Proceedings of the Ninth International Space Syntax Symposium
Edited by Y O Kim, H T Park and K W Seo, Seoul: Sejong University, 2013

CONSTRUCTING GENOTYPE IN HOSPITAL DESIGN:
A comparative study of the layouts of hospital buildings in Bangladesh

022

Nayma Khan
The University of Kansas
e-mail : n221k306@ku.edu

Abstract

Space Syntax describes the spatial configuration of a building in terms of the pattern of connections. The analysis process gives a measure to each "unit" of space and describes how it relates to others in a configurational system. In space syntax literature, genotype is defined as relational and configurational consistencies in the spatial layout of buildings that express social and cultural patterns. The aim of this paper is to describe the genotype of 250-bed hospital layouts of Bangladesh. The study analyzes six hospitals of 250-bed hospital buildings within a cultural tradition. The six hospitals represent two types of hospital building forms: courtyard type and linked compact block. An "Integration" measure is used to look at the distribution of departments, their ranking order, and their difference factor value. The objective is to determine the consistency and difference in spatial patterning that exists in the layouts of these hospitals of Bangladesh. The findings show that the clinical categories of spaces do not show any consistency in the design of hospital layout; rather the social categories of spaces are more dominant in the formation of space in 250-bed hospital design in Bangladesh. This understanding is important for describing the functional relationship among different departments that comprise the hospital buildings and also for explaining how culture and social relations shape the hospital layout in Bangladesh.

Keywords: *Genotype, Hospital Design, Linked Compact Block, Courtyard Type, Bangladesh*

Theme: *Building Morphology and Performativity*

Genotype in Space Syntax

The term “genotype” refers to all or parts of generic constitution of a cell, an individual, or an organism. In space syntax literature, this term is used to describe the systematic difference in spatial configuration between similar types of a building form from a region. The term “genotype” was first introduced by Hillier and Leaman (1974) to describe how personal and environmental factors make a difference in the design process. They argued that culture plays a big role in in modifying the unwritten design of a building’s program. The deep cultural structure that remains unchanged through several generations in the design process is called “genotype”. Later, Hillier, Hanson, and Graham (1987) define “genotype” as a consistent configurational and relational pattern of a building that represents the social and cultural order of using space in a building. They used space syntax theory and method to rank order the functions of houses according to the integration value and thereby recognize the relational structure of spatial configuration.

“Space syntax” is a methodology, or a set of techniques, for the representation, quantification, and interpretation of spatial configuration in buildings and settlements (Hillier, Hanson, and Graham 1987, Hillier and Hanson 1984, Hillier 1996). It provides a systematic approach to analyzing spatial configuration and to understand how social and cultural contents are embedded in spatial patterns. In space syntax, the configuration is defined as an organization of spaces that describes the relation of two spaces considering the other spaces in the system (Hillier and Hanson 1984). The arrangement of each space is critically affected by its position and accessibility to other spaces. According to Hillier and Hanson (1984), through a systematic organization of the integration values of functional spaces, it is possible to observe the structural relation between different programmatic spaces in a building (Hiller, Hanson and Graham 1987). If ranking order of programmatic spaces according to their integration values shows a systematic numeral difference in spatial pattern, the ranking order represents the presence of cultural influence in shaping the spatial configuration of that building. Hillier, Hanson, and Graham (1987) term this type of relational differentiation of functions within a plan as “inequality genotype”.

The aim of this paper is to interpret the inequality genotype in spatial patterns existing in the layout of the 250-bed hospitals of Bangladesh and to develop an understanding of how culture and social relations shape the arrangement of clinical functions in these hospitals. The analysis has been done across a sample of 250-bed hospitals by observing the difference in integration value among the clinical functions. Numerical differences in the integration value of clinical functions helps us to understand the cultural pattern that exists in the layout of hospital buildings of Bangladesh.

The Sample and the Problem

Hospitals are one of the complex building types that require smooth coordination of different services and functional units. An ideal hospital form is comprised of inpatient and outpatient functions; diagnostic and treatment functions; service functions; research and teaching functions (Figure1). In the hospital layout, the outpatient and inpatient functions are connected with each other through administration, diagnostic and treatment, service, research & teaching functions. The physical relations among between these functions mainly determine the configuration of a hospital. In Bangladesh, the 250-bed district hospital provides secondary level out-patient, in-patient, emergency, laboratory and imaging services to the people. In the past,

the buildings that served as health facilities and clinics were not different from other buildings in terms of space, meeting functional requirements or architectural expression. But in the 1970s and 1980s, the government started to build hospitals designed to serve as secondary healthcare facilities. A great variety of shape and layout have been used among typologies in the design of 250-bed district hospitals in Bangladesh (Figures 1 and 2).

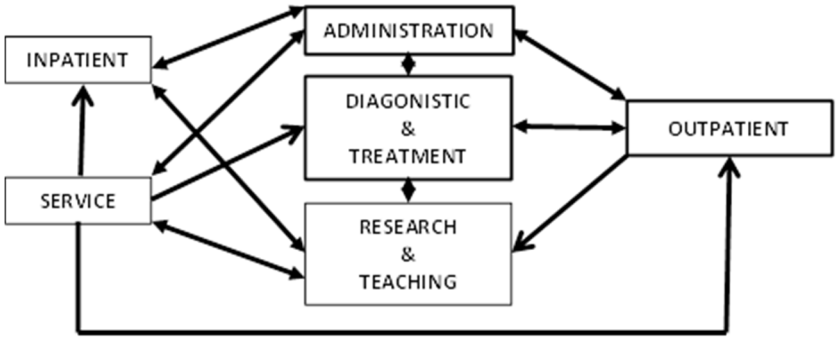

Figure 1: General Hospital Functional Relationship

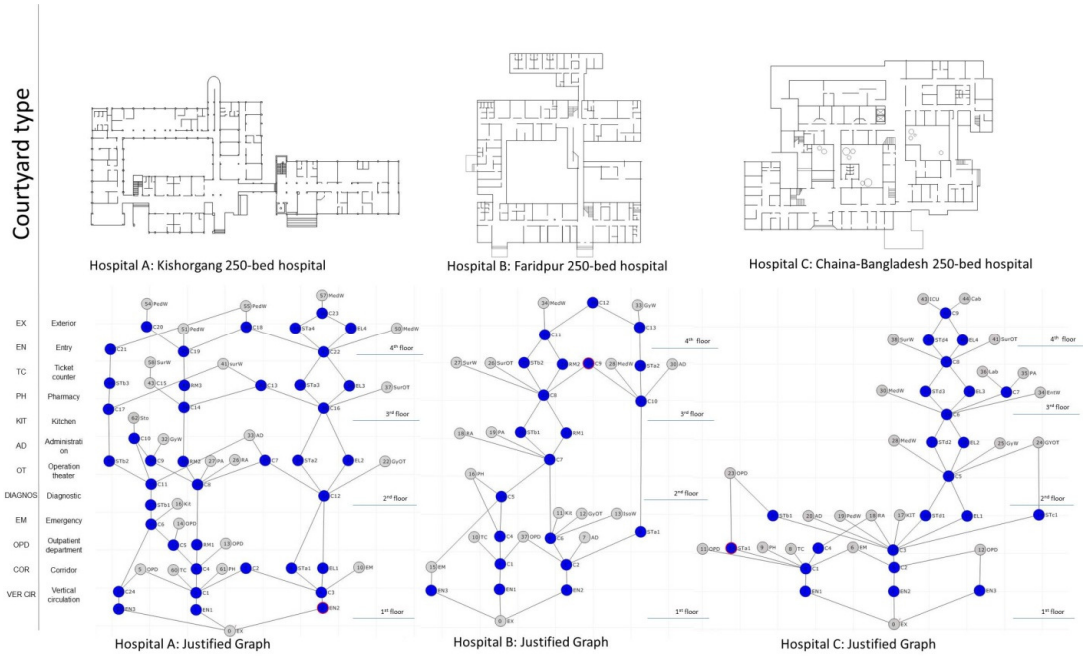

Figure 2: Agraph analysis of courtyard type 250-bed hospital layout

In the courtyard plan, the compartmentalization of hospital functions is evident in the layout. All programmatic functional spaces are designed in separate blocks around a courtyard and are connected with each other through corridors. Visually, this type of layout provides certain degree of hierarchy, security and privacy. For analysis, the study took three samples from courtyard type: Hospital A—Faridpur 250-bed district hospital; hospital B—Chaina-Bangladesh 250-bed district hospital; hospital C—Kishorgang 250-bed district hospital.

In the linked compact block layout, four blocks constitute the plan. All the blocks are connected with short corridors and separated by open spaces. This type of layout reduces the walking distance between departments and also ensures privacy and security. The study selected three samples from this type: hospital D-Narayangang 200-bed district hospital; hospital E-Jamalpur 250-bed district hospital; hospital F -Cox's Bazar 250-bed district hospital (Figure 3).

This study is mainly concerned with the spatial analysis of these two different types of 250-bed hospital layouts to understand if any systematic relation exists between, on the one hand, the ranking order of integration values and, on the other hand, the arrangement of programmatic space within these two types of samples. The goal is to reveal the cultural pattern that exists in the layout of 250-bed hospitals of Bangladesh.

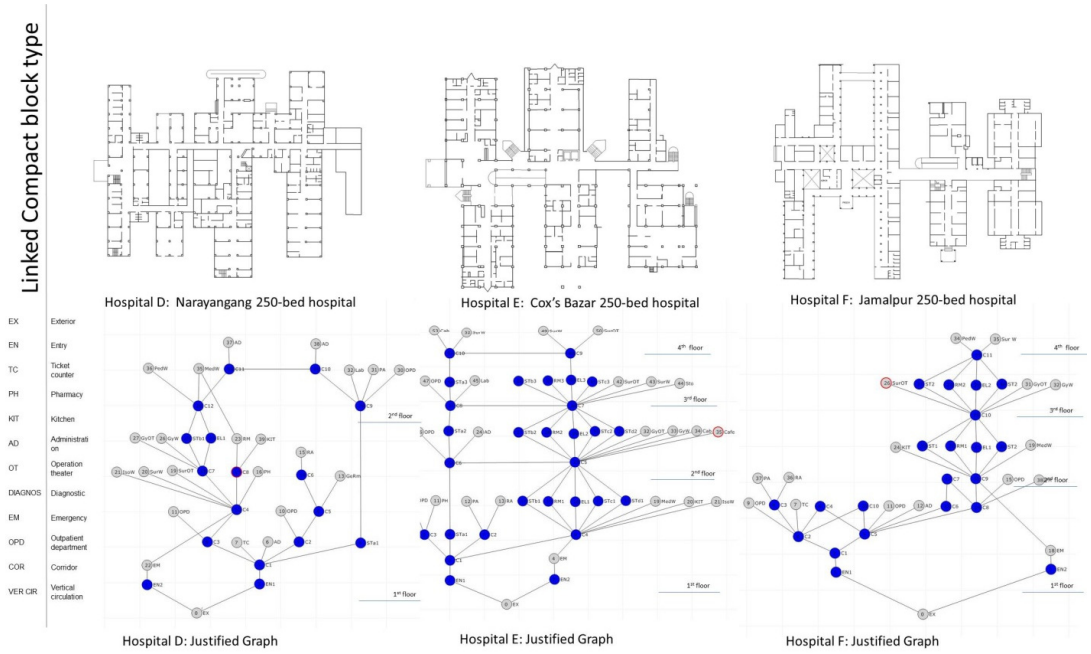

Figure 3: Agraph analysis of linked compact block type 250-bed hospital layout

Procedure of Analysis

Justified graphs are analyzed for each hospital using the exterior as a root (Figures 2 and 3). In these graphs, each space- a room or a clearly differentiated space supporting clinical functions- is represented by a gray colored circle. Each transition or circulation space- passageways, lobbies and stairs –is shown as a dark point. All clinical functions are aligned in levels to show how one must reach each space from the root.

The first stage of the analysis has been done based on depth and choice -two of the configurational properties of spatial layout. According to Hanson (1998), "the depth among a set of spaces always expresses how directly the functions of those spaces are integrated with or separated from each other, and thus how easy and natural it is to generate relation among them." The study uses the depth measure to state how directly the clinical functions are accessible from the transitional space (corridor). If the space is directly accessible from a transition space, the space is described as being at depth 1 from the transition space. If it is necessary to pass one intermediate space to get to the space under consideration, then that space is described as being at depth 2 from the transition space. Likewise, if the space passes through a minimum of two spaces, then it is described as being at depth 3, and so on.

The choice measure defines the spatial layout in tree-type or ring-type layout. The presence of ring in the layout provides more choice of movement from any particular space by adding connections within the configuration. On the other hand, the tree type layout provides less choice of movement: it always forces permeability from any specific space to reach different

functional spaces in the layout (Hanson 1998). The movement in tree-type layout is highly controlled and predictable and supports highly framed social interaction, whereas the ring-type layout provides less control on that movement which that supports more social interaction.

The second stage of the analysis uses the integration value to describe the differentiation or the relational pattern of the clinical functions. The integration value of each space numerically expresses a key characteristic of how each space is embedded in the system. Through systematic organization of the integration values of functional spaces (their rank order, their difference factor value), the study describes the structural relation between different clinical functions of two different types of layout. In this study, the difference factor (DF) computes the spread and degree of configurational differentiation among integration values of functional spaces in hospital layouts (Hillier, Hanson, and Graham 1987, Hanson 1998). In the third stage of analysis, the spatial organization of clinical functions are clustered in terms of social and service space to identify the cultural order and genotype that shape the layout of hospitals in Bangladesh.

Configuration Analysis of Hospital Layout

The arrangement of clinical functions shows two varieties of spatial layout in the courtyard plan. In the first type of spatial layout, clinical functions are always accessible directly from the most integrated transitional space at depth 1. In the second type of spatial layout, clinical functions lie on a single ring so that one can enter the space at one point on the ring and leave from a different point. The three hospitals with a courtyard plan are each connected with their exteriors in a very similar way. Each of these hospitals has three entries which form two rings with the exterior. In this case, the connection of ring with the exterior forces people to enter interior space from the exterior through some specific space. A graph analysis shows that hospital A is more ringy than hospital B and hospital C. It is possible that multi-phase construction of hospital A from 50-bed to 250-bed hospital developed more connections among different functions thus making the layout more ringy. In three cases, we find the Emergency Department always lies on the exterior ring and has more controlled entry from the exterior. The transition space shows more than two links with other functions in the layout and provides more choice of movement to other functions in the layout. In each of these three hospitals, the transition space makes an internal local ring between different floor levels through connecting the vertical circulation space.

In the linked compact block type, the three samples show similar patterns that form locally ringy but globally bush like sub complex. At the same time, all clinical functions are linked in tree like layout. These layouts show two entries that form one single ring with the exterior. Compared to the courtyard plan, the linked-block layout provides less choice of movement from the exterior to enter the interior complex. The Emergency Department always lies on the exterior ring and allows more controlled entry through the exterior. In all cases, the transition spaces provide more choice of movement to link the clinical functions at depth 1. As in the courtyard plan, the transitional space (the corridor) in the linked-block plan makes a local ring with upper floors through vertical circulation. The main distinction between courtyard plan and the linked-block layout is that, in courtyard type, clinical functions are placed in the ringy route, whereas in the linked compact block type layout, except for the Emergency Department, no functional space participates in the ringy route that passes through the exterior.

Type	Sample	Name	Min (i)	Mean(i)	Max(i)	DF
Courtyard Type	Hospital A	Kishorgang	4.09	6.45	9.77	0.84
	Hospital B	Faridpur	3.68	5.65	9.05	0.85
	Hospital C	Chaina Bangladesh	3.04	5.12	8.01	0.81
Linked Compact Block Type	Hospital D	Narayanganj	3.42	5.98	9.37	0.8
	Hospital E	Cox's Bazar	5.14	7.25	13.5	0.82
	Hospital F	Jamalpur	3.56	5.57	9.63	0.81

Table 1: Integration analysis as a whole

Integration Analysis of Layout as a Whole

This study performed a quantitative analysis by looking at the mean integration value of each sample and in each type of hospital layout as a whole. The degree of difference between the integration values across the samples show a consistent pattern in 250-bed hospital layout. To measure how weak and strong these integration inequalities are in the layout, the study calculates the degree of difference (DF) between maximum, mean and minimum integrations values of each type of hospital sample following the same method that was described by Hanson (1998). The analysis shows that the DF of linked-compact block layout is comparatively lower than the DF of the courtyard plan. This indicates that the configuration of clinical functions is more consistent and organized in the linked block type than the courtyard type. That is, there is less configurational difference in the courtyard layout.

The ranking order of DF in courtyard type layout- hospitalB (.84)> hospitalA (.85) > hospital C (.81) -represent that hospital A and hospital B are holding higher DF than hospital C,a DF that is closer to 1. That means the arrangement of clinical functions in hospital A and B are more homogenized than the hospital C. On the other hand, the ranked order of the DF in the linked compact block type layouts- hospital E (.82)> hospital F (.81) > hospital D (.80) - show almost similar value and are comparatively closer to 0. This denotes that the linked compact block type layouts have more differentiated and structured space in the layout.

Integration Analysis of Clinical Function

In table 2, all clinical functions are arranged according to the rank order of integration value from least integrated space to more integrated space. The mean integration value is taken as a borderline to allocate the clinical functions under integrated and segregated zone. The integration value above mean integration indicates the most integrated functions in the layout, whereas the integration value below mean value represents the segregated clinical functions in the hospital layout. In this analysis, the mean integration value states how shallow or deep on average the clinical functions are from one another in the layout.

In the three courtyard-plan hospitals, the ranking order of clinical functions shows no consistent pattern in the distribution of integration values. In this type, all corridors (COR) and vertical circulations (VER CIR) are located in the most integrated space (Table 2). The pharmacy (PH) and ticket counter (TC) are always located in the segregated zone. The kitchen is located in the most integrated zone in hospitals B and C. The integration value of the Diagnosis Department is above the mean integration value in hospital A and hospital B, whereas in hospital C, the position of the department is below the mean integration value. The operation theater (OT) is always closer

to mean integration in all three samples. The administration (AD) is located at integrated zone for Hospital A and Hospital C, but in Hospital B, it is closer to the mean integration value. The outpatient department (OPD) and Emergency Department (EM) do not show any consistent pattern in three samples. The positions of nursing units (ward) are in the most segregated zone across all samples of courtyard type layout.

COURTYARD TYPE						**LINKED COMPACT BLOCK TYPE**					
Hospital A		**Hospital B**		**Hospital C**		**Hospital D**		**Hospital E**		**Hospital F**	
KIT	5.34	TC	4.5	PH	4	DIAGNOS	4.54	TC	5.69	DIAGNOS	3.56
WARD	5.68	WARD	4.83	TC	4	KIT	5.21	PH	5.69	TC	4.28
TC	5.78	EX	5.2	EN	4.6	AD	5.24	EX	5.74	WARD	4.69
EM	5.84	PH	5.28	EX	4.61	OPD	5.51	DIAGNOS	6.2	OT	5.16
EN	5.87	EN	5.29	OPD	4.8	WARD	5.72	EN	6.58	EX	5.32
PH	5.96	EM	5.37	DIAGNOS	4.94	EX	5.74	WARD	6.99	OPD	5.42
EX	6	AD	5.51	WARD	5.03	OT	5.98	OPD	7.14	EN	5.46
OPD	6.25	OT	5.62	OT	5.36	EN	6.2	OT	7.34	AD	5.76
OT	7	KIT	5.79	EM	5.56	TC	6.38	KIT	7.4	PH	6.22
COR	7.12	DIAGNOS	5.94	AD	5.8	PH	6.38	EM	7.57	KIT	6.39
DIAGNOS	7.37	OPD	6.4	KIT	5.8	EM	6.67	AD	8.4	VER CIR	6.69
VER CIR	7.42	COR	6.74	COR	5.91	COR	7.1	COR	9.2	COR	6.7
AD	8.27	VER CIR	6.93	VER CIR	6.13	VER CIR	7.1	VER CIR	10.31	EM	6.75
Mean	**6.45**	**Mean**	**5.65**	**Mean**	**5.12**	**Mean**	**5.98**	**Mean**	**7.25**	**Mean**	**5.57**

Table 2: Integration Analysis of Clinical Function

In the three hospitals with linked-compact block layouts, the analysis shows some consistency in the distribution of integration pattern. Like the courtyard type, the vertical circulations (VER CIR) and all corridors (COR) are in the most integrated space and therefore easily which is easily accessible from different clinical functions. The integration values of the Diagnostic Departments (DIAGNOS) are always located below the mean integration in three samples. That means the location of diagnostic department is not easily accessible in the layout. On the other hand, the position of the Emergency Department (EM) is always above mean integration and in a more integrated zone. The pharmacy (PH) and ticket counter (TC) do not show any consistent integration pattern in the layout. As in the courtyard plan, the operation theater (OT) is closer to the mean value in the three compact-block layouts. Moreover, like the courtyard type, the nursing unit (WARD) is also positioned in the segregated zone.

The analysis shows two distinct pattern of genotypical tendency in the layout of 250- bed hospitals in Bangladesh. One pattern characterizes the highly integrating transitional spaces (both corridor and vertical circulation) that assimilate all clinical functions to form a more integrating interior. The other pattern signifies the secluded position of nursing units (WARD) that are always located in the deeper area in both types of layout. But the distribution of other clinical functions does not follow any order in the spatial layout. That means the clinical functions are assembled together by placing them next to each other without following any organizational order.

	COURTYARD TYPE						LINKED COMPACT BLOCK TYPE					
	Hospital A		Hospital B		Hospital C		Hospital D		Hospital E		Hospital F	
SERVICE	KIT	5.34	KIT	5.79	KIT	5.8	KIT	5.21	KIT	7.4	KIT	6.39
	TC	5.78	TC	4.5	TC	4	TC	6.38	TC	5.69	TC	4.28
	PH	5.96	PH	5.28	PH	4	PH	6.38	PH	5.69	PH	6.22
	AD	8.27	AD	5.51	AD	5.8	AD	5.24	AD	8.4	AD	5.76
Mean		6.34		5.27		4.9		5.80		6.80		5.66
SERVE	OT	7	OT	5.62	OT	5.36	OT	5.98	OT	7.34	OT	5.16
	EM	5.84	EM	5.37	EM	5.56	EM	6.67	EM	7.57	EM	6.75
	DIAGNOS	7.37	DIAGNOS	5.94	DIAGNOS	4.94	DIAGNOS	4.54	DIAGNOS	6.2	DIAGNOS	3.56
Mean		6.74		5.64		5.29		5.73		7.04		5.16
PUBLIC	COR	7.12	COR	6.74	COR	5.91	COR	7.1	COR	9.2	VER CIR	6.69
	VER CIR	7.42	VER CIR	6.93	VER CIR	6.13	VER CIR	7.1	VER CIR	10.31	COR	6.7
	OPD	6.25	OPD	6.4	OPD	4.8	OPD	5.51	OPD	7.14	OPD	5.42
Mean		6.93		6.69		5.61		6.57		8.88		6.27
PRIVATE	WARD	5.68	WARD	4.83	WARD	4.03	WARD	5.72	WARD	6.99	WARD	4.69

Table 3: Cluster of Clinical Functions into Social and Service Space

Integration Analysis of Social and Service Space:

According to Hillier and Hanson (1984), the organization of space reflects the living patterns of a society. In exploring the cultural order in these two types of layout, the study clustered all clinical functions in terms of social and service spaces. First, all the clinical functions of the 250-bed courtyard plan and of the compact linked type layout are grouped into private and public space (Table 3). Public space indicates the possibilities of social interaction within clinical functions that is provided by the Outpatient Department (OPD), corridor, stair, ramp and elevator. Since public space here needs less control over communication to facilitate social relations, the e 다시 xpected position should be in most integrated spaces. Because private space requires more personalization and privacy as perceived by patients and staff, this type of space needs more control over communication and movement to maintain privacy. Therefore, the placement of private space should be in the more segregated space in the hospital layout. The study grouped other functions of hospital space under the categories of served and service space, although these categories and those of public/private are not mutually exclusive. That is, it is always possible to find public spaces that are also service areas. In this analysis, the service space category denotes those spaces that do not hold any primary function of hospital but provide secondary services to patients, like ticket counter, kitchen, café, and pharmacy. The category of served space indicates that the primary use of that designated space is to provide treatment to the patient like Radiology, Pathology, Emergency and Operation Theater.

COURTYARD TYPE						LINKED COMPACT BLOCK TYPE					
Hospital A		Hospital B		Hospital C		Hospital D		Hospital E		Hospital F	
PRIVATE	5.68	PRIVATE	4.83	PRIVATE	4.03	PRIVATE	5.72	SERVICE	6.80	PRIVATE	4.69
SERVICE	6.33	SERVICE	5.51	SERVICE	4.9	SERVE	5.73	PRIVATE	6.99	SERVE	5.16
SERVE	6.73	SERVE	5.64	SERVE	5.29	SERVICE	5.8	SERVE	7.04	SERVICE	5.76
PUBLIC	6.93	PUBLIC	6.69	PUBLIC	5.61	PUBLIC	6.57	PUBLIC	8.88	PUBLIC	6.27

Table 4: Integration Analysis of Social and Service Space in Hospital Layout

Table 4 shows that, in the courtyard plan, the location of public, private, served and service spaces reveals a more systematic ordering of Public > Served > Service > Private space in the hospital layout, describing the genotypical tendency of the 250-bed courtyard-plan hospital. On the other hand, in compact-link block type, the analysis shows that the spatial allocation of social and service space follow Pubic> Service > Served> Private order, where service space is located in more integrated zones than is the served space. As a grouped function, the integration value of the served and service spaces is always in between the public and private spaces. The most distinct consistency appears in the analysis of private and public space. In all six samples of both courtyard and compact-link layout, the public space (OPD, corridor , stair , ramp and elevator) that helps to generate more social interaction, are located in the most integrated zone, and the private space (nursing unit) that needs more privacy is placed in the less integrated zone. Exception is made in case of Hospital E, where service space (6.80) is located in the least integrated zone. The analysis of the mean integration in hospital E shows that the private space has a higher integration value (6.99) than the service space (6.88), but the difference is not distinct in the analysis. It is possible that the minor variations in the justified graphs may have altered the rank ordering without necessarily changing the function of the hospital layout in a sufficient way.

Discussion & Conclusion:

The study describes the structural relationship among different clinical functions and the possibilities for exploring the cultural order in hospital layout. In this research, Integration analysis highlights the way in which the two different types of 250-bed hospital layout are similar as a sequence of social program. The design process in the field of architecture usually groups the spaces of a given building according to the function of spaces. The integration analysis shows that the allocation of clinical functions does not follow any logic in the 250-bed hospital layout. Within each type, some phonotypical pattern exists in the layout, but this doesn't show any genotype tendency within the layout. The study determines that, in Bangladesh, hospital spaces are laid out without considering the hierarchical order of depth of similar functions. Therefore, the spatial configuration shows less control on patient's movement. Patients can move anywhere in the building and some patient areas even have to be crossed to enter other patient areas and non-patient areas. According to Murcus (1987) this type of spatial arrangement is obvious where medical and nursing professions were not well organized. In early period until the classifications of hospital functions were firmly established, the floor plans of hospital were more ringy and confused. Over time and with the advancement of the medical profession, hospital layouts showed high degree of articulation in the distribution of clinical functions. Patient areas in hospitals began to be designed in a tree-like structure to prevent patient-to-patient communication, while staff areas began to be designed in a ring structure to facilitate easy supervision by staff (Murcus 1987). In Bangladesh, the history of healthcare delivery with formal training facilities for medical practitioners is not very old, starting as it did in the 19th century during the colonial period. At that time, the hospitals started as dispensaries which, within short time, developed into a small hospital. But the effort to institutionalize the healthcare did not solve the healthcare problem caused by shortage of skilled manpower. With a view to increase the number of medical professional, government started to establish a number of medical colleges in Bangladesh. History shows that the government took a number of initiatives to improve healthcare services in Bangladesh. Several healthcare programs were implemented to control malaria, small pox, and cholera. Family planning programs were implemented to control population growth. Hospital services were improved through the expansion and construction of healthcare facilities. However, all of these programs were implemented in isolation, which may explain why the quality of service remained poor and the

majority of the population had poor access to healthcare services, as well as why the medical profession never conceived a more comprehensive and unified plan for the organization of hospital space.

To discover a logical functional pattern in the hospital design, the layout of hospital is viewed as a relation of social and service space. According to Murcus (1987), this type of classification is important to define social structure and to elaborate the meaning of spatial relationship of a programmed building. Power and social structures, ideas, practices and beliefs of the societies play a great role in producing the form and structure of any classification system. This study shows that the courtyard plan and the compact-link block type both have high number of transitional spaces that are connected to the functional space in hospital layout. The transitional space that represents all corridors and vertical circulations generates more interaction between people. According to Hanson (1994), this type of transition space in hospitals generates un-programmed activity that does not directly support the clinical functions but acts as a highly permissive area that people occupy according to spatial hierarchy. Like transitional space, the outpatient department also offers more socialization in waiting area. The study defines this outpatient department and transitional space as public space and the analysis shows that in both types of hospital layout, the public space is located in the most integrated area of the hospital. On the other hand, the ward and patient room where people stay for a longer time are grouped under private space that need less socialization and more privacy. The expected location of this type of space is in a segregated zone. The integration analysis shows a low integration value for the private space in hospital of both types. The exception is present only in the case of Cox's Bazar whose mean integration is higher than the rest of the sample. Here the relation of hospital layout to clinical function follows the morphological order by which social relation gives spatial meaning in term of segregation and integration (Hillier 1985).

Hospital design practice in Bangladesh shows a homogeneous cultural pattern in the layout of hospital functions. The analysis shows that architects follow the simple generic pattern of house form and organization in designing space for hospital. The traditional house form in Bangladesh consists of several room arranged around a courtyard (Rahman & Ferdouse 2001). A clear physical distinction between formal, family, and service zones is evident in the organization of house form (Ahmed& Khan 2000). These zones are created based on considerations of privacy and accessibility (Mahmud 2013). In the spatial layout of a residential building, the outer public zone represents the formal living area while the private zone within a house is reserved for the deep-rooted practice of local lifestyle (Ahmed& Khan 2000). Because of privacy needs, the public zone is always placed in the front of the building and is easily accessible from the outside, while the private zone is always located at the back of the building. In courtyard and compact-link type hospital layouts, the spatial organization follows the same concern about privacy and accessibility. The outpatient departments (the public space) that serve the patients for short time periods are located in the most integrated zone, and nursing units or wards (private space) where patients stay for a longer period and need more privacy are placed in the less integrated zone. That means the design process follows the pre-acquired design conception of architects, where public, private, and service area, formal and informal zone, follow strong Bengali culture, values and norms without considering the detailed spatial arrangement on the caring units.

According to Prior (1988), "Space is neither a container in which the social life occurs, nor a mere reflecting glass of social practices and social categories, nor indeed a determinant of social order. Rather like language, it has elements of all these, but ultimately its significance can only be fully comprehended in the context of situated social practice." In that sense, the structure of hospital layout in Bangladesh represents some order of consciousness and purposeful

interaction of social practice. Research shows that architects of Bangladesh shape the layout of hospital building according to their own pattern language. Alexander (1979) defines this pattern language as a useful tool to design various new building types. Human lifestyle, behavior, social structure, power relationships and meaning help to create individual pattern language that actually is translated into some aspect of built form. Lawrence (2000) terms these aspects as culture which is "an integrated pattern of human beliefs, customs, norms, knowledge, morals, values, behaviors and institutions shared by a group, the inhabitant of a region or a nation." To explain how culture is translated into built form, Rapoport (1980) defined culture as a system of symbols, meaning and schema that is translated through human action into built form. The study shows that the spatial organization of hospitals reflects the culture of residential architecture practice in Bangladesh. The communication, social status, identity and social meaning of space are the most influential cultural mechanisms that shape the hospital architecture in Bangladesh.

The organization of clinical functions in hospitals of Bangladesh reflects the designer's cultural values and norms. According to Hanson (1998), "Culture may influence design both through the framework of idea and social practice which architects acquire by socialization and in the most restricted concepts and values which have been acquired during their architectural education." This study supports the findings of Bafna (2001), where he argued that the designer's conscious design process does not follow the order of programmatic space, but rather that the designer's personal and cultural beliefs play a big role in formulating the core of houses. Therefore, we can confidently say that the hospital design practice in Bangladesh mainly depends on other building genotypes that the designers practice as a method of design and which are reflected in the form of an integration inequality genotype in this research. This means that life style and culture as a combination of practice and representation give meaning to space in the design of 250-bed hospital environment in Bangladesh.

References

Ahmed, Nizamuddin. and Nayma Khan. 2004. "Evolution of House Form in Dhaka City." *Global Built Environmental Review (GBER)* 3(3): 38-48.

Alexander, Christopher. 1979. *The Timeless Way of Building.* New York : Oxford University Press.

Hanson, Julienne. 1998. *Decoding Homes and Houses*. Cambridge University Press.

Hillier, Bill. 1985. "The Nature of the Artificial: The Contingent and the Necessary in Spatial Form in Architecture." *Geoforum* 16(2): 163-78.

Hillier, Bill. 1996. *Space Is the Machine*. Cambridge University Press, Cambridge.

Hillier, Bill, and Julienne Hanson. 1984. *The Social Logic of Space*. Vol. 1: Cambridge University Press, Cambridge.

Hillier, Bill, Julienne Hanson, and H. Graham. 1987. "Ideas Are in Things-an Application of the Space Syntax Method to Discovering House Genotypes." *ENVIRON PLANN B* 14(4): 363-85.

Hillier, Bill, and Adrian Leaman. 1974. "How Is Design Possible?". *Journal of Architectural and Planning Research* 3(1): 4-11.

Lawrence, R. J. 2000. "House Form and Culture: What Have We Learnt in Thirty Years." *Culture-meaning-architecture; critical reflections on the work of Amos Rapoport, Ashgate Aldershot.*

Mahmud, Shihabuddin. 2013. "Transformation a Way to Make an Old Building Potential for Income Generation: A Study in Core Dhaka, Bangladesh." *Emirates Journal for Engineering Research* 18 (1): 67-80.

Markus, Thomas A. 1987. "Buildings as Classifying Devices." *Environment and Planning B: Planning and Design* 14(4): 467-84.

Prior, Lindsay. 1988. "The Architecture of the Hospital: A Study of Spatial Organization and Medical Knowledge." *British Journal of Sociology*: 86-113.

Rahman, Mahbubur, and Ferdouse A Haque. 2001. "Multiple Courtyard Mansions of Dhaka: Form and Context." *Traditional Dwellings and Settlements Review* 12(2): 57-72.

Rapoport, Amos. 1980. "Cross-Cultural Aspects of Environmental Design." *Human Behavior and Environment. Advances in Theory and Research* 4: 7-46.