. However, a thematic explanation was developed by several researchers which is as follows.

2.2.2 Level of Tolerance and Critical Point

As mentioned, housing stress does not necessarily bring in any immediate change or to cover up the gap between actual and preferred level of housing consumption. Every household has a 'level of tolerance' until which point no action is taken. Household initially adapts to the situation by changing its 'housing aspirations' i.e. sacrifice the aspiration to reach the preferred level of housing consumption (Michelson 1977). However, this tolerance level can be shifted upward or downward. For example decrease in income, wealth or status can shift the tolerance level upward. Again, there are 'shocks' which can be discrete events into an otherwise gradually changing situation of housing intensity. For example the birth of a child can drop the tolerance level abruptly as the stress level curve can take a stepped shape instead of a smooth curve. Therefore, the level of tolerance can be reached much earlier than anticipated. When the level of tolerance is reached, it can be called as 'critical point' when actions are needed for necessary 'housing adjustment' in order to cover the housing gap.

2.2.3 Tradeoff Between Action and Non-Action

There are differences of actions according to tenure. If the households are tenants, they usually do not have the option to improve by themselves, so they can either tolerate or move out. In case of the household are owners, they have several options such as making improvements to the existing dwelling, move to another suitable dwelling, or move and then improve the new dwelling. Whichever alternative to be

selected depends on the relative costs and benefits associated with each of them. The benefits must be sufficiently large before any action is taken. The costs associated with either moving or improving can be quite high (Tipple 1999). A last minute uplifting of tolerance level can also occur, which can be termed as 'non-action'. The difference between the uplifting before and after reaching critical point is that it might leave an undesirable permanent mark on the household in some way or other.

2.2.4 Decision to Move or Improve

If actions are taken, a fare comparison between the two basic options of moving and improving shows that 'moving' costs are significantly higher. This prevents households from frequent moving (Maclennan 1982; Fallis 1986). The costs involving improvement are also not negligible. As a consequence the majority of householders at one time are not expected to fulfill the gap totally (Littlewood and Munro 1997). That infers that they are likely to continue to suffer further states of disequilibrium in near future. A cumulative cost of part-by-part improving may involve far more expenses.

Goodman (1995) in his research estimated that moving cost increased housing expenditure by 3 % in a year. Not surprisingly, in another research, housing expenditure due to cumulative large scale improvements was increased by 40 % in a year (Edin and Englund 1991). However, housing satisfaction does not always relate to the expenses directly. Littlewood and Munro (1997) pointed out that moving is directly related to the housing market by studying the trend of recent movers. Households are more mobile at certain stages, while not so in some other stages. Therefore, the second alternative i.e. improving the house has a significant role in housing adjustment. Different studies on decisions about housing adjustment describe the decision to improve as a distinctive alternative to moving (Montogomery 1992; Potepan 1989; Shear 1983).

In some theories, improving is postulated to be an inferior form of housing adjustment to moving as the potential change in consumption is presumed to be less and improvement costs per adjustment are usually lower. The inferiority of this choice is argued to result in a reducing tendency for home improvements and a greater likelihood of moving as incomes rise (Potepan 1989). But this is actually a market policy to highlight the term 'inferiority' as it tries to relate moving as an improvement in status. But Seek (1983) already pointed out that the home owners all over the world tend to live in the same house for a long time whether they are rich or poor. This inference was further evident in the results of the 'Survey of Housing Occupancy and Costs' conducted by the Australian Bureau of Statistics (ABS 1980). Contrary to the exploiters in the housing market, improving has been regarded actually as a way of reducing the loss in consumer surplus which can occur where a household in a sub-optimal housing situation does not move (Seek 1983). Littlewood and Munro (1997) concluded that improvement is a larger practiced phenomenon and moving into the 'right' house is also very common.

However, with the evidences that moving into a new house might not provide the households gain an outright equilibrium, they also may undertake significant improvement expenditure on their newly acquired house.

However, most of these researchers chose the term 'improving', which takes into granted that there has been some positive upgrading. In reality, it may not be always like that. Improving refers to alteration, with the necessary gap to be covered. But, in some other aspects, it may not refer to positive upgrading. Therefore, the term 'transformation' used by Tipple (1999) seems to be more suitable for this study.

2.2.5 Explicit Reasons of Spontaneous Transformation

There have been studies to relate the transformation incidents with different issues, for example, demographic, economic etc. This section does not go into details, but just mention them citing from literature.

2.2.5.1 Demographic Issues

Demographic issues have been universally recognized as major reasons behind transformation. Some of them were identified so far by researchers are:

- Increase in number of households (Tipple 2000)
- Children getting older (Seek 1983; Tipple 2000)
- Better arrangement of spaces to suit changing family needs (Tipple 2000).

2.2.5.2 Economic Issues

Economic issues come next. In houses where the owners are the only inhabitants, the demographic issues are the prime concern for transformation. However, some other researchers have found out transformation to be related to more other concerns generated from other issues also. Especially in houses where owners do not need the whole house for themselves, they can transform part of it for rental income which would benefit to their survival issues. Mentioning them as 'economic issues', Tipple (2000) studied transformation in different parts of the world where people transform a lot due to the need for extra income. They can be summarized as follows:

- To increase rental income in the form of habitable flats
- To increase rental income in the form of renting shops, or offices
- To increase income by transforming part of the house for home-based enterprises.

2.2.5.3 Other Issues

Several other issues were also found to be related to survival issues resulting in transformation. Since the studies on transformation are quite limited, and the contexts chosen for those studies do not have wide range variety of reasons to necessitate transformation, we got only the followings:

- To overcome cramped conditions
- Change of ownership.

2.3 Transform to Belong and to have Freedom

However, survival alone is not the sole motivator for transformation. Turner (1972) stated that people want to make own decisions on how they would live, It brings them satisfaction that brings a sense of self-belonging. Transformation incidents are often outcomes of such decisions, where a strive for achieving self-belongingness and freedom are expressed. These two phenomena were revealed more elaborately by his three laws.

Housing is a universal human activity, and transformation is one significant part of that. Irrespective of affluence, education level, cultural level, or whatsoever the status of a person, housing is one's essential activity. However, as Colin Ward stated, once this activity is defined as a problem, and a particular group of experts, bureaucrats or researchers are engaged in solving that problem, their very existence is a guarantee that the problem will not go away (Turner 1976). But the lessons from Turner, perhaps more than anyone else, have changed the way we perceive any settlements. Originally starting to learn mostly from illegal squatter settlements, he showed that from the poorest to the richest people, there are some universal truths about housing. This can be summarized through his 'second law' that dweller satisfaction is not necessarily related to the imposition of standards. Probably most important is the third law, which states that housing is infinitely more tolerable if they are the user's responsibility than if they are somebody else's.

Seek (1983)'s postulation of the housing stress curve actually synchronized with the third law, where he stated the level of tolerance is adjustable. Turner's statement also implied that needs apart from those generated from the family needs, are not strong enough if users have the responsibility of their housing. It is supplemented by the second law, where dwellers remain satisfied not with the standard in which they live, but with having the control over major decisions in design, construction, and management. Thus, only when group of experts starts dictating housing decisions to users in a way that strips them off their authority, only then that adds to the stress generated by family needs, and pushes the level of tolerance further lower to aggravate house improvements.

In his first law Turner (1972) already mentioned about the necessity for the dwellers of having the control the major decisions, and urges to let them become free to make their own contribution to the design, construction, and management. Significantly he did not imply that only the poor will be the 'do-it-yourself' house-builders, and the rich will hire the professionals. It is irrespective of the affluence, he reiterated. It is not the kind of idealization that might relieve public authorities of their responsibilities for providing housing aid for poor, but is that kind of idealization that does not deprive the poor off their control by trapping them inside the culture of mass housing and cultivate their poverty, which in terms become a barrier to personal fulfillment, and a burden on the economy.

2.4 Transform to Belong, and to Control

Habraken's theory on territorial control can be related to transformation as well. Human beings play control games every day, probably every moment, and have a good grasp of control patterns in operation (Habraken 1998). Not only humans play the control games, they are expert at recognizing who controls what in the environment. Habraken's attempts to show it in the built environment is harmonious to social scientist's study on human behaviors which shows man needs a certain degree of power and also needs to express that power in order to establish his importance or existence. To show this power, man wants to have control on certain things around their surroundings. In a family, the head might show that power over the rest of the family in making certain kind of decisions, in an office the head of a department needs to show that power over the others in the department in the form of different decisions, and so on. However, there are levels of hierarchy and the actors need to understand that. Usually, if an actor at a certain level is happy with the designated boundary of the level, and is allowed freedom inside that boundary, it results in satisfaction. This is the same satisfaction that was revealed in Turner (1976)'s laws, which also leads them not to worry much about the standards, and allow them to control their design, construction, and management. However, satisfaction is not the only things at stake, that freedom also gives the actor a sense of recognition.

2.4.1 Horizontal and Vertical Levels of Control

Talking about the boundaries and levels, the definitions are not that straightforward, For example, in a family, a father and a mother might belong to the same vertical level of control, and at a higher level than their children while guiding them. But, they might control the children on mutually inclusive or exclusive issues. That means the horizontal boundary of the parents might be separated or overlapped, though they are in the same vertical level. And again, when it comes to respect their own parents (i.e. the grandparents of the children), they are in a

lower vertical level than that of the grandparents. Considering an organization in an office, the managers of different branches might be considered as acting on the same level while controlling the subordinated on a lower level, while the general manager is on the highest level.

However, control does not depend on formal relationship all the time. In fact, a set of previously unknown actors can immediately select a level, or thrive for getting to an upper level of control over the others, and the struggle continues until a clear boundary is set, and the actors are distributed. Moreover, the definition of levels and boundaries may change if violation of boundaries both at horizontal and vertical is tolerated by the upper level of actors, or the respective affected actors.

When it comes to housing, the owners become the actors who belong to the same level of control with their neighbors (owners). The authorities can be recognized as belonging to an upper level, while tenants in the house can belong to a lower level of control. In terms of transformation, regulations by authority indicate the do's and not-to-do's for the owners, thus controlling the actors at individual owners' level. However, a lapse in control or tolerance by authority might result in illegal constructions and a struggle for horizontal boundary with the neighbors.

2.4.2 The Five Levels of Control in Built Environment

Dominance and dependence can thus be expressed through behavior by people living in different vertical levels. Interpreting it into built environment, actions related to construction and transformation are expression of the actors concerned. Therefore it is important to identify the different vertical levels where all these actions take place. Habraken recognized five distinct levels and showed that nine types of dwelling can exist involving the combination of freedom in this five levels.

For example, the domed Nubian Mud brick house with no furniture or partitions inside allow actions only on two levels considering the inhabitants utensils as the first level, and the house itself as the second level. A common freestanding urban single family dwelling allows actions on four levels. A rented apartment allows dwellers to act only on partition wall level and utensil level. The self-built houses allow actions from owners on four levels. For this study, only two levels i.e. building level (BL), and partition level (PL) are considered as transformation refers to these two levels.

For each individual such house, transformation at building level are controlled by upper level of control i.e. building authorities; while transformation at partition wall level are controlled at a lower level by the owners. The tenants cannot operate beyond the furniture level according to the context, and the owners are the actors both at BL and PL.

2.4.3 Habraken's Three Orders

The other major significance in understanding the levels is to conceive the orders, because the orders help us understand human behaviors through physical forms and their transformations. The first order is more a physical thing where we get the idea of the physical elements that constitute a particular form. It shows how a system is built on several sub-systems.

However, the second order is more crucial when inhabitants are concerned. This is about the control of space rather than control of form. Habraken (1998) emphasized that the very act of inhabitation is fundamentally territorial. Territorial control might involve struggle for dominance between two persons either in same or different vertical level, and it can be explicit by their human interaction in the form of manner of conversation, or movement, but it is essentially the physical forms that sets the basis of the rule system of dominance.

For example, sitting uninvited on neighbor's lawn is a violence of formal order, but territorial order may allow it as it might be seen as a guest's behavior. But when one places garbage on neighbor's lawn, it is violation of both formal order and territorial order. The point is that we might set the rule as 'not to provoke neighbor', but it essentially involves the formal elements to identify the placement of that rule.

In another example, when the mother is trying to behave the teenage daughter, it is the house within which she can have more comfort to place that control rather than in a shopping mall, or in the playground. Even though the bodily presence is already a dominance in other places, but it is only so with the fact that they both belong to a house where the mother dominates the daughter inside. In case of a policeman, he can dominate any people anywhere outside, but needs a warranty to enter a home. So, in many ways, the formal order acts as the basic premise to exercise territorial order, though the border are not always the same. One more important point is that one's formal boundary may be limited, but territorial boundary can be large scale, just as man has physical community in the form of neighbors, but an intellectual community in the form of people of same profession etc.

From the other way round, a single formal boundary cannot guarantee one single territory. For example, a three bedroom flat, which currently denotes one territory as it is occupied by a single family, can become two territories if one room is rented to another person. Some other examples may include part of room becoming a shop, home enterprise, or a garage.

Again one form can represent various territorial structures just because of the user changes the habitations, and the access changes locations. Thus, not only the forms, but also the accesses can change the territorial control. A little transformation by changing the access may generate from the aspiration to control whatsoever, and can reflect traces of human behavior.

The importance of access is thus a very important issue in territorial control. While built forms show it very much explicitly, human social behaviors do not show it that explicitly. While two persons interact, one has to understand the point

of access the other has given one in order to interact. For example, a father at a higher vertical level, interacting with the son gives access through the point of obedience. If it is not understood by the son, his behaviors will not follow the rule set, and obviously the interaction will not go smoothly. But, when grown up, the same father can give access to the son as a friendly way, or when old, can give access as to asking for care, then the whole pattern of behavior changes.

Thus, the territorial control through built forms gives us a good perception about the territorial control of human behaviors. However, the control game moves to a new dimension when we consider the third order, which is introduced by Habraken as cultural order. According to him, built environment is all about the unspoken. These include regularities, customs, habits, conventions. Urban environment everywhere in the world has been set up with all kinds of unspoken rules as evident in non-urban settlements. But as density increases, implicit agreements starts to be formed, which eventually leads to formal codes or regulations. Shared knowledge becomes formalized. However, shared knowledge continues to gather on top of regulations. Thus we can always find traces of unspoken, which can only be grasped through some patterns, types, and systems. They are the same patterns that Alexander (1977) suggested to find out in order to analyze the vernacular. Thus typological patterns in urban tissue becomes the evidence of those patterns, and the sole reason behind growing up a collective pattern is that people have to co-exist, and thus need to respect one another, and thus they have to share their knowledge and as a result express in a similar way. This is just like we need to speak the same language to co-exist as a society, to dress similarly, or to eat similar food. In build forms, or in territorial control, they should develop some patterns when they need to co-exist. It does not mean new styles cannot generate. Actually new style can generate only within the cultural order because people always experiment on their own properties, just like trying some new food one day, or try a new outfit, and if they work they become gradually the part of the custom. But the point is that the whole process must go without disrespecting the existing custom. That is what the spirit of cultural order is.

2.5 Transform to Fulfill Emotional Issues

Finally, the emotional issues play a major part in human behavior. When it comes to housing decisions, emotions are not less significant. Emotions are studied more in psychology, rather than in architectural studies. But if architects can comprehensive knowledge on how important emotions role are in housing decisions, their approach to design would be a bit different. Studies related to housing decisions where emotions and psychological issues were placed at high stake are a rarity. One interesting study by Marcus (1995) showed how emotionally a dweller can be attached with their houses. She emphasized the fact that house-building is a self-expression by studying an evolving house, both its form and space.

But she also noticed that self-expression in any form may not come that easily. To express ourselves in the material world is not a light work; rather it involves a strong and constant desire. In case we are searching traces of emotion through the transformation, the other needs which are much stronger, and probably more influential behind transformation, might hide the trace of emotion behind that particular transformation incident. Marcus focused on the furniture level and the utensil level, on which a user of that space has the control. She highlighted several interesting attributes that came out through the arrangement or re-arrangement of furniture or personal utensils. In many cases she studied, people through these arrangements tend to express numerous emotional issues such as recognizing childhood home in the current home, one's problematic relationship with home, particular points of comfort in the house, to accommodate a lost part of the self etc. While these emotional behaviors were stated by the dwellers through their interview, the other way of analysis was to look at the arrangements, and find the emotional values behind them. For example, particular houses showed couple in conflict with contrasting images of home, order versus chaos in couple's behavior, home as a status, creating a fantasy dwelling and so on. Studies showed that once a dweller finds a territorial control over a particular space one calls it home, be it a part of the room, a whole room, or the whole house, one rests one's self there, and try to express one's self through the elements in hand. The degree of the territorial control restricted them to show their emotion at transformations in partition or building level. However, this study opens up the possibility to investigate role of emotions in transformation in houses on higher levels as well.

Devakula (1999) showed that being a trustworthy participant observer can also be a useful method of psychological analysis even in architectural studies in order to investigate the role of the emotions behind behaviors. By observing for days, and sharing living with them, the need to interview for hours answers becomes less significant because the information not only come through the inhabitants, but also from the researcher's own understanding as a member of the family. The role of the researcher is thus very significant in collecting data regarding emotional issues, and then analyzing and interpreting them. In data collection, ethnographic methods work well when the researcher becomes participant observer. In data description, phenomenology works well, while hermeneutics suggest a deep method of interpretation. Such a combination might just work in order to interpret human behavior through transformation through the window of human emotions.

2.6 Summary: You Are How Your House Transforms

People transform for various reasons. Alexander (1979) mentioned that the basic search of humans lie behind explicit description of the patterns. Explicit patterns form the 'gate' helping us to find the implicit 'way' we are looking for. Afterwards, we leave the gate behind, and only then we can follow the way. The search for the implicit human behavioral patterns behind transformation patterns is thus

the second part of the study, but studying the explicit physical patterns and behavioral patterns of transformation become the precondition of that study just as forming the gate is a precondition to find the way. Transformation of course is just one of many ways human behavior can be explained or can be tried to be explained. However, through this section, an attempt was made to relate transform incidents as an expression of human behavior.

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Chapter 3
Categories of Spontaneous Transformation

Abstract Urban setup in confused sprawl in Dhaka city is dense. Obviously, there are plenty of building regulations and bylaws to control their growth. Yet, a high level of versatility in the combination of different architectural elements can be noticed that is a resultant of site forces, bylaws, availability of local materials or technics, and different incidents of spontaneous transformation. Together they give the impression of an unconscious, yet powerful vocabulary of a particular urban residential form, especially common in the context of the rapidly growing cities in developing countries. This chapter searched for a prototype of building form in the self-built houses in confused sprawls in Dhaka city, and consequently tried to identify the existence of any categories of spontaneous transformation in those houses. The write-up started with empirical observation, and then was gradually consolidated by field studies stretched over many years of inhabitation in these neighborhoods by the author.

Keywords Building regulations · Bylaws · Spontaneous transformation Dhaka city

3.1 General Overview of the Physical Elements of the Self-Built Houses in Dhaka City

The built forms of individual houses usually take the form of rectangular blocks set tightly inside the site boundary with occasional projections responding to the non-orthogonal angles offered in the site. There is a clear absence of elevators, mostly because of its high cost. The height is consequently restricted to walk-up levels, though mostly they are **three or four storied.** There is no height restriction in most of these confused sprawls as a part of land-use planning. But, since height is a function of the road width, narrow width of the internal streets are the obvious reasons of these houses to be walk-up low rise development. Interestingly, owners

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SpringerBriefs in Geography, DOI: 10.1007/978-3-319-00720-5_3,

seem to keep the hope of adding more floors in future which is often characterized by the open reinforcement steels of columns extending beyond the last completed floor (Fig. 3.1a).

These buildings generally have no space left at the ground floor for parking mainly for two reasons, the owners or tenants are not rich enough to afford cars, and many of these plots had difficulty in car access. As a result, any later incident of buying car must need transformation in the ground floor as garage. The **entry staircase** (Fig. 3.1b) generally appears at the front façade with some exceptions of having it on the side façade where access to the staircase is through a passage created at ground floor to give access to that staircase with the passage having just enough width for people and furniture to move in and move out. Invariably in all cases **boundary walls** with around 1.5 m in height exists in order to protect trespassing. They also demark the property line. Gates appear at the staircases which in some cases are always locked and in other cases, controlled during the night (Fig. 3.1b).

The **plinth levels** of newer houses are kept considerably high to protect the ground floor from serious floods that predictably occur as frequent as once in ten years, an estimation based on experience from the last three decades. Since the entry point is usually through the staircase, the first flight of the stair remain quite high (around 2.25 m) to allow people and furniture to pass comfortably enough under it. **Balconies** usually are projected at the front façade (Fig. 3.2a) and occasionally at back façade (Fig. 3.2b), while the side walls in upper floors are mostly projected beyond the structural line at several points in order to make bigger spaces. This is usual in both cases whether the floors were constructed at one single stretch or they were built in phases. In ground floor, the walls generally do not exceed the setback lines so that there could be enough space for maintenance of service pipes which run underneath the mandatory open space (setback area) between the building and the boundary wall.

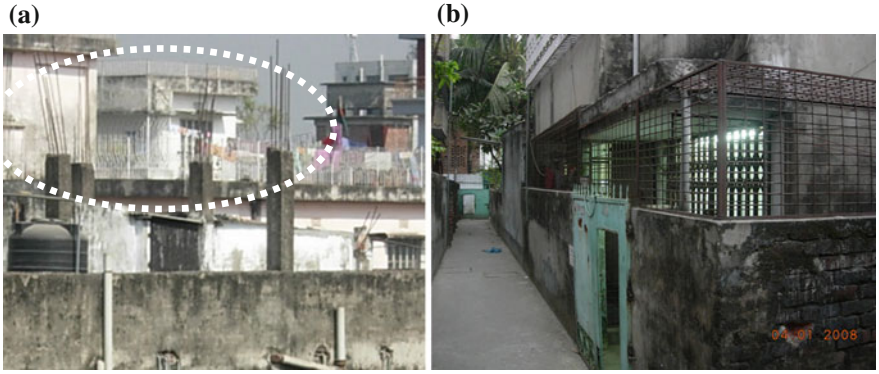


Fig. 3.1 Extended columns for never-to-be achieved newer floors, and solid ground floors. *Source* Author

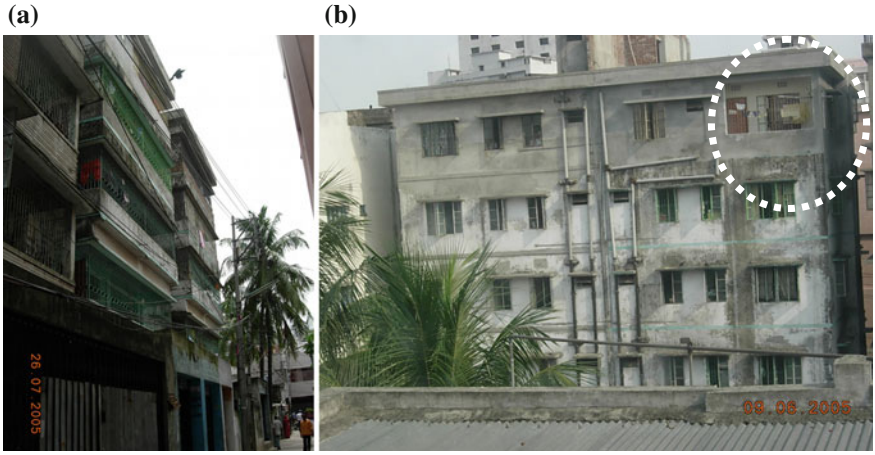


Fig. 3.2 A house with balconies at front (**a**) only one on back, exposed service pipes (**b**). *Source* Author

Column-beam structures remain common though there are some older buildings with load bearing brick walls. Buildings built on lower lands or marshy plots generally stand on columns until the desired plinth level is reached. To connect the main entrance with the road, wooden, bamboo or concrete bridges are often used.

The **service pipes** such as sanitary pipes made of CI (Corrugated Iron) or PVC (Poly Vinyl Chloride), and water and gas supply pipes made of GI (Galvanized Iron) are generally exposed (Fig. 3.2b). The electric cables enter the building through the main staircase. They come from the main road after passing through some complicated web like network on its way to the house. Any later transformations resulting in change of location of rooms, toilets or kitchen are associated with the alteration in the service pipes.

Windows are generally located at the middle of the corresponding walls with an average width of 1.5 m and a height of 1.33 m reaching 2.15 m lintel level. Previously the most common type of window was paneled iron frames with small pieces of glass fit inside those frames. However, aluminum sliding windows with bigger tinted glass panels have become popular now-a-days due to their aesthetic look, availability, and cheaper price than it was before. Sometimes, any subsequent transformation result in change of location of windows corresponding to the newly positioned rooms.

The **External walls** are mostly just plastered. Only few are painted and some are even without plasters (Fig. 3.3). Concrete sunshades appear above the windows with an average depth of around 0.5 m.

Door panels and **door frames** are generally made of *Gamari* and *Koroi* wood respectively, painted in dark in order to reduce maintenance. Internal partition walls and ceilings are generally plastered and then painted with water based

Fig. 3.3 Example of non-plastered, plastered, and painted facades. *Source* Author

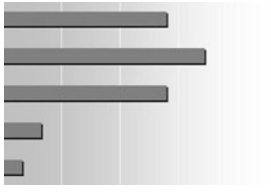
distemper due to its cheaper rate. However, plastic paint is not uncommon these days. Internal wires are mostly concealed during the construction, though a transformed room might need exposed wiring on walls or ceilings.

In terms of **habitable spaces**, area of standard **bed or living rooms** varies from 9 to 16 sqm with a minimum dimension is kept around 3 m at least on one side, though smaller dimensions are not uncommon. In case of transformation, especially in the cases of subdivision, either the room sizes tend to be reduced or the number of habitable rooms inside one unit is reduced. Bylaws stated that at least one external window must be kept in these habitable rooms and this is usually maintained both before and after transformations. **Dining rooms** have variety of solutions ranging from minimum dimension of 2 m to more. With current bylaws, dining spaces need external windows, but buildings built before this bylaw was instated in 1996, do have some non-ventilated dining spaces. There is no inspection from the authority at post-construction phase for the internal layout, such as occupancy permit in some other countries. So, there are instances that transformed interiors might ignore these by laws to some extents. Table 3.1 shows the summary of the sizes of living rooms and master bedrooms.

Kitchen and toilets must have at least one external wall for ventilation as bylaws indicate, and generally toilets have small high windows to create visual barrier, while kitchens have normal height windows but less wider than that of the bedrooms. These features are easily recognized from outside. These characteristics are maintained after transformation also. Toilets usually have an average median value of area of 2.75 m^2, with an average minimum width of 1.125 m and the length of 2.25 m, with a false ceiling invariably at 2.15 m height providing extra storage spaces in between this ceiling and the roof. Kitchens with an average median value of area of 3.5 m^2, normally have a minimum average dimension of 1.5 m on the shorter side and the maximum dimension of 2.25 m. Table 3.2 show the summary of the sizes of toilets and kitchens.

Table 3.1 Size of living rooms and master bedrooms

Area of master bedrooms		Area of living rooms	
Area (m^2)	%	Area (m^2)	%
10.0–12.5	28	7.5–10.0	3
12.5–15.0	34	10.0–12.5	28
15.0–17.5	28	12.5–15.0	20
17.5–20.0	7	15.0–17.5	15
20.0–22.5	3	17.5–20.0	16
Total	100	20.0–22.5	16
		22.5–25.0	2
		Total	100



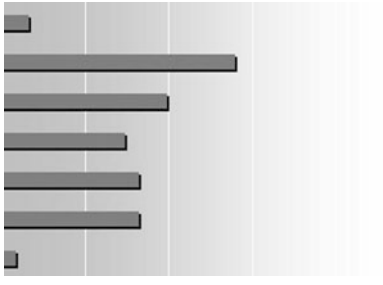


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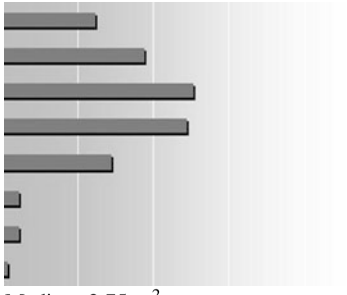
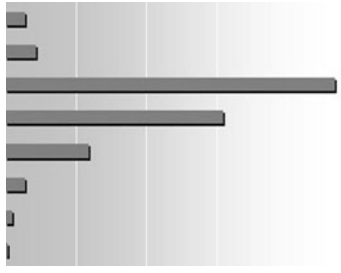
Table 3.2 Area of toilets and kitchens

Area of toilets			Area of kitchens		
Area (m^2)	%		Area (m^2)	%	
< 2.0	12		< 2.0	3	
2.0–2.5	19		2.0–3.0	4	
2.5–3.0	25		3.0–4.0	47	
3.0–3.5	24		4.0–5.0	31	
3.5–4.0	14		5.0–6.0	12	
4.0–4.5	2		6.0–7.0	3	
4.5–5.0	2		7.0–8.0	1	
> 5.0	1		> 8.0	0	
Total	100	Median: 2.75 m^2	Total	100	Median: 3.5 m^2

Source Author

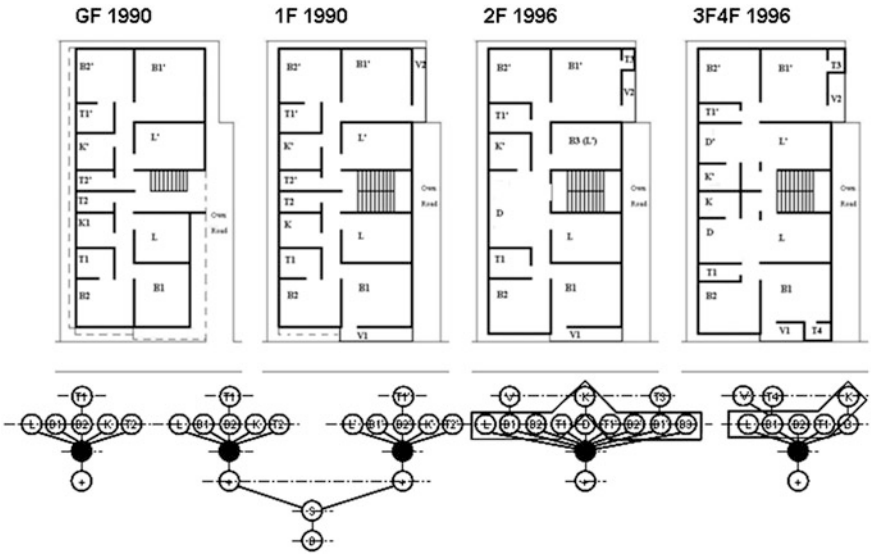


Fig. 3.4 Gamma diagram showing depth of rooms. *Source* Author

Studying plans with the help of Hillier and Hanson's (1984) **gamma diagrams** helped to analyze them more in depth (Fig. 3.4). The gamma diagrams show 'Ringiness' and 'Distributedness' of spaces. The former leads to a symmetrical spatial relationship, while the latter leads to an asymmetrical one. Ringiness refers to alternative accessibility of one space to other space, while distributedness refers to indirect relationship among spaces (Onder 2002).

Major rooms in the plans were mostly asymmetrical and distributed, but there were examples from the older houses where non-distributed rooms were also featured, while symmetric major rooms could also be found in some rare cases. Minor spaces such as toilets and verandahs were mostly asymmetrical (especially in case of attached toilets) while there were considerable examples of non-distributed toilets or verandahs where they could be accessed from two different spaces. In original designs the levels of distribution generally did not cross more than three excluding the level of entry point, while after transformation the number of levels was changed. Whatever the change is, the number of rooms in the horizontal clusters generally at the second level springing from the main circulation level tends to increase (Fig. 3.4).

When the site is **regular**, the designs are obviously simpler and thus, distributed and asymmetrical spaces are likely. In case of **irregular site**, complicated design solutions often arise with non-distributed or symmetric major spaces.

It is common for households to **alter the balconies** into usable spaces in upper floors thus achieving more than what the floor area should legally get. In case of acquiring spaces at the ground floor, or making extension at **rooftop**, their roofing is usually made of temporary materials such as corrugated iron sheets. Added

shops or toilets at ground levels also have similar temporary roofs. Often the alteration in ground floors are associated with evolution of newer entry points other than stair cases as it is obvious that at ground floor any part of the external wall is good enough to become an entry point, even though there may not be enough space for that.

In determining **locations** of major habitable rooms such as beds or living rooms, attempts are made to acquire at least one of the southern or eastern façade in order to catch most of the sunlight and air-flow. However, some such rooms may be deprived of that after transformation. Kitchens are usually located on non-south walls so that ventilation does not allow smoke to flow towards the habitable rooms. Just to remind that dominant breeze comes from South in the context of the country. Toilets tend to be placed on west if not there is a demand for a toilet to be 'attached' in any of the bed rooms. West walls remains most heated walls and toilets located there can act as buffer zone. But again in case of multiple unit floors, toilets could be on any walls. There is not much consideration on grouping service facilities together in order to ease the distribution of service lines, and design evolve due to piecemeal development, not with an integrated futuristic vision.

A more precise **building regulation** has arrived only in 2007. Post-occupancy control of design in the form of occupancy permit does not exist yet. Thus it allows households (owners) to exercise a much higher level of freedom to practice transformation, a familiar phenomenon in many other developing countries in the world (Tipple 2000). If transformation is a good measure to visualize the life going through households, this particular context offers one of the most diversified characters of transformation in terms of categories. Buildings designed without formal designers and being transformed without professional advice as well, assisted by tolerance from authorities to implement bylaws strictly, all led to a very versatile and random urban form. Together they have the potential to show a high level of community spirit and expressed freedom of life (Wong 2003). But whether they are capable to offer an healthy urban order inside this apparent disorder is a point to find.

3.2 Construction Process in General

However, a little knowledge on the conventional construction process applied in the context appears to be useful here. As mentioned before, the owner remains in control of all the four types of jobs related in the process i.e. design, construction, management, and maintenance. Professional designers or architects are rarely called on, nor are contractors to deliver any or the whole set of job. One of the main reasons is that money flows in smaller amounts here. Moreover, if single tradesman is engaged for the smaller works inside each job, the owner could control both the money flow and the time (Tipple 2000). Popular building materials are used and locally available techniques are used. The materials as well as

labor is usually available in shops close to the household and all the works are usually managed and supervised by using the owners someone's leisure time (sometime, the owner can also choose a designated person for that such as elder son, younger brother etc.). Thus the leisure time is converted into capital value very efficiently. Therefore, as also explained earlier, these self-built houses involve 'user-controlled' actions mentioned by Carmon (2002). Considering the fact that only owners have the authority to do that, the term can be customized as 'owner-controlled' actions.

Overwhelmingly an informal sector, these construction processes present a typical mixture of ideas between craftsmen and owners. In the beginning, a master-mason (*rajmistri*, Head of all masons) is hired. He himself hires several more masons to assist him. Less skilled labors (*jogali)* help them in the supporting activities such as carrying, mixing etc. Though usually there is a working design for the intial construction of the houses, transformation works do not necessarily have one. An agreement between the owner and the master-mason is usually reached depending on the nature and extent of the work. If changes are required during the work, negotiations are inflicted into it. The owners or their designated person work as an informal project manager and are usually responsible to select and buy materials. In some cases master-masons are also entrusted with this. If the construction works involve RCC works, the master-mason may hire another skilled mason specialized in RCC works (*rodmistri*, a mason who works with Reinforcement Steel). The *rodmistri'*s works include roof casting, sunshade, drop-wall, false ceiling etc. He again could have his own assistants. Master-mason is also responsible for several other smaller jobs such as fixing the windows, jamming the door frames with the wall, fixing air ventilators, fixing hand railings, main gates, collapsible gates etc., whichever involved cement concrete (CC) works. The carpenter (*kathmistri*) is hired for fixing the doors, the electrician is hired for concealed wiring of ceiling and walls, as well as arranging electric fittings, the plumber is hired for any sanitary works involved, the painter is hired for whitewash, lime putty, or any other paint related works, the glass *mistri* (mason) works on the window glasses and so on. In case of shanty (non-permanent) type extension that might appear in ground floor or rooftop, carpenters usually do the roofing which might involve woodwork or corrugated iron sheets. All these parties are usually hired separately and dealt separately, so the owner always has control over the work and holds the authority to fire someone they do not work satisfactorily.

Payments are done incrementally on daily basis and the total balance is paid after the completion of each party's individual job. Materials are not usually stored long before the work, because no one ever knows clearly when a house involves construction.

The initial construction can take months to finish. Even the hassle related to smaller transformation works may continue for days or even weeks depending on the complication of the work. Small scale transformation not involving RCC works may take less time. Masonry and RCC works require proper curing, thus,

take longer period of time. Carpentry, grills, metal works, glasses, windows etc. can be done outside the site and could be installed without taking much time on site. Roof casting obviously takes much more time, probably a month or more, due to the need for proper curing for the RCC roofs. Floor finishes can take less time if tiles are used. Heavy machineries are not used in general. Even in multistory construction up to 5 or 6 stories, manual labor is used to haul materials upstairs instead of using cranes. The reasons included difficulty to bring in heavy machinery through the complicated narrow roads, or to avoid complications arising to deal with the corresponding agents. Moreover, manual labor still remain cheap. Similarly transport of material is commonly done by small scale transport contractors in flat bed rickshaw vans. Though brick chips are available these days, preparing brick chips (*khoa)* are often done on site both by men and women, sometimes assisted by their children.

3.3 The Transformers

Focusing on the transformers, Tipple (2000) divided them into two categories namely the 'established' transformers and the 'recent' transformers. But their definition was modified according to the context in this study, so that the trend of transforming could be pictured more specifically (Table 3.3). Both had the condition to have started construction before the building regulation of 1984. The former included those who did not transform in the last 5 years. The latter included those who have transformed at least once in the last 5 years.

Average (Median value is considered throughout this study) year of land purchase was 1972 from the sample of around two hundred houses spread among the confused sprawls in Dhaka. Purchase was usually immediately followed by temporary tin-shed construction. Even though the owner's might not start living there instantly, they moved there within three years (in 1975). It took fairly another decade to save enough money to start the foundation work for the main structure (in 1983).

Households usually moved in when the owner was in the mid-forties. Established transformers moved in at an age of 44, while recent transformers moved in at an average age of 49. It inferred, in the past people used to move in during younger ages, but now they do not. It is partly because land in these neighborhoods was much cheaper in the past when they were part of swamps. Construction cost was also cheaper. But they became heavily dense later on, the price of land got much higher, and construction cost was even higher. People could not buy them or build houses in their young age anymore as they used to do in the past.

The age of the head of household at last transformation (58 years) indicated the end of a sequence spanning around 13 years with 5 transformations on average. Interestingly, established transformers did it much quicker in around 10 years, while the recent ones did it in 17 years. Though one must remember that established transformer could also have a very recent transformation, but that did not

Table 3.3 Critical attributes of transformers

Age and establishment records of heads of main households (medians)	All transformers	Established transformers	Recent transformers	Non-transformers
Age at moving into the house (yr)	46	44	49	48
Date of initial construction	1,983	1,981	1,986	1,990
Length of stay in the house (yr)	23	25	21	18
Current age of head (yr) (year 2008)	69	70	67	67
Age at first transformation (yr)	50	49	51	
Date of first transformation	1,989	1,986	1,991	
Time Gap between moving in and first transformation (yr)	4	5	4	
Age at last transformation (yr)	58	53	61	
Date of last transformation	1,998	1,992	2,005	
Time gap between first and last transformation	7	5	12	
Number of transformation	5	5	5	
Time interval (yr) for each transformation	1.4	1.0	2.4	
Time gap between last transformation and onset	13	10	17	

Source Author

qualify them as recent, as they started before 1984. It showed that the houses following previous regulations had gone through more frequent transformations slightly hinting that there might be an effect of the previous regulations in transformations. The opinion was slightly more enhanced due to the fact that the non-transformers had started construction even later in the nineties, when a more comprehensive new regulation had been active.

3.4 Search for a Prototype Self-Built House

Several architectural parameters were identified to describe these houses. They are described below.

All the houses had access to basic urban services and majority had car access, even though that could be barest minimum (for example, access road of just 2 m wide, or the car reaching as close as 6 m from the gate of the house). There were several cases when owners created a road by sacrificing setback areas between them. In several other cases, owners did the same to widen access road. The overall street network is well-planned in terms of car-accessibility, as the reasons were described in detail earlier.

In Table 3.4, 'Deep' refers the location of a plot more than one turn from Second Order Street and 'shallow' refers to maximum one turn from Second Order Street. From the study, we could see a fairly high percentage of non-accessible deep plots. Even in shallow plots, there was significant number of plots with no car access (Tables 3.4, 3.5).

Plots usually have narrow frontages, and most commonly they have the staircase at the middle of the wider arm of the building predictably to divide the floor into more squarish units.

The owners are responsible for the management of the whole construction process which includes transformation. As mentioned earlier, no formal contractors or developers are usually hired at any stage. Usually separate masons are

Table 3.4 Road width and accessibility matrix

Plot	Road width	Car access		Grand total (%)
		N (%)	Y (%)	
Deep	Less than 3 m	24	2	26
	3–4 m	3	13	16
	More than 4 m	0	2	2
	'Deep' count of 'car access'	27	17	44
Shallow	Less than 3 m	6	0	6
	3–4 m	5	27	32
	More than 4 m	3	15	18
	'Shallow' count of 'car access'	14	42	56
	Total count of car access	41	59	100

Source Author

Table 3.5 Location of staircase

Plot frontage	Location of Stair		Total (%)
	Center (%)	Corner (%)	
Narrow	57	21	78
Wide	18	6	24
	75	27	100

Source Author

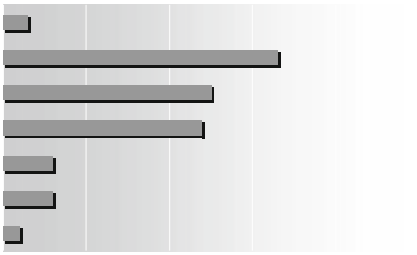
engaged to carry out separate services such as masonry work, RCC work, plumbing, electric, paint or woodworks.

In average, the buildings are four stories high, with an average of seven unit altogether (median values). Owners occupy one unit, but that counts for around 25 % of the total floor area. The rest 6 rental units occupy the available 75 % area (12.5 % each). Thus a rental unit is approximately half the size of owner's unit. Table 3.6 showed the percentage of different flat numbers in houses as they were during the study.

The difference between transformers and non-transformers showed that by transformation more space is occupied (Table 3.7), both in terms of area, and number of rooms.

There were 24 rooms in 7 units, thus a median of 3 rooms per unit (Quartile values 2–3) inferred that these units were largely 2 or 3 room flats (Table 3.8).

Table 3.6 Number of flats in a house

Number of flats in one house		
2–4	3 %	
4–6	33 %	
6–8	25 %	
8–10	24 %	
10–12	6 %	
12–14	6 %	
14–more	2 %	

Source Author

Table 3.7 Measures of occupancy

Measures of occupancy for main household (medians)		
Habitable space occupied by main household (m^2)		
Transformers	123	Sqm
Non-transformers	89	Sqm
% of space occupied by owner or his independent children		
Transformers	25 %	
Non-transformers	13 %	

Source Author

Table 3.8 Number of habitable rooms (after all transformations)

In the whole building	24
In one unit	3

Source Author

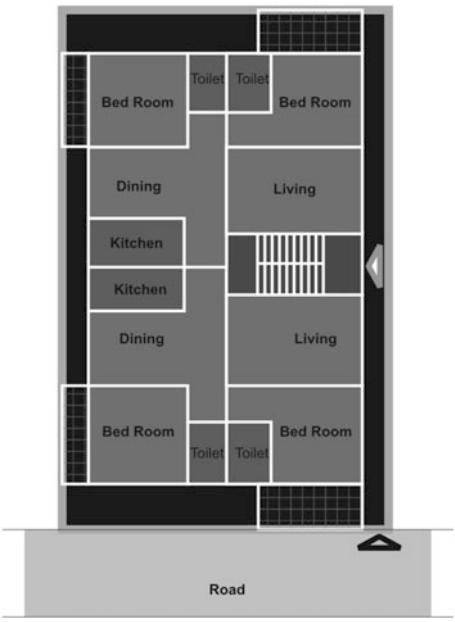


Fig. 3.5 A schematic layout of the typical floor of an conceptual house. *Source* Author

With an average of 5:3 ratio, and 139 sq. m floor area, the sides of the building were around 9 and 15 m long. With the stair at the center of the wide arm, and two units in each floor, each unit had approximately 65 sq. m floor area. Though south and east are desirable locations for bedrooms, still that preference was relegated to secondary as far as twin unit subdivision in each floor was concerned. A conceptual schematic diagram above shows a typical floor in Self-built houses with all those inherent qualities found from empirical observation and descriptive analysis (Fig. 3.5).

3.5 Categories of Spontaneous Transformation

Using Habraken (1998)'s two major levels, namely the Building and Partition levels, the explicit physical patterns gave an expression of the inherent orderliness inside their apparent disorder. They are discussed in the following sections.

3.5.1 Building Level (BL) Transformation

Two major categories of transformations were identified at BL. They were:

- Vertically added permanent floors or temporary structures (VA), and
- Horizontally added permanent floors or temporary structures at any floor (HA).

One easier way to distinguish them from Partition Level transformation was that the shadow area of the transformed built form became different than that of the existing building interms of height (Table 3.9). Some of the sub-categories of BL transformation were also associated with Partition Level (PL) transformation, which were mentioned here.

Obviously VA_P is the most dominant form of building level transformation and VA_T is relatively less. For HA, it can also be either permanent, or temporary construction. The added space may or may not affect the previous layout. One important finding is that, after any incident of Building Level transformation, it is likely that internal layouts of newer floor would be different from the previous floors. It means that a PL transformation is expected to follow BL transformation.

In VA, new layout was definitely the likeliest incident as owners learn from the shortcomings of the previous floors.

Table 3.10 shows a recap of the relative frequency of BL transformations.

3.5.2 Partition Level (PL) Transformation

Transformation at PL was defined as rearranging space usages inside the house without any change in the building form. It also meant that there was no change in the shadow area of the house. The only major category was identified as Internal Alteration (IA). IA occurred when units were extended or subdivided; rooms were added together, or subdivided etc.

Though BL transformations were always associated with consequent PL transformations, the vice versa was not automatic. PL could happen independently without BL transformation. The sub-categories of IA are described in Table 3.11.

PL transformation appears to be equally significant as BL transformation. Subdivision remained the dominant subcategory showing that need for extra rental income is the most important reason. Expansion and internal redesign mainly involved the interest of owner's flat.

BL transformations are associated with some PL transformations. However, PL transformation under IA can occur independently. Moreover, they can occur in isolation or simultaneously.

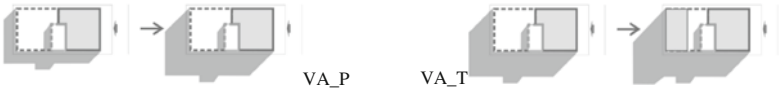
Table 3.12 shows a recap of the number of partition level transformations.

Buildings were generally not built at a single stretch. Ground floor was the only floor completed at the initial phase. The consequent phases were largely dependent on the money at hand. On average, a building had 3 phases of BL transformation

Table 3.9 Categories of building level transformations

Vertical Addition (VA): construction of new floor added vertically

Permanent (VA_P): construction of RCC roofing and masonry walls to increase habitable spaces to the existing floor(s) vertically.

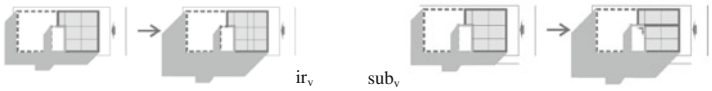


Temporary (VA_T): addition of habitable spaces usually at the highest floor (roof-top) characterized by masonry walls (corrugated partition walls in some cases) and corrugated iron sheet roofing.

Associated Internal Alteration

same layout (sl): previous layout appears in new floors.

(virtual) internal-redesign (ir_v): same number of units are repeated in newer floors but with different layout compared to those in previous floor(s); usually floor area in the upper floor is more than that of ground floor due to projected roof if it is permanent vertical addition, but with reduced floor area in case of temporary vertical addition at rootop.



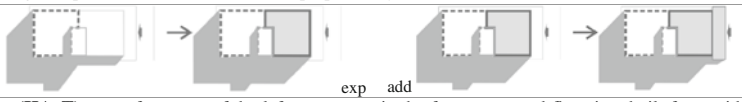
(virtual) subdivision (sub_v): more number of units appear in newer floors. It can occur both in permanent or temporary vertical additions

Horizontal Addition (HA): addition of habitable spaces extended horizontally either in upper floors (a part which was previously terraced) with RCC roofing or with temporary structures, or in ground floor, usually by temporary roofing on previously leftover space at the mandatory setback area at the front.

Permanent (HA_P): addition of permanent structures (with RCC roofing) at upper floors, on areas which were previously terraced.

Associated Internal Alteration

space expanded (exp): expansion implies the new space to be merged with the functions of the original space, thus used for residential purpose only.



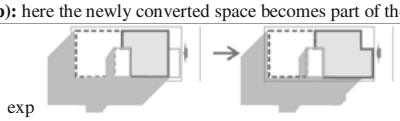
Temporary (HA_T): transform part of the left over space in the front at ground floor into built-form with temporary roofing. Temporary structures can also be added in upper floors, but it was excluded as a separate sub-category as they did not tend to exist for a significantly longer period.

space added (add): added space are usually for ancillary non-residential purposes such as garage, shops, toilets etc., which are independent functions from the residential part, and are occurring mainly on the front

Balcony Transformation (HA_BT): transformation of a balcony into habitable spaces such as toilet, kitchen etc. It can be independent or can happen simultaneously associated with demands from other transformations.

Associated Internal Alteration

space expanded (exp): here the newly converted space becomes part of the older unit.



Source Author

and 2 phases of PL transformations. Later on, owners mostly did the renovation works, but that had been excluded from this study. Since BL transformation (especially VA) was more intriguing, study shows that they were performed when the owners were relatively younger. The basic structure of the building was completed by then. The later transformations were PL transformations (all IE), when they were relatively older.

Table 3.10 Building level transformations in numbers

VA	VA_P (%)	VA_T (%)	%
sub_v	10	–	10
ir_v	53	19	72
sl	18	–	18
Total	81	19	100

HA	HA_P (%)	HA_T (%)	HA_BT (%)	
exp	35	–	27	62
add	–	38	–	38
Total	35	38	27	100

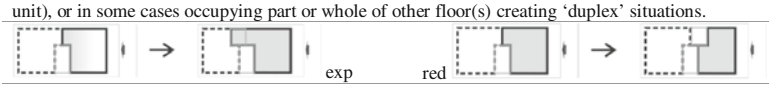
Source Author

Table 3.11 Categories in partition level transformations

IA: Transformation in layout without affecting the building form

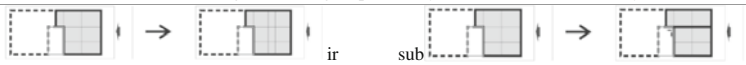
IA_P: permanent construction work is involved during internal alteration.

expansion (exp): size of one unit is increased by devouring some space from adjacent units on the same floor, or sometimes the whole floor becomes one single unit (if previously it had more than one unit), or in some cases occupying part or whole of other floor(s) creating 'duplex' situations.



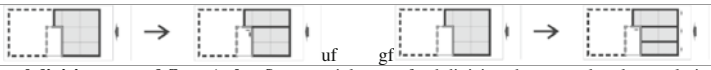
reduction (red): size of one unit is reduced, usually due to change of usage of part of any floor into non-residential activities (ex. the reduced part becoming Garage at GF; office or storage at any floor etc.).

internal redesign (ir): redistribution of usage of spaces involving construction works and only inside one unit without increasing or reducing its previously defined area and boundary.



subdivision (sub): subdivision involves constructing or demolishing partition walls, or simply closing a door or two, so that rental units become physically independent.

subdivision upper floor (sub_uf): in upper floors, with all the new units having access from the staircase.



subdivision ground floor (sub_gf): a special type of subdivision that can take place only in the ground floor where entry points of newly subdivided units can evolve from places other than from the stair cases.

IA_T: construction work is not involved during internal alteration.

shared subdivision (share): redistribution of usage of spaces by renting out separate rooms to separate families, or by mutual co-habitation (with the help of shared toilet and kitchen), thus one entry point is sufficient. It can happen at any floor.

Source Author

Table 3.12 Partition level transformation in numbers

IA	IA_P (%)	IA_Tshare (%)	%
exp	28	–	28
red	2	–	2
ir	29	–	29
Sub	28	13	41
Total	87	13	100

Source Author

The owners were mostly dependent on house rent for their living. Even though some had other sources of income, that only supplemented the rental income. So they had always the drive for increasing rental income. That is why transformations in earlier or later phases were mostly related to subdivisions that led to increase in the number of rental units.

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Chapter 4
Explicit Behavioral Patterns of Spontaneous Transformation

Abstract After generating the categories of transformations under the category of Building Level (BL) and Partition Level (PL) transformations, this chapter tried to identify the behavioral patterns of such transformations, which were stated as themes. To have a better understanding, several themes were grouped into domains. There were major, minor, and meta domains. The major domains reflected those themes which were more frequent. The minor ones reflected those themes which were not that frequent. The meta domain reflected those themes which were related to the whole history of transformations of the houses. These themes also showed association with particular categories of transformation either at BL or PL.

Keywords Building level transformation · Partition level transformation · Behavioral patterns of transformation

4.1 Major Themes

The major themes were those behavioral patterns of transformation which resulted frequently from different actions. Three major domains were identified, with each of them consisting of several behavioral patterns as such themes.

4.1.1 Domain I: Building Regulations: Six (6) Themes

Several themes were unfolded which was grouped inside a bigger domain related with building regulations. In self-built houses, transformations often looked for loopholes in existing building regulations. A higher level of tolerance from building authorities also increases the chance of such incidents. Since the buildings

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regulations deal largely on the built form rather than the interior space, all the three subcategories of BL transformations showed these exploitations.

4.1.1.1 VA_P: (Virtual) Internal Redesign (on Projected Upper Floors)

Upper floors often produce different layouts than the ground floor. It may not occur simply because new ideas develop as construction progresses, but it may be associated with the fact that upper floors are often projected beyond the ground floor, and thus provide more spaces than the ground floor giving the owner option to develop the layout. This phenomenon is associated with the fact that inspectors from authorities visit only once and that is only to check the foundation work and location of structural columns. The visit takes place when the construction is completed up to plinth level. There is no inspection to check whether the internal partitions are following the plan, or even if the upper floors are following the setback lines. The lack of inspection at later stage of construction encourages violation of regulations. High level of tolerance form authorities intensifies the situation.

Upper Floors Project Beyond Column Lines

While applying for permission to construct, all the floor plans need to be submitted to building authority. The layouts should show that the structural columns do not enter the mandatory setback area. However, as mentioned, lack of inspection at later stages encourages owners to extend upper floors hanging over the mandatory setback area. The major purpose is to increase the area of habitable space in upper floors (Fig. 4.1). As a result the neighboring buildings can become very close to each other at the sides.

Projected Sides Become Part of the Habitable Floor Space

The setback rule allows buildings to leave more space in the front and back, than the sides (Appendix I). If the projections are in the form of balconies in the two sides, they do not fetch much of an advantage, as they cannot be sufficiently deep (anything less than 1 m can be called not deep enough as a balcony). Therefore, the owners opt to integrate them inside the habitable spaces in the upper floors. As a result, very close face-to-face windows might exist, causing privacy problems (Fig. 4.2).

Projected Front and Backs are Mainly Balconies

Projection at the front and back can be used as balconies because the setback areas are more there (Fig. 4.3). Moreover, these balconies can also be transformed into small toilets, kitchens, or small rooms in some cases. Balconies can also be used as an articulating element in the front.

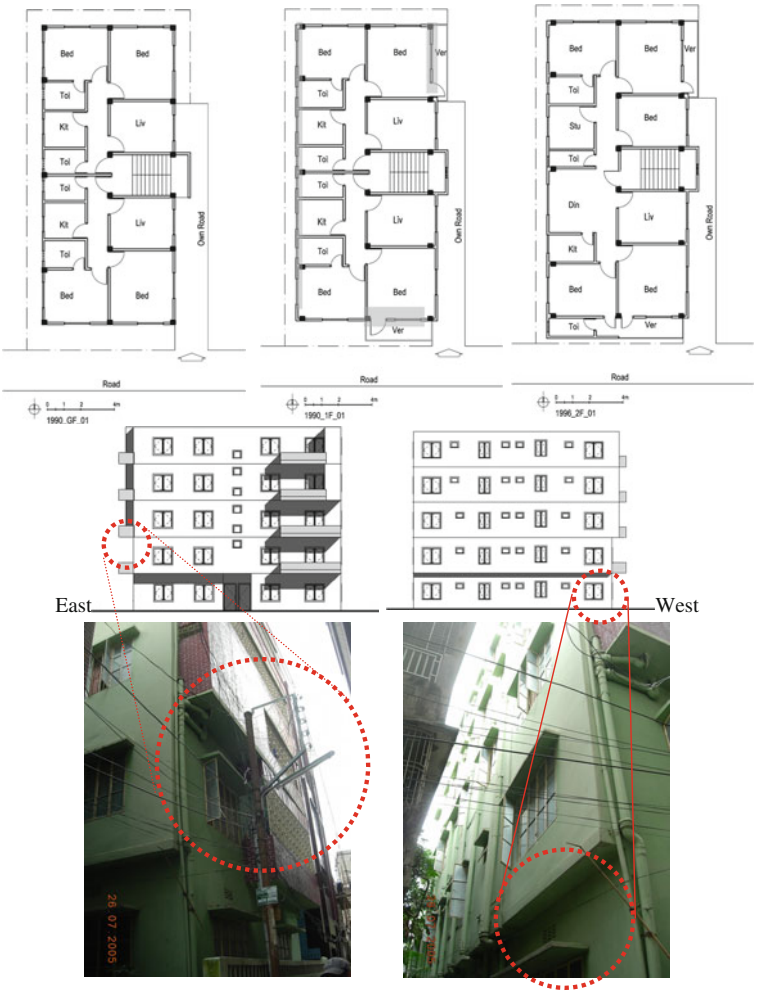


Fig. 4.1 An example showing projections at different sides of the buildings. The ground floor followed the setback rules. But the upper floors were projected on both east and west side (*shaded*), where the neighboring plots were. In the front side, balconies projected from the setback line somewhat differently than the sides. *Source* Author

Front balconies can act as buffer from the nearest other balconies facing them at the opposite side of the road. The back balconies are usually a space for household uses such as drying clothes, storage etc. as they are likely to face the back balconies of the plot next to it. Therefore, the front balconies are often articulated, while the back balconies have much simpler look.

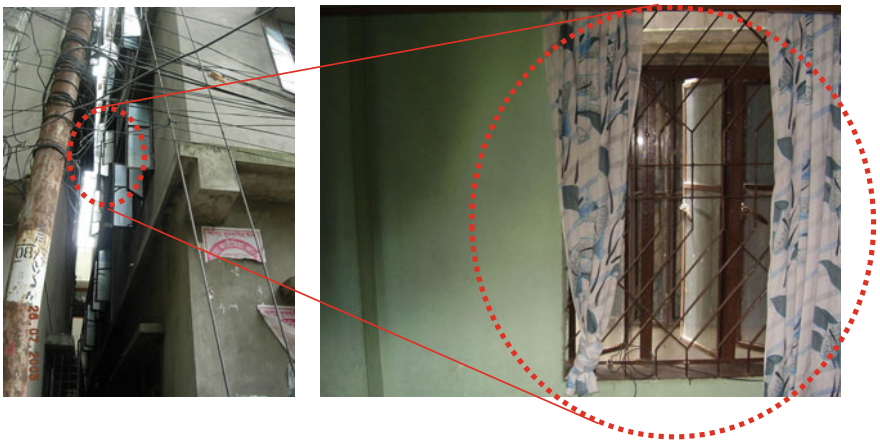


Fig. 4.2 The close face-to-face neighboring windows. *Source* Author

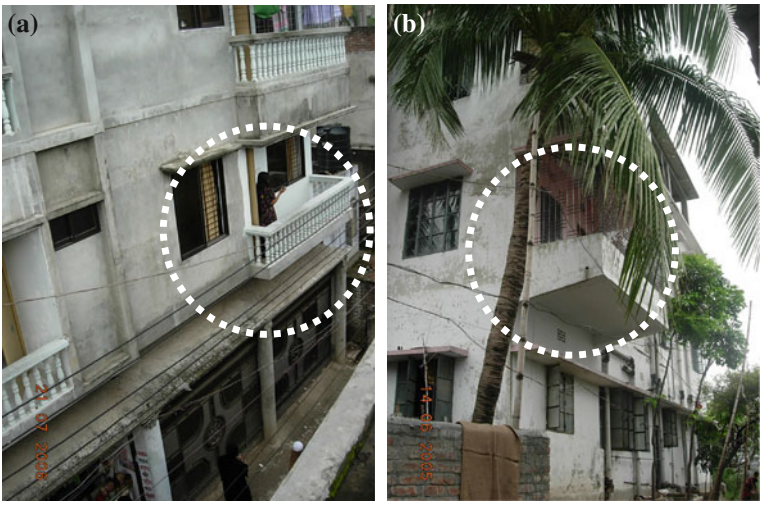


Fig. 4.3 Front balconies and back balconies. Front Balconies are often used for decoration or articulation since they have more chance to be visible (**a**), Back Balconies are used more to act as future resources, and are more often kept simple (**b**). *Source* Author

4.1.1.2 VA_T: (Virtual) Internal Redesign

This is the result of another exploitation of existing building regulations. The past regulations determined the number of permanent floors, depending on the width of the access road that the plot is abutting. However, it did not mention about any temporary construction at the top. There are examples that people use to construct additional spaces at the rooftop using temporary materials.

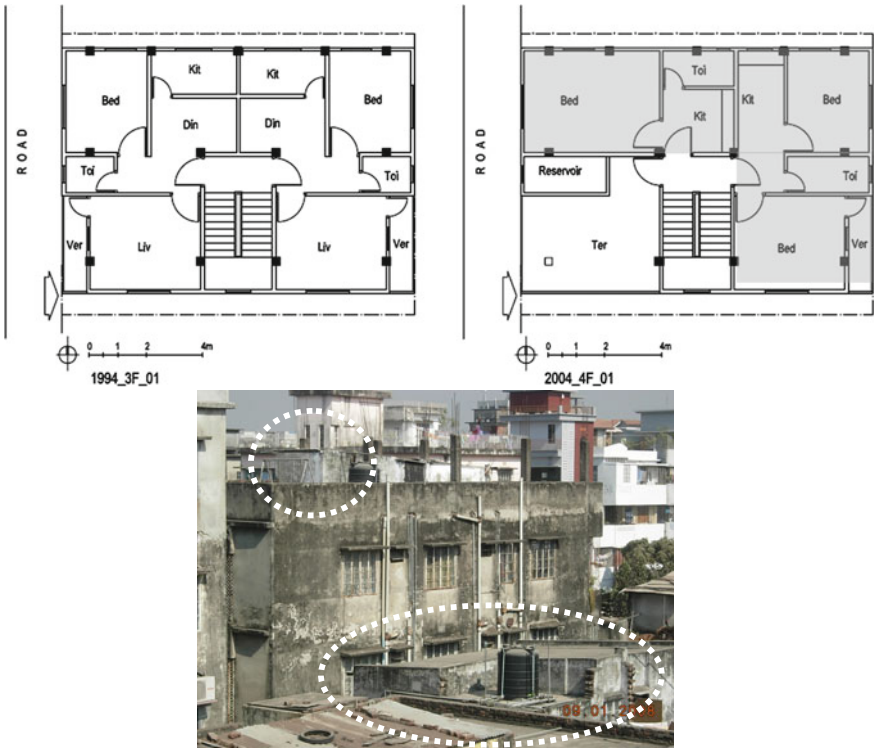


Fig. 4.4 Examples of rooftop additions. Examples showing rooftop additions occupying rear part of the roof, away from the access road (*circle*). *Source* Author

Roof-Top Additions are Common at the Final Floor

Rooftop additions (with temporary roofing) can serve different purposes. They can be the source of additional rental income with the help of minimum investment. They can also be used as storage spaces. (Fig. 4.4). However, it is also found that the whole of the rooftop is not used for such purposes. The rest is used for recreation areas, space for drying laundry or for roof-gardening etc.

4.1.1.3 HA_T: Added Space (at Frontal Setback)

A house located abutting a busier road (such as secondary road) has the potentiality for being commercially used. The easier way is to open up shops facing the road. The mandatory setback area at the front can often be the perfect setup for this purpose. Temporary sheds are not violation of building regulations. Therefore, this kind of shop houses is in abundance in these neighborhoods.

Fig. 4.5 Example of overstepping. The width of the access road is around 20 m in paper; however, cadastral map shows just around 10 m remaining. This house is just one of many on the street which has incrementally claimed some spaces in the front, and now unusable as road. *Source* Author

Constructions Oversteps Roads

However, there are often disputes over the marking of the plots and roads. As mentioned before in Chap. 1, this results from original land division. Demarcations in the older leasing contracts and recent cadastral maps, which show real time markings, are often significantly deviated. While opening up the shops, it might overstep the road. When neighbors start to follow the same trend, it may cause the abutting road to gradually become narrower (Fig. 4.5).

4.1.1.4 BT: Balcony Transformations (on Mandatory Open Space)

Balconies are usually located at the front or at the back of the house. From the study, it has been found that balconies are multifunctional. It is a buffer between outside and inside. It is a good place for laundry drying. Some people put plantations here. Some others may have enough space to put chairs to relax. However, balconies may not remain as balconies forever. Need for extra space tempts owners to transform into usable spaces, be it a separate room, or become part of the adjacent room.

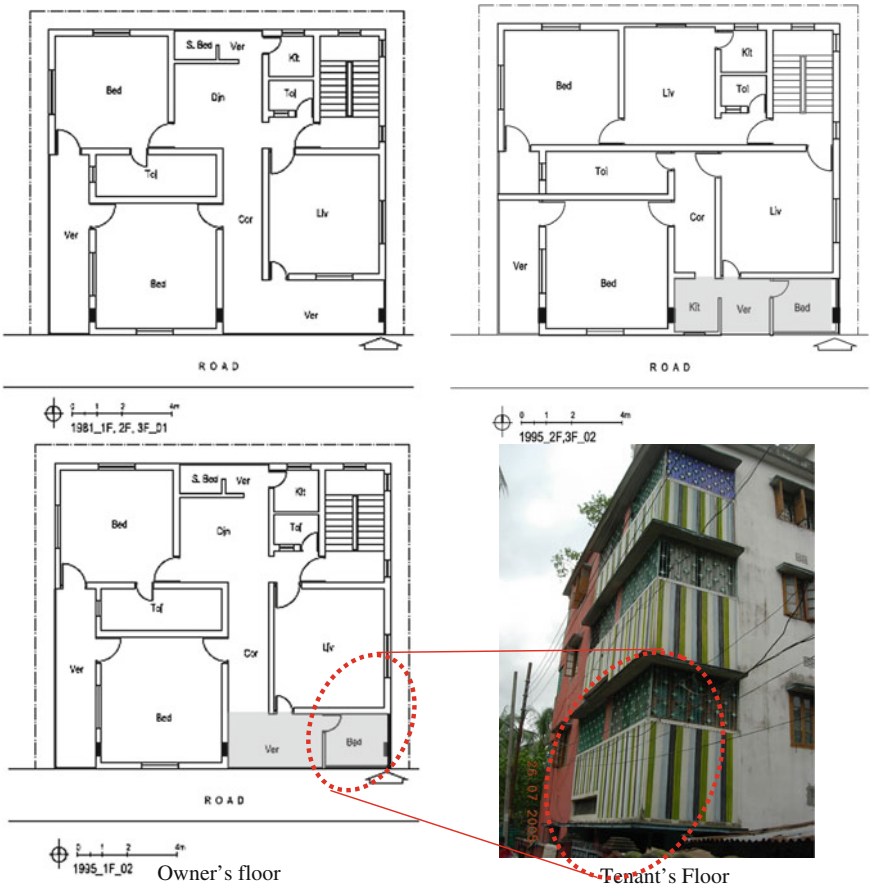


Fig. 4.6 Examples of balcony transforming. The 2 m wide balcony at each floor was later transformed according to necessity. For the owner's floor, it was an extra bedroom, while at the tenant's floor, a kitchen was also provided as one unit became two units (*shaded*). *Source* Author

Balconies Projected on Setback Areas will Invariably Transform at Some Point in Future

According to current building regulations (2006), balconies cannot exist beyond the mandatory setback area over ground floor. But houses built during previous regulations do have projected balconies on setback areas. However, if they have enough depth, they might be transformed. Most likely option is to become a toilet, though there are examples for balconies to become kitchen, study, or even small bed rooms (Fig. 4.6).

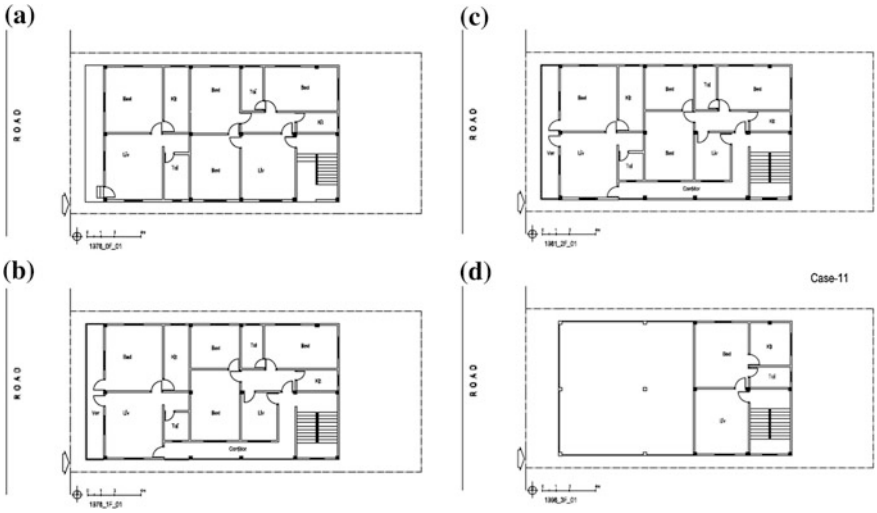


Fig. 4.7 Example of buildings with phases. As a two story building, this house remained such for 2 years (**a**, **b**). In 1981, another floor was added (**c**). In 1998, the temporary rooftop addition was added (**d**). The owner addded the eastern part of the building on the remaining left out land. *Source* Author

4.1.2 Domain II: Habitual Practice (BL): Three (3) Themes

Habitual practice is referred to lessons that are learnt informally due to the necessity to co-exist inside the community and that gradually become a part of the culture. Habitual practice can be explicit in wide range of behaviors, for example, from the very basic cultural expression, like the way people greet each other, the way they dress, the way they cook etc. When concerned with the built forms, it can have a wide range as well such as the way they organize their spaces in the layouts, the way they construct their houses, the way they build the boundary walls of their houses etc. When transformation is expressed as a behavior, several habitual practices could be identified as well.

4.1.2.1 VA_P: (Virtual) Internal Redesign, (Virtual) Subdivision, or Same Layout

Buildings are not usually built at a single stretch. All the possible floors are not cast immediately together. They grow in time. It had been a dominant feature of these buildings.

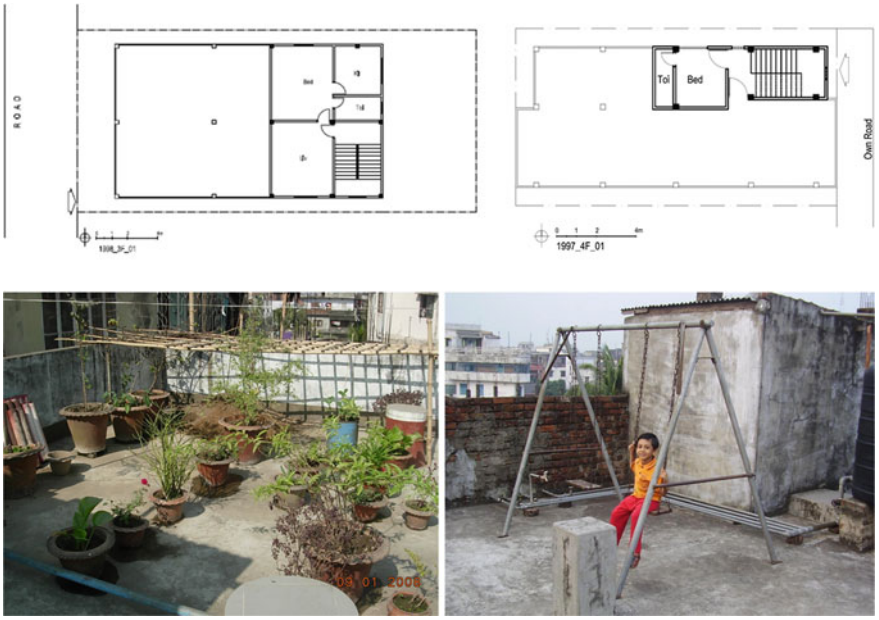


Fig. 4.8 Examples of rooftop additions occupying part of the roof. Plans showing rooftop additions kept away from the access road, and pictures showing different ways the rest of the roof can be used for. *Source* Author

Buildings Grow in Phases

There are two major reasons for buildings to be constructed in phases. One is of course affluence. Roof casting is the most expensive stage of construction. Most people do not have enough money needed to construct all the floors at one stretch. It is easier to build the floors in phases. The other reason is that most of these owners started building these houses for their own accommodation. So they definitely did not need a full four or five story building. Later on the floors are added as rentable flats are a good and continuous source of income. Since the owner is usually in charge of the management of the construction of the building along its lifetime, it is the owner who can decide best how much or how many floors to be built in a particular phase (Fig. 4.7).

4.1.2.2 VA_T: (Virtual) Internal Redesign

Rooftop additions are usually addition to the number of approved floors. Owners tend to add this extra floor by not using permanent roofing materials.

Rooftop Additions Usually Occupy Part of the Roof, the Rear Part to be Specific, Thus Away from the Road

As mentioned before, rooftop additions do not occupy the whole of the roof. They tend to occupy the rear side of the roof, probably to keep it away from being visible from road, so that it does not draw much unwanted attention (Fig. 4.8).

4.1.2.3 BT: Balcony Transformation

A balcony deep enough, for example, more than 1 m, is always likely to be transformed at some point in future. They can be transformed to satisfy different purposes.

Balconies Transform into Variety of Spaces During Inhabitation

Balconies are the essential part of buildings. Basically, they consist of three potentials:

1. A shading option for rooms
2. A buffer space which is semi-outdoor
3. A future prospect to be incorporated into extra habitable or service spaces

Considering the first two serving the early parts of the building, the third one is an option as households grow mature, and need for spaces increase. Most commonly they transform into toilets. However, kitchen, store rooms, study rooms, or even small bedrooms are also experienced. In each of these cases, the transformed spaces are independent spaces. But there are also examples when the balcony can be included into existing adjacent space (such as the bedroom). Figure 4.9 shows different examples of transformations of balconies into habitable spaces (shaded).

4.1.3 Domain III: Habitual Practice (PL): Seven (7) Themes

Transformation in interior walls is defined as Partition Level (PL) transformation. Two different broader categories exist in such transformation. The first one is the actual transformation by rearranging existing walls, and the other is the virtual transformation where same layout do is not followed in immediate upper floors. The latter is explained first.

4.1.3.1 VA_P: New Layout

In upper floors, if not specifically designed for the owner to stay, similar layout is expected. However, due to the fact that all the floors are not constructed in a single stretch, it is likely that owners learn from previous mistakes, and are likely to experiment something new in the upper floor constructed later on.

Fig. 4.9 Examples of balconies transforming into habitable spaces. **a** In this example, part of the toilet at the N-E is transformed into a toilet. **b** Here the balcony is even extended to be transformed into kitchen and toilet. **c** Another example of a balcony transformed into toilet partially. **d** Here, part of the toilet is transformed into a kitchen. **e** In this example, part of the 2 m deep verandah is transformed into a small bed and a kitchen. *Source* Author

Fig. 4.9 (continued)

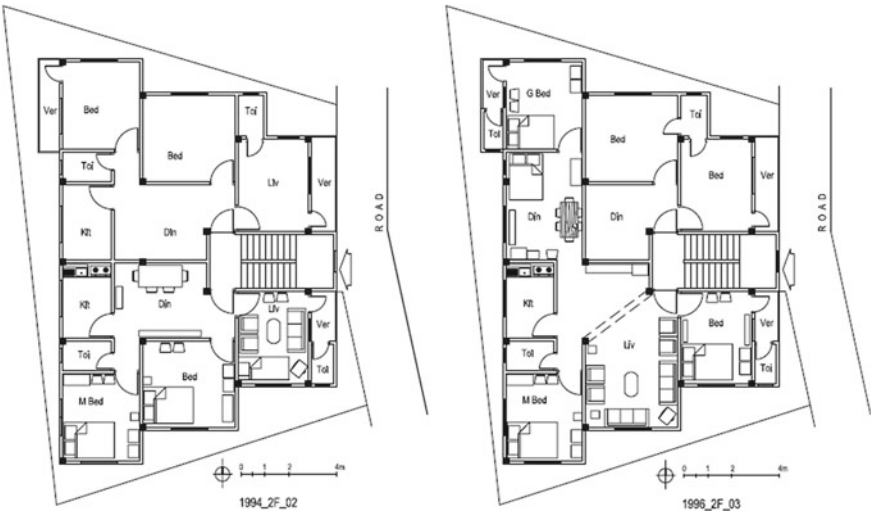
New Layouts are Experimented in Floors Added in Different Phases

Owners learn from experience. The major sources of such knowledge can be listed as:

1. Owner's own understanding from previous weaker design solutions
2. The influence of family members to amend a previous decision
3. The indigenous knowledge gathered from the on-site workers such as masons, or contractors
4. Influential relatives or neighbors who are in regular interaction with the owner
5. Free advice from familiar professionals within the community
6. Professional advice

Fig. 4.10 Experimentation in new layouts. In this example, the arrangement of spaces were reshuffled when a new floor was added. In this example a whole new solution was introduced when the new floor was added. *Source* Author

As a result existing layout may not be repeated in upper floors, a phenomenon defined as virtual internal-redesign (ir_v). The time gap between two different phases of floor addition allows them to gather that knowledge and contribute to the newer solutions. Whether those decisions are of a better quality, is another question, but the point is that owners try to do something different (Fig. 4.10).



Gamma diagram:

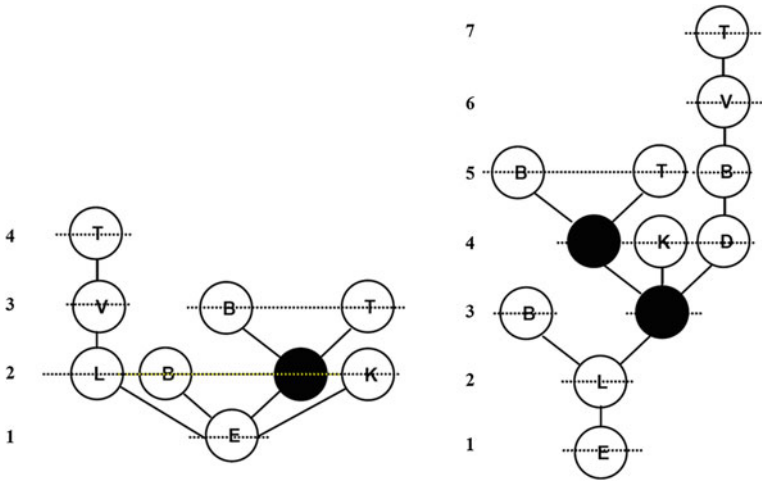


Fig. 4.11 Increase of depth after transform. Previously no space had more than four levels. Now, the toilet at N–W has is at the seventh level from entry: Living-Pantry-Dining-Bed-Verandah-Toilet. The circulation spaces (*Black dots*) also increase meaning more wastage of space. *Source* Author

4.1.3.2 IA: Expansion (at Owner's Flat)

In this particular category of transformation, a unit takes over some space from adjacent unit on the same floor during transformation. However, it is usually associated with the owner's unit. Of course, while the owner's unit is expanded, the other adjacent unit is reduced.

Fig. 4.12 Example of rooms shifting locations. At some point of inhabitation, the living room was not required to be so big anymore, rather the owners decided to have a big master bed. So master bed moved to the living room, living room moved to the smaller family living room, and the previous master bed was shrank to daughter's room who often visited them. *Source* Author

Depth Increases Along Transformations

Owners usually plan their unit to meet the current demand. As they are seen to move in at the earlier part of the mature stage, the families still have the potential to grow. Predictably, needs also grow, and households need more space. The easiest solution is to take over some space from adjacent unit, or devour the whole floor. In some cases, some other floors can also serve as a single unit especially redesigned to meet the changed demands of the owner's household. However, with the professionals not around, not all the transformations follow basic architectural norms of space hierarchy. Examples of such transformation include entry to toilet through verandah, entry to a bedroom through another bedroom, multiple entry of a room to solve circulation, evolution of complicated circulation spaces etc. Using Gamma diagram, it is found that the levels of depth increase after transformation (Fig. 4.11).

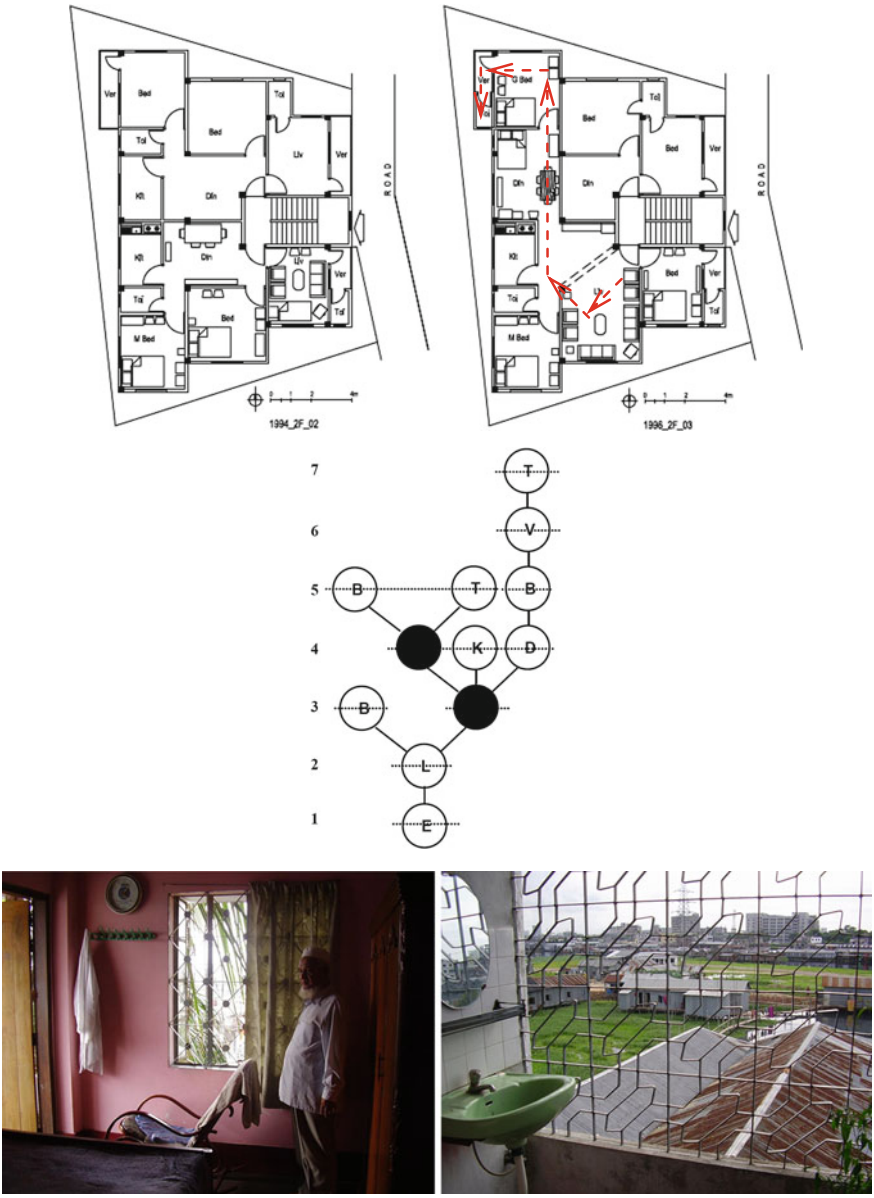


Fig. 4.13 Space hierarchy gets complicated. The verandah was partially transformed into a toilet, while the wash basin was kept outside the toilet. The dining room also contained bed also, in order to accommodate visiting daughters in three rooms i.e. one in living room, one in dining, and the other in the Guest bed. *Source* Author

Fig. 4.14 Deviation from institutional standards. The ground floor has an extra unit in the middle, which leaves the eastern unit with more complicated and unused spaces. The access of the western unit at the first floor is through a circulation space, which can be considered as wastage of space. The increase of circulation space at first floor, the lack of definition of a particular space (mixed use of living, dining and bed) in the middle unit of ground floor, the lack of privacy in the eastern unit due to the passage at first floor, the lack of hierarchy of zoning at the eastern unit of first floor, all show how they are widely deviated from those institutional standards. *Source* Author

Rooms Shift Locations

Another interesting finding is the shifting of rooms. If the transformed layouts are visualized sequentially, a careful observation will show how a room shifts from one location to another (Fig. 4.12). It does not refer to physically shifting, but the usage of rooms change. Depending on the changed needs of the family, owners often want to choose a different size or shape of rooms. It is often easier to shift rather than physically transforming. Room shifting can also be associated increase in the levels of depth.

Space Hierarchy is not Maintained After Transformations

Proper hierarchical zoning is related to follow sequences from public, semi-public, semi-private, and to private zones. When depth of spaces increases due to transformation, the hierarchy of zoning of spaces may also be valiantly violated. It is obvious that when living rooms become bedrooms, bedrooms are combined to become living room, dining rooms are moved from one location to another, toilets are carved out from balconies, conventional hierarchy is often sacrificed. Gamma diagram is also helpful to visualize this phenomenon (Fig. 4.13).

Institutional Standards are not Maintained

Institutional standards may refer to the followings:

1. Less space is dedicated to circulation, and the travel distance from one end to another in that circulation should be minimum, which would effectively render maximum space to other priority spaces.
2. A particular room with a particular usage should consider climatic variables such as sunpath, ventilation etc.
3. The basic concept of zoning should be maintained in terms of privacy.
4. The hierarchy of the size of rooms should be maintained, such as toilets should be the smallest spaces, followed by kitchen, dining, bedrooms and living room up in the order.

After transformation, each of these might not be respected (Fig. 4.14).

4.1.3.3 IA: Subdivisions (at Tenant's Flats)

Subdividing units is a frequent category at PL transformation. Basically this phenomenon is found in tenants' units.

Increase of Rental Units is a Major Objective, and Subdivision is the Major Method

Increasing rental income is the major reason of transformation in these self-built houses. They are more frequent than expansion. Given the fact that these owners depend heavily on rental income, subdivision appears to be a fruitful method to increase that income.

Subdivision literally divides one existing unit into two or more. The resulting total rental income is always expected to be higher than the income from the undivided one. Subdivision may result in two or more independent units (Fig. 4.15), or it may involve dependent units who share toilet and/or kitchen. Though sometimes occur in the former, the latter usually need no construction works for subdivision (Fig. 4.16). Construction works are often considered as a hassle, so sharing units can be an easier solution if there are tenants available.

Rental Units are Much Smaller Than Those Of Owners, Half the Size on Average

From the previous two phenomenon (expansion in owner's flat, and subdivision in tenant's flat), it is obvious that the owner's flats tend to get bigger, while the tenant's flats get smaller. In fact, the median value shows that average size of tenant's flats end up in half the size of owner's flat after the final transformation (Fig. 4.17). Subdivision only stops when the size becomes too small to be subdivided further. According to standard norm, the smallest subdivided independent unit has one room, one toilet, and one kitchen. When this cannot be subdivided further, the method of sharing can be used.

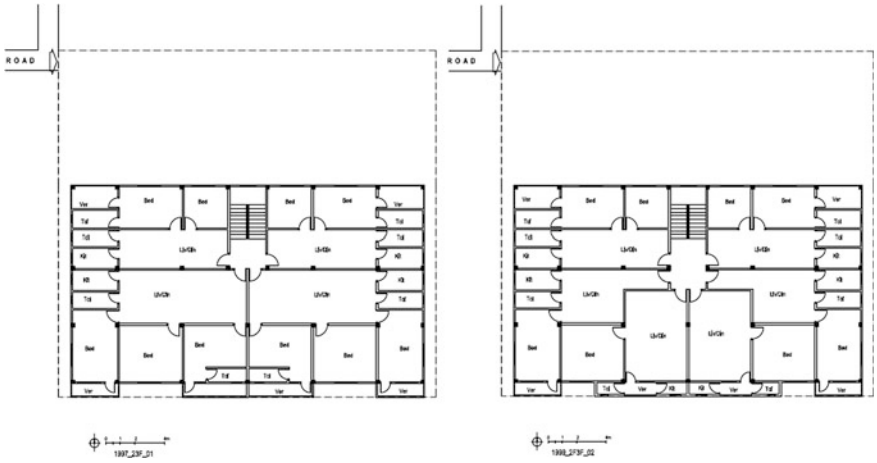


Fig. 4.15 Subdivision by separation resulting independent tenant units. Example of subdivision by separation. Here the subdivision resulted in two independent units. However, the major challenge was to provide individual toilets and kitchens. Often happened in similar such cases, existing verandahs were transformed into kitchen and toilets. They appear to be too tight, considering space provided. However, they continued to fetch tenants even after that. *Source* Author

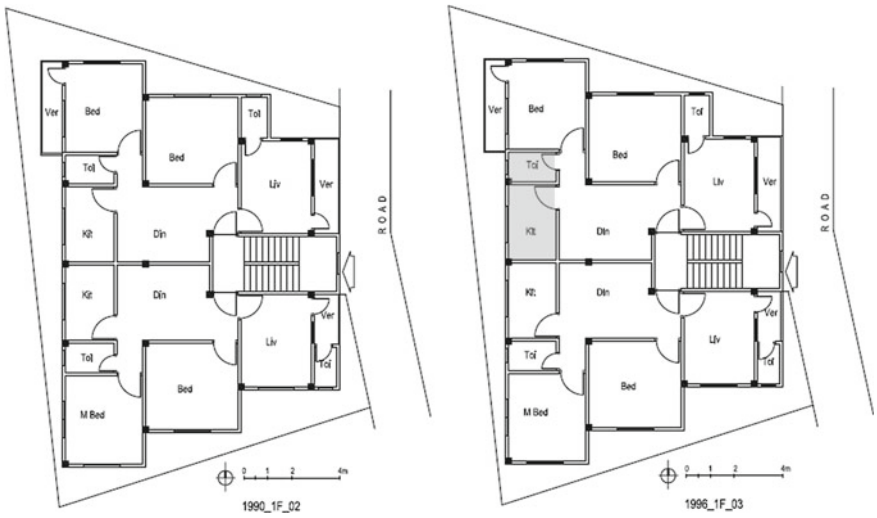


Fig. 4.16 Subdivision in the form of shared units. Example of subdivision by sharing toilet and kitchen (*shaded*) each family get one bedroom each. In this case, the subdivision was done not by physical separation but by using sharing method, where families shared services, and dining/living spaces. One of the families here got an own toilet, while the other two shared the other toilet. All the three families shared the kitchen, and the dining space. The cooking was internally managed by shifts. *Source* Author

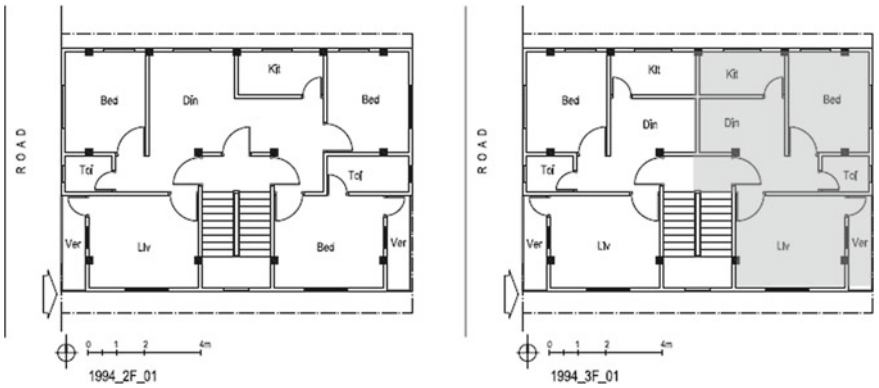


Fig. 4.17 Rental units are always smaller than that of owners'. In this example the common trend is shown, where the owner occupies one total floor, and the tenants occupy half of each floor (*shaded*). However, rental units can be much smaller too. *Source* Author

4.2 Minor Themes

Minor themes as defined before are those which do not occur frequently. Some of these themes occurred only in a single case, but they were given enough significance in this study. Three domains were identified from them.

4.2.1 Domain I: Construction Methods and Techniques: Four (4) Themes

The habitual practice showed how owners value advices or suggestions from around. Again, on the contrary, there are evidences as well, when common methods are also contradicted.

4.2.1.1 VA_T: New Layout

As mentioned before, rooftop additions are common, and they have temporary materials for roofing. But there are other features associated with rooftop additions as well.

Construction and Finish Materials are Relatively Low Standard

The rooftop constructions can be used as storage, toilets, but more frequently they are used for extra rental units. Owners are not willing to spend much money on this. Tin-shed roof on wooden frame is the most common form of roofing material.

Fig. 4.18 Horizontal extension mainly in the form of supporting facilities. Here shops were added between the front of the building and the front boundary line. *Source* Author

The walls are usually 5″ thick brick wall. The toilet and kitchen floors do not usually have any expensive finish materials such as tiles or mosaic, thought they have become much cheaper these days. The fittings and fixtures are the cheapest one available in the market. Doors are often not made of customary wooden panels, but just wooden framed with corrugated iron sheets as the panel. As a result, they are usually aimed at lower income tenants.

4.2.1.2 HA_T: Space Added or Expanded

Added space at the frontal setback area are used mainly for shops, though there can be some other ancillary facilities such as toilet, guard's room etc. depending on the available spaces.

Constructions are of Low Quality

Similar to the constructions at rooftop, these structures are not illegal as long as they have temporary roofing material. But for that same reason, spending much on its interior is not something that the owners want to do. For ground floor shops, dispute in boundary marking is also associated, so they do not intend to invest on them much. Therefore, a general low quality of construction exists.

Dependent Functions are Provided

Usually the activities housed inside these constructions are dependent functions. The most common usages are shops and garages. Other functions include temporary toilets, guard's room etc. Though in most of the cases they are separated from the existing ground floor area, sometimes they can be added with existing spaces of ground floor too. For example, a garage may not fit in the frontal setback area, and therefore a room or part of a room must be added for that (Figs. 4.18 and 4.19).

Example: 1 Shops were added between the front of the building and the front boundary line.

Example 2: Shops were added on both sides to take advantage of the busy road.

4.2.1.3 IA: Expansion, Subdivision

There are some common behavioral practices involved in any Internal Alteration (IA) in general. The following is one significant one.

Minimum Hazard is the Objective

Any BL transformation involves significantly higher amount of money and time than any PL transformation that involves construction. The general tendency for any PL transformation is to minimize construction hazards (Fig. 4.20). For

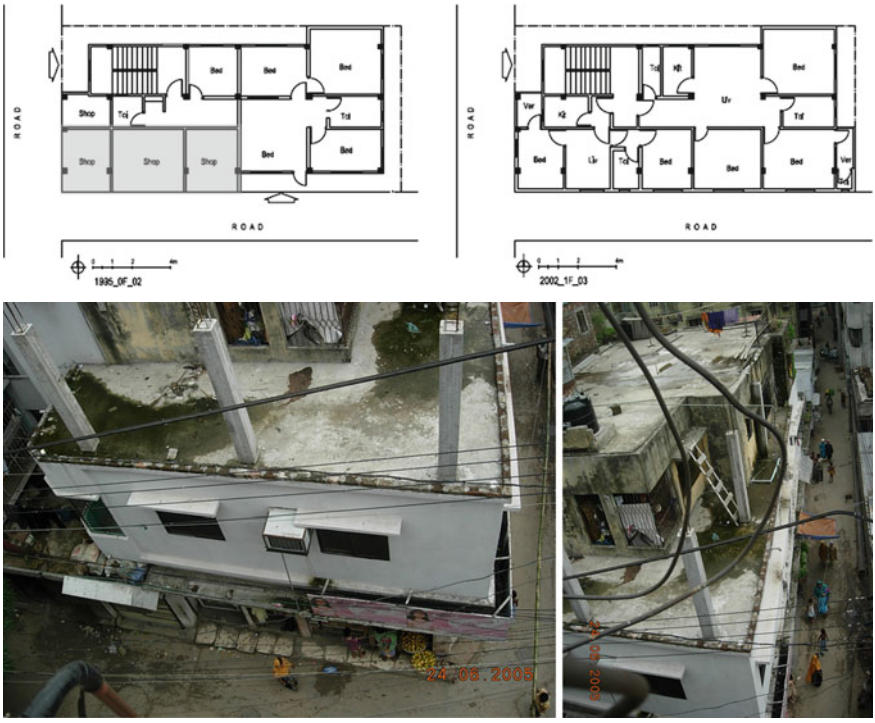


Fig. 4.19 Shops are the most common form of Horizontal extension. Here shops were added on both sides to take advantage of the busy road. *Source* Author

example, a small wall construction or just closing one door can be the solutions for a subdivision or expansion, rather than making a wholesale change in search for a better layout.

4.2.2 Domain II: Tenancy Issues: One (1) Theme

Tenants are the major part of the population in these neighborhoods. However, they seldom have the authority to transform the houses according to their own needs. The owners usually have the goal to maximize rental income as that is usually their main source of income. Therefore, different methods of transformation are used during the lifetime of the building. Subdivision being the most common method, there is a limit of how much an unit can be subdivided and still can be maintained as an individual unit. The minimum requirement is one room, one toilet, and one kitchen. If an existing unit cannot be subdivided into two independent units because the existing toilets or kitchen cannot be subdivided, nor any new toilet or kitchen space can be evolved, the final method is the 'sharing'

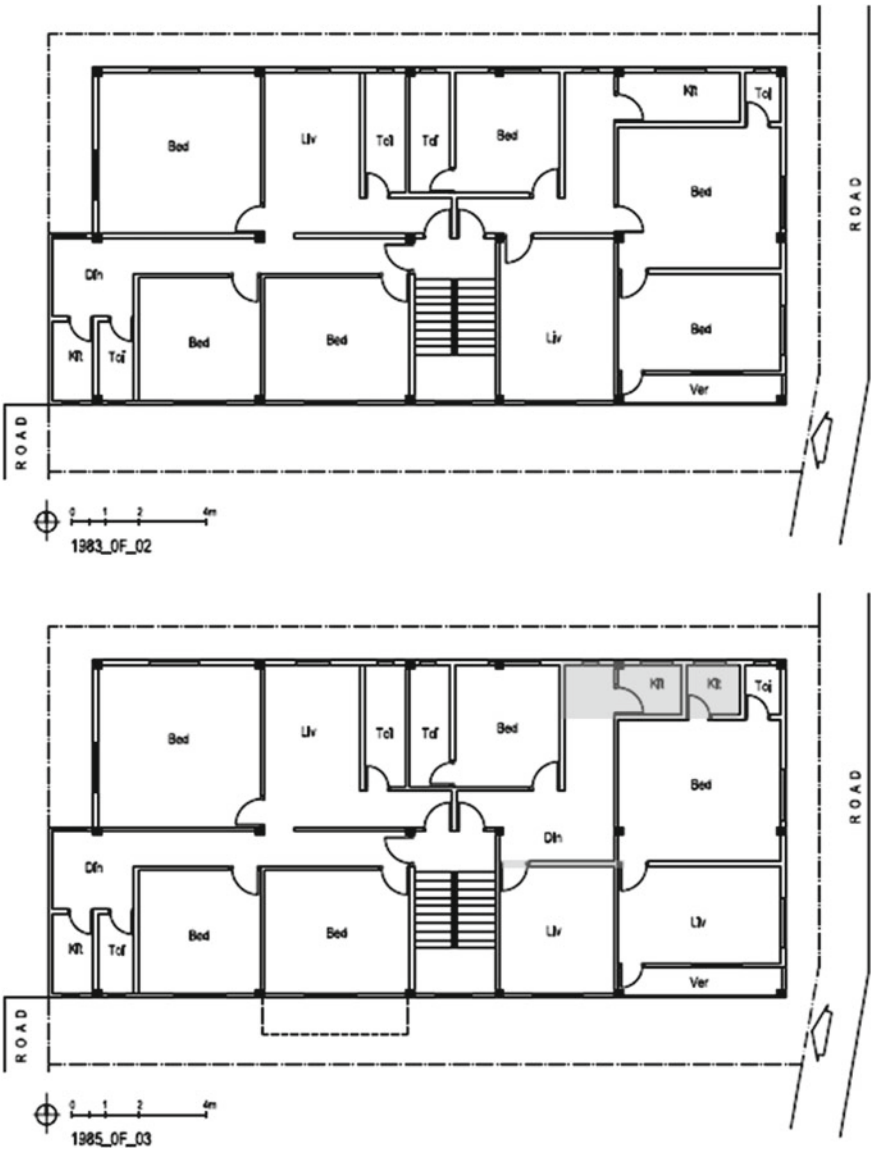


Fig. 4.20 Construction hazard tends to be limited to minimum. Here dividing an existing kitchen into one toilet and one kitchen, and shifting one wall to make a dining space is all that was needed to subdivide the existing unit into two (*shaded*). *Source* Author

units, where tenants share kitchen, toilet, living or dining spaces. Many such instances have been experienced in these houses. One major issue related to these sharing units is privacy. It is found that tenants, who belong to lower middle

income groups, often sacrifice the level of privacy in order to get a cheaper rentable flat where they share facilities with other tenants.

4.2.2.1 VA_P: Same Layout; IE: Sharing

Co-Habitation of Multiple Families is a Frequent Solution

The first method is to share kitchen, toilet, living or dining rooms, but not sharing the bedrooms by the tenants' family. The other method is to rent even the bedrooms to multiple people (presumably bachelors), and toilet and kitchen can be shared by them as usual. The total rental income increases by both of these methods, however, the standard of lifestyle is sacrificed (Fig. 4.21).

Example 1: No change in layout, only the tenure is changed. One family each in each bedroom at the northern flat, with toilets, kitchen, and dining space shared.

Example 2: Changes in the floor plan, transformed layout. Bachelors share the bedrooms (Fig. 4.22).

Example 3: Virtual transformation, same layout in new floor but the target tenancy is different. New floors were same layout, but rented to bachelors (sharing kitchen and toilet) instead of families (Fig. 4.23).

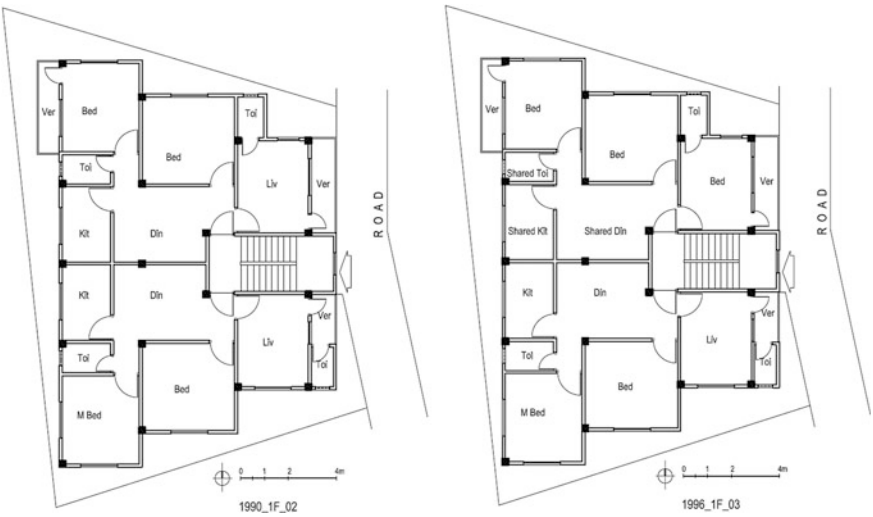


Fig. 4.21 Example of different solutions in similar layouts. Here one family each in each bedroom at the northern flat, with toilets, kitchen, and dining space shared. *Source* Author

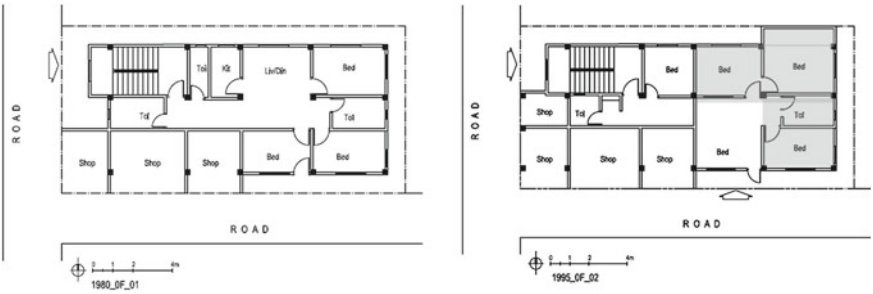


Fig. 4.22 New layouts are more common in case of sharing. Here bachelors share the bedrooms. *Source* Author

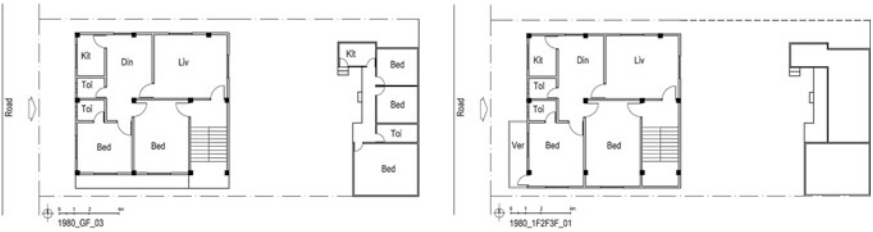


Fig. 4.23 Individual tenants sharing the same room can also be another solution. Here new floors were same layout, but rented to bachelors (sharing kitchen and toilet) instead of families. *Source* Author

4.2.3 Domain III: Subtle Decisions: Three (3) Themes

Subtle decisions refer to quick and smart outcomes sparked as a consequence of some unique situation never experienced before. Necessity spurs subtle decisions to come up. One important characteristic of these decisions is that they infiltrate just to solve immediate necessity, but might remain as an example to be repeated.

4.2.3.1 VA_P: New Layout; IE: Expansion, Redesign

Recursive and Frequent Transformations are Common

There are instances when similar events take place repetitively. In different cases of subdivision, one experiment at one floor can take place in other floors if that works well. There can be recursive actions if the situations offer similarity, such as, balconies having potential to be transformed. So, one balcony transformed in one floor can easily lead to other balconies to transform later on.

Very Small-Scale Transformation is also Common

There are numerous occasions when a very trivial transformation can take place, though small scale transformation may not always refer back to small reasons. The example of balcony transformation can also be considered as a very small scale transformation.

4.2.3.2 HA_T: Added Space; IE: Subdivision (at Ground Floors)

Unique and Extempore One-Off Solutions Occur

In some situations, there are examples that some unique solutions are done. One reason can be that there are urgent situation and a better solution might take more time, or it can be that the owner could not come up with any better idea. Figure 4.24 shows such a situation.

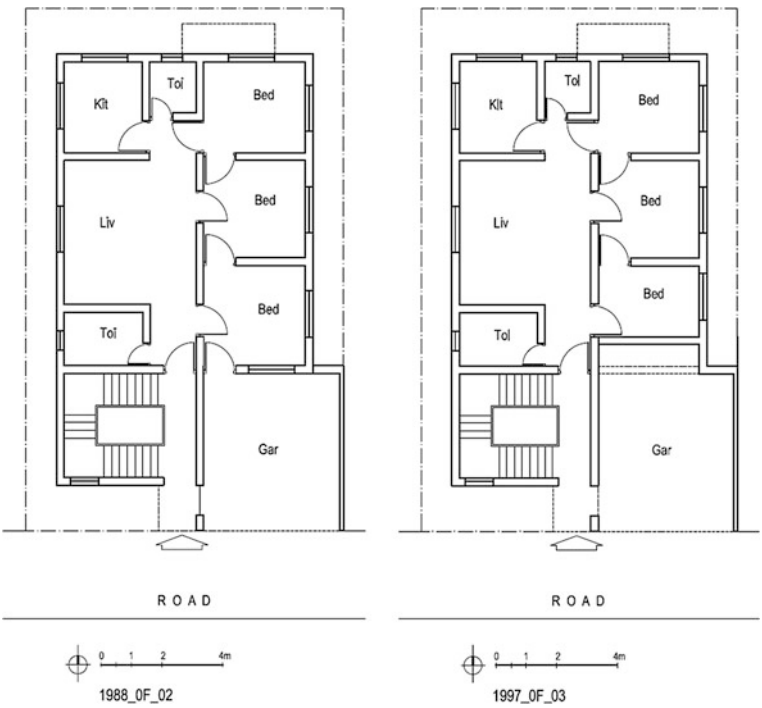


Fig. 4.24 One-off solutions often happen. At first the garage served for the first car. When a new model was bought, there was not sufficient space there. Since it was brick foundation building, the structural wall could not be shifted. As an extempore solution, part of the wall was demolished just to accommodate the rear part of the car. At sill level, the space was still usable by the tenant at ground floor. *Source* Author

Fig. 4.25 Initially planned for a duplex for the owner himself, it remained one unit in one floor for some time. Laterthe ground floor was divided into three units. To provide services such as toilets or kitchens, innovativearrangements were made. For example, the south-eastern unit (shaded) has only one room, the toilet isshared with the northern unit, and a separate kitchen is built at the southwest corner of the house, completelydetached from the only room it has

GF can Offer More Experimentation Because of its Accessibility from Multiple Points

Since ground floor has a great advantage that any room can literally be an entry point, thus usually in case of subdivisions in ground floor interesting solutions are found which cannot be repeated in upper floors due to the fact that upper floor entry is limited only from the staircase. Figure 4.25 shows such an example.

4.3 Meta-Themes

Meta themes were those related to the total history of the transformations of the buildings. While keeping track of the total transformation incidents of a house, it was often found that they start to show relationships hinting that individual transformation incidents are not always isolated phenomenon. The following themes showed such relationships.

4.3.1 Physical Patterns Exist

The categorization of the physical patterns of transformation showed in the Chap. 3 already explained that transformation incidents do not have endless varieties, but they can be categorized. Therefore, it is not restated here again in detail.

4.3.2 The Transformation Categories and Subcategories have Interdependency

This final theme showed some interesting findings. Two major categories of BL and PL transformation have been identified in this study. While putting them in a time sequence, some traces of relationships were spotted. For the purpose of this analysis, the following nomenclature was developed (Table 4.1).

Statistical methods were used to test their dependency on each other. All individual transformation incidents for each house in the sample were listed according to their sequence. By using Chi-test, and Test of significance, the followings were found:

1. At first all BL and PL transformations were tested together. It was found that there exists significant dependency between these variables (Table 4.2).
2. Then BL transformations (VA, and HA) were grouped together. PL transformations were also grouped together separately. Their dependency was tested (Tables 4.3 and 4.4 respectively). It was found that:

   a. BL transformation subcategories were dependent of each other
   b. PL transformation subcategories were not dependent of each other

The most significant findings from these results were as follows.

BL transformations start earlier and PL transformation start later

Invariably, BL transformations started earliest, and were succeeded by some more BL transformations. PL transformations occurred later in the lifetime of the buildings.

Table 4.1 Nomenclature of various types of transformations with definitions and frequencies

Coding	Definition	
VA_P(ir_v)	*Permanent vertical addition* with *internal redesign*, but *virtual*	1a
VA_P(sl)	*Permanent vertical addition* with *same layout*	1b
VA_P(sub_v)	*Permanent vertical addition* with *subdivision*, but *virtual*	1c
HA_P(exp)	*Permanent horizontal addition* resulting *expansion*	2a
HA_T(add)	*Temporary horizontal addition* resulting *addition* of space	2b
HA_T(exp)	*Horizontal addition* with *temporary* roofing with *expansion* of space	2c
HA_BT(exp)	*Horizontal addition* by *balcony transformation* resulting *expansion* of space	3
VA_T(ir_v)	*Temporary vertical addition* resulting *internal redesign* but *virtual*	4
IA(exp)	*Internal alteration* resulting *expansion*	5a
IA(ir)	*Internal alteration* resulting practical *internal redesign*	5b
IA(red)	*Internal alteration* resulting *reduction*	5c
IA(sub_{sh})	*Internal alteration* resulting practical *subdivision* with *separated* tenants	5d
IA(sub_{se})	*Internal alteration* resulting practical *subdivision* with *shared* tenants	5e
IA(sub-ne)	*Internal alteration* resulting practical *subdivision* with *separated* or *shared* tenants, but with a *new entry*, usually in ground floor	5f

Source Author

Table 4.2 Chi test showing dependency between the individual types of transformations

Expected chi: 173.004
Chi observed: 183.241 (>expected chi)
Dependent

Table 4.3 Chi test showing dependency between individual BL transformations

Expected chi: 50.998
Chi observed: 56.917 (>expected chi)
Dependent

Table 4.4 Chi test showing dependency between individual PL transformations

Expected chi: 24.996
Chi observed: 12.555 (<expected chi)
Independent

BL transformation subcategories tend to follow sequence
BL transformation occurs first. Most of its subcategories finished before any PL transformation started. Among these subcategories, VA_P categories came first during the initial stages of the house, followed by HA_P. HA_T was next, followed by HA_BT, with VA_T coming last. This stated that transformation associated with bigger amount of money occurred first. VA_P and HA_P were related to roof casting that cost substantial amount of money. HA_T mostly involved non-economic and lesser functions, and their needs were generated only during the mature stage onwards. HA_BT was usually associated with IA, thus came later in the lifetime of the house, and VA_T was a less frequent option, with major drive for it was to get some extra cash in the form of rental income.

PL transformation do not tend to follow sequence, they are quite random
PL transformation did not tend to follow any such clearer sequence. Any subcategories could appear anytime. The minor themes gave some idea about their unpredictability.

BL and PL transformation subcategories can occur in between later on
This stated that BL and PL did not block each other. One BL transformation can be succeeded by a PL transformation or vice versa, though the initial BL transformations (VA_P, and HA_P) did not experience any IA in the middle. It is probably because IA is mostly related to family conflicts, and these come at later stages of life.

The findings had some differences from Seek's (1983) findings who suggested that demographic issues come first when transformation is concerned. Nevertheless, the reason is probably that the houses studied here were tenant-oriented houses, not owner oriented only, so economic issues were very important from the beginning.

Table 4.5 The complete list of themes

	Related categories	Building regulation
Major themes	VA_P (ir_v)	Upper floors project beyond column lines
		Projected sides become part of the habitable floor space
		Projected fronts and backs are mainly balconies
	VA_T (ir_v)	Rooftop additions are common at final floor
	HE_T (add)	Construction oversteps roads
	HA_BT (exp)	Balconies projected on setback areas will invariably transform at some point
		Habitual practice: building level
	VA_P (ir_v), (sub_v), (sl)	Buildings grow in phases
	VA_T (ir_v)	Rooftop additions occupy rear part of the roof, away from the road
	HA_BT (exp)	Balconies transform into variety of spaces during inhabitation
		Habitual practice: partition level
	VA_P (ir)	New layouts are experimented in floors added in different phases
	IA (exp)	Depth increases along transformation
		Rooms shift locations
		Space hierarchy is not maintained after transformation
		Institutional standard are not maintained
	IA (sub)	Increase in rental income is a major objective, and subdivision is a major method
		Rental units are much smaller than those of owners, about half the size in average

(continued)

Table 4.5 (continued)

	Related categories	Building regulation
Minor themes		Construction methods and techniques
	VA_T (ir_v)	Construction and finish material are relatively low standard
	HE_P (exp), HE_T (add)	Constructions at HA_T are of low quality
		Only dependent functions are provided at HA_T
	IE (exp), (sub), (red)	Minimum hazard is the main objective in IE
		Tenancy issues
	VA_P (ir_v)	Co-habitation of multiple families is a frequent solution
	VA_T (ir)	Low standard for lesser tenants in rooftop: thus mixture of standards
		Subtle decisions
	VA_P (ir_v), IE (exp) (red)	Recursive and frequent transformation incidents occur
		Very small scale transformation is also common
	HE_T (add), IE (sub)	Unique and extempore one-off solutions are abundant
		GF can offer more experimentation due to the potential of multiple access points
Meta-themes		Physical patterns exist
		The categories and sub-categories of transformation are interdependent

At a given moment, what is observed is only a part of the whole scenario. All of these houses are in a motion living in transformation. Each of them is just at certain stage of their life and with different momentum from each other. It is like a lively bunch of houses containing different ages and different characters just like humans live in a society.

An interesting analogy can be drawn by comparing the phenomenon of transformation with aging of humans. BL and PL transformations resemble the young age and old age of a person, where old age definitely following young age, not the other way round. Considering the subcategories, the sequences in BL transformations are predictable, just like the development from adolescence to adult age is predictable. However, the subcategories of PL transformations are not that predictable, just as different signs of aging such as balding, decrease in eye-sight, hair turning gray, etc. appears at different age for different people.

4.4 Summary

The list of major and minor themes was quite informative. However, meta-themes showed how the transformation incidents represent some greater meanings apart from just the physical behavioral patterns in transformation. It pictures the houses as a living entity rather than a mere place of construction. It also helps to convince that the static houses as one sees them at a given time are just in a stage of its journey towards its own system of aging. For convenience, the total list of themes are grouped again with their association with the categories and subcategories of transformation (Table 4.5).

Reference

Seek, N. H. (1983). Adjusting housing consumption: improve or move. *Urban Studies, 20*, 455–469.

Appendix

Building Regulations (RAJUK 2004)

Extractions related to setback issues, from Building Construction Rules by RAJUK, available at http://www.rajukdhaka.gov.bd/rajuk/page/web/devcontrol/building_Act_1996.pdf, visited on April 30, 2013.

Phase 1: 1984

Selected part of the 1984 building construction rules in Dhaka (*applicable to residential buildings*):

In residential areas inside Dhaka *Pourashabha* (Current City boundary of Dhaka City Corporation), no building can be constructed in a plot abutting a street with a width less than 3.5 m (12′−0″). For less dense areas, the minimum width of the road is 4.75 m (15′−0″).

Any cul-de-sac (dead-end lane) cannot be more than 100 m (325′−0″) in length and width cannot be less than 2.5 m (8′−0″).

For any residential building:

- The front façade of the building will be 1.5 m (5′−0″) away from site boundary or 4.5 m (15′−0″) away from the center of the abutting street (whichever is greater)
- Plot coverage will be a maximum of 2/3rd of the site area
- If the back boundary line is not parallel to the front line, the setback might be varied due to *maataam* (90 degree usual for walls). In that case the overall setback of from the back boundary will be an average of maximum and minimum setback
- The mandatory setback from back or sides of the plot are:

T. H. Khan, *Living with Transformation*,
SpringerBriefs in Geography, DOI: 10.1007/978-3-319-00720-5,

Land area	Back setback	Side setback
Up to 2 Kathha (1,440 sft or 133 sm)	1.5 m (5′−0″)	N/A
Up to 3 Kathha (2,160 sft or 200 sm)	1.5 m (5′−0″)	1.25 m (4′−0″)
Up to 4 Kathha (2,880 sft or 266 sm)	1.75 m (6′−0″)	″ ″
Up to 5 Kathha (3,600 sft or 333 sm)	2.5 m (8′−0″)	″ ″
>5 Kathha (>3,600 sft or 333 sm)	3 m (10′−0″)	″ ″

Building height

Maximum building height = (Width of abutting street + Front setback) × 2

Example: 5′−0″ setback on a 15′−0″ wide road, maximum ht is (15 + 5) × 2 = 40′−0″ or 4 storey.

Phase 2: 1996

Additional important parts in the 1996 building construction rules in Dhaka (*applicable to residential buildings*):

Any building:

In any area inside Dhaka *Pourashabha* (Current City boundary of Dhaka City Corporation), no building can be constructed in a plot abutting a street with a width less than 3.65 m (12′−0″). For less dense areas, the minimum width of the road is 4.75 m (15′−0″) (changed later). For privately owned road, the minimum width can be 3 m (10′−0″).

Any cul-de-sac (dead-end lane) cannot be more than 100 m (325′−0″) in length and width cannot be less than 2.5 m (8′−0″) (Changed later).

For any residential building:

- The mandatory setback from back or sides of the plot are:

Land area	Back setback	Side setback
Up to 134 sm (1,440 sft)	1 m (3′−0″)	0.8 m (2′−6″)
134 sm (1,440 sft)−200 sm (2,160 sft)	1 m (3′−0″)	1 m (3′−0″)
200 sm (2,160 sft)−268 sm (2,880 sft)	1.5 m (5′−0″)	″″
>268 sm (3,600 sft)	2 m (6′−0″)	1.25 m (4′−0″)
>5 Kathha (>3,600 sft or 333 sm)	3 m (10′−0″)	″″

Building height

Maximum building height = (Width of abutting street + Front setback) * 2

H = (W + S) * 2

Example: 5′−0″ setback on a 15′−0″ wide road, maximum ht is (15 + 5) * 2 = 40′−0″ or 4 storey.

Added condition:

If,	$(W + S) * 2 = 7.6$ m (or 25′) − 10.59 m (or 35′)	Then,	$H^{max} = 9.5$ m (or 30′ = 3 story)
If,	$(W + S) * 2 = 10.6$ m (or 35′) − 13.59 m (or 45′)	Then,	$H^{max} = 12.5$ m (or 40′ = 4 story)
If,	$(W + S) * 2 = 13.6$ m(or 45′) − 16.59 m(or 55′)	Then,	$H^{max} = 15.5$ m(or 50′ = 5 story)

And so on.

Further added condition:

If the height of the building is not less than the previous clause,

If,	W = 4.55 m (or 15′) − 7.59 m(or 25′)	Then,	$H^{max} = 18.5$ m (or 60′ = 6 story)
If,	W = 7.6 m(or 25′) − 10.66 m (or 35′)	Then,	$H^{max} = 27.5$ m (or 90′ = 9 story)
If,	W = 10.67 m(or 35′) − 15.24 m (or 45′)	Then,	$H^{max} = 42.5$ m(or 140′ = 14 story)
If,	W = 15.25 m(or 45′) − 22.99 m (or 75′)	Then,	$H^{max} = 60.5$ m (or 200′ = 20 story)
If,	W > 22.99 m(or 75′)	Then,	H^{max} = no restriction

Phase 3: 2006

For any residential building:

- The mandatory setback from back or sides of the plot are: (Up to 10 story, 33 m)

Land area	Back setback	Side setback
Up to 200 sm (2,160 sft)	1 m (3′−0″)	1 m (3′−0″)
200 sm (2,160 sft)–275 sm (3,000 sft)	1.5 m (5′−0″)	1 m (3′−0″)
275 sm (3,000 sft)–1,300 sm (14,000 sft)	2 m (6′−6″)	1.25 m (4′−0″)
>1,300 sm (14,000 sft)	2 m (6′−0″)	1.5 m (5′−0″)

- If height is more than 10 story or 33 m, side and back setback is minimum 3 m (10′)
- Two buildings in one site must be situated at least 4 m (13′) away from each other if in line, and 2.5 m (8′) away if they are side by side.

Building height

Maximum building height = (Width of abutting street + Front setback) * 2

H = (W + S) * 2

Example: 5′−0″ setback on a 15′−0″ wide road, maximum ht is (15 + 5) * 2 = 40′−0″ or 4 storey

Added condition:

If,	$(W + S) * 2 = 7.6$ m (or 25′) − 10.59 m (or 35′)	Then,	$H^{max} = 9.5$ m (or 30′ = 3 story)
If,	$(W + S) * 2 = 10.6$ m (or 35′) − 13.59 m (or 45′)	Then,	$H^{max} = 12.5$ m (or 40′ = 4 story)
If,	$(W + S) * 2 = 13.6$ m (or 45′) − 16.59 m (or 55′)	Then,	$H^{max} = 15.5$ m (or 50′ = 5 story)

And so on.....

Further added condition:

If the height of the building is not less than the previous clause,

If,	W = 4.55 m (or 15′) − 7.59 m (or 25′)	Then,	H^{max} = 18.5 m(or 60′ = 6 story)
If,	W = 7.6 m (or 25′) − 10.66 m (or 35′)	Then,	H^{max} = 27.5 m (or 90′ = 9 story)
If,	W = 10.67 m (or 35′) − 15.24 m (or 45′)	Then,	H^{max} = 42.5 m (or 140′ = 14 story)
If,	W = 15.25 m (or 45′) − 22.99 m (or 75′)	Then,	H^{max} = 60.5 m (or 200′ = 20 story)
If,	W > 22.99 m (or 75′)	Then,	H^{max} = no restriction

Habitable rooms:

- A one room building must have minimum dimension of shorter side as 2.1 m (7′) and area of 9.5 sm (100 sft)
- For a building with more than one room, minimum area of rooms will be 80 sft and minimum dimension of shorter side as 2.1 m (7′)
- Kitchen:
  - Minimum width = 1.8 m (6′)
  - Minimum area = 4.5 sm (48 sft) (Thus minimum length = 2.5 m or 8′)
  - Minimum area of window = 1 sm (10 sft)
  - External window can be exempted
- Toilet and Bathrooms:
  - Minimum width = 1 m (3 ‘), area = 1.6 sm (18 sft), height = 2.1 m (7′)
  - External wall can be exempted if good ventilation

Glossary

Self-built house (*SBH*) Different from a more popular similar concept of self-help houses, self-built houses do not necessarily imply people building their houses literally by their own hands, but usually hiring masons, or small contractors for the construction of different technical aspects of the house, if not a single contractor is not hired for the management of construction for the whole house. The house is defined as a permanent construction generally of multiple stories, with usually more than one flat in each floor, and the owner occupying one or more flats and renting out the others. The construction is managed by the owners, by using their leisure time, thus no formal developers are used to manage the construction. These houses are usually the basic shelter in the city for the owner.

Transformation is defined as the process of adding, altering, or extending *SBH* by using permanent or temporary construction materials. In this study, transformation is essentially owner-controlled.

Owner is defined as the one who owns a particular *SBH* including the land. The owner's household usually lives in part of the house for example one unit or more, and the rest of the house if left, is rented to tenants. In some cases, there can be more than one owner, for example, brothers inheriting part of the building.

Tenant are defined as the ones who rent a particular flat/apartment or in some cases, particular rooms in the *SBH*s, but having no authority to change any partition walls of the house. Usually they have to accept the owner's decision while transformation takes place.

Owner-oriented house is defined as a *SBH* where the owner is the sole inhabitant of the whole house, may it single, or multi storied, single unit, or multi-flat.

Tenant-oriented house are defined as a *SBH* where the owner is completely absent in the house, and there can be one or more tenants inhabiting the house.

T. H. Khan, *Living with Transformation*,
SpringerBriefs in Geography, DOI: 10.1007/978-3-319-00720-5,

In some extraordinary cases, the tenants might have the authority to transform the house.

Owner-tenant oriented house are those where owner and tenant co-habit in the same *SBH*, with owner living in a particular part of the house, and responsible for the management of the whole house. The tenants live without having authority to change any part of the house.

Formal settlement in this study is defined as a collective noun for houses made of permanent construction materials, thus referring to those houses that are supposed to be built for long term inhabitation.

Informal settlement in this study is defined as a collective noun for houses made of temporary construction materials, thus referring to those houses that are supposed to be built for temporary inhabitation, but is subject to easy demolition (example: slum, squatter, shanty).

Formal housing is defined as part of formal settlements, where public or private enterprises are responsible for constructing and developing houses as a commodity, whether subsidized or sold as a consumer product, thus generally built in a larger scale than just a single house or flat. However, in specific cases, a single house also can be formal if it is worthy as a consumer product, especially targeted to higher income groups.

Informal housing is defined as part of formal settlements, but with no public or private enterprises being responsible for constructing and developing them as a commodity. Acting within legal building regulations, these houses are products of individual owner's involvement with or without engaging a formal contractor to manage. Usually they are not considered as a commodity, but as the basic shelter of the owner.

Urban sprawl is defined as extension of urban development towards the rural-urban fringe areas, most likely by devouring adjacent agro land.

Formal sprawl is defined as a system of urban land development by procuring big chunk of land in urban fringe areas and developing it with street networks and plot divisions before selling it to public. It can be done either by public authority such as government agencies, or by private developing companies.

Confused sprawl is defined as a spontaneous system of urban land development where agro land in the urban fringe areas turn into urban plots mainly for residential purpose, and agro walkways transform into urban street network.

Private sector is defined as enterprises other than public sector, which produce houses (both formal and informal housing). For the formal housing, private sector are developers who produce houses as a consumer product, and for the informal housing, they are individual land owners who build their individual houses with or without a formal contractor.

Public sector is defined as agencies directly connected to the government or the different formal subdivisions of power in a society, who formally produce houses but not as a commodity, but provide subsidies to citizens or members of the society with an attitude of welfare.

Developers are defined as agents, individuals or company, who invest and manage the whole construction project, and are usually involved in activities where housing is considered as consumer goods.

Contractors are defined as agents or company, who do not invest, but manage the whole or part of the construction of a house. They can be engaged by individuals in the informal sector, or by developers in formal sectors, both in public and private sector.