A STUDY OF CUSTOMERS WAYFINDING EXPERIENCE TO IMPROVE FUNCTIONAL EFFICIENCY IN A LARGE SCALE SHOPPING COMPLEX IN BANGLADESH

By

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DEDICATION

To my Parents,

Ad. Md. Khurshid Alam
Rokeya Alam

&

my mentor

Dr. Nayma Khan

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Abstract

Customer's wayfinding experience is an important factor for designing a functionally efficient shopping environment. During shopping activity, the customer prefers those environments that help them to understand the environment and provide clues for findings their own way. Research shows that efficient signage system, spatial layout and the legibility of the environment help customers to move through the shopping environment and help them finding their desired items within preferred time. When customers face difficulties in finding their way in a shopping environment, this make them feel lost, stressed, and insecure. Loss of time and energy due to frequent backtracking for reaching the desired destination also create a negative impression about the shopping complex, which may affect the customer return visit and preferences of shopping complex. Therefore, for designing a functionally efficient shopping environment, it is important to satisfy the customers need by developing a legible wayfinding system so that they can reach a specific destination within their desired time. However, few researches have tried to understand how the spatial and environmental variables influence the environmental legibility and functional efficiency of the shopping complex. Therefore, this research focuses on customer's satisfaction in relation to signage system, spatial layout, and the legibility of the environment. In addition, how these variables create an impact on customer wayfinding experience as well as functional efficiency of the shopping complex. The research uses data collected from 60 customers of Bashundhara city shopping complex. The data include 75 hours of field observation over a period of four weeks, customers' interview using a pre-coded questionnaire and syntactic properties of floor plan layout from depth map analysis. The research findings suggest that identification, directional, and orientation signage with appropriate size are very important for improving customers' wayfinding experience. Symmetrical layout make customers confused and decrease their satisfaction level due to increase their travel time. In shopping environment atriums as landmark help customer to orient them within the shopping environment and make the customer satisfied by decreasing their travel time which help to improve legibility as well as functional efficiency of shopping environment. In addition, multiple atrium help customer to construct cognitive map and customer easily orients himself or herself within the shopping environment. It also improves customer's travel time and wayfinding experience. It is expected that this research will help to propose design decision for architects, designer, and planners to improve customers' wayfinding experience in large scale shopping complex.

TABLE OF CONTENTS

List of Figures

List of Tables

CHAPTER 01:
PREAMBLE

1.1. Introduction

Wayfinding is a problem-solving activity that used to describe the processes people go through to find their way in an environment. People's perception of the environment, the availability of wayfinding information, their ability to orient themselves spatially and the cognitive and decision-making processes all affect how successfully they find their way. A Successful wayfinding system helps people to develop a plan to find their destination and to identify their specific destination (Weisman,1981; Oneil,1991; Passini,1992). In a complex environment, people face wayfinding problem when they find difficulties in the decision-making process. Most of the time, it happens for various reasons like, if people have never visited a site before and cannot understand the information available, or if people cannot remember or recognize the route they took last time and or else the environment and wayfinding system at the site have changed.

In a complex setting people find their way through understanding the organization of the setting (Arthur &Passini,1992). They always try to identify spatial clues from the setting to form a mental map. For these circumstances, information regarding specific locations, spatial relationships among those locations and those locations in relationship to the rest of the building must be stored easily in one's head (Dogu & Erkip, 2000). For storing this information in the user's mind they should be able to differentiate the whole setting from each other. According to Arthur & Passini (1992), People can only map those spatial entities which are distinct from surrounding spaces. This distinctiveness can be achieved by the form and volume of the space that define architectural and decorative elements and by the use of finishes, light, colors, and graphics (Arthur & Passini, 1992).

Legibility of the environment also helps people to construct a mental map in an environment (Lynch, 1996; Oneil,1991) which facilitates the ability of users to find their way. In a legible space people easily identified and navigate the environment with ease (Lynch, 1960). According to Weisman (1981) , 1) signage system (Arthur & Passini, 1992; Conroy, 2001; O'Neill, 1991) , 2) floor plan configuration (Moeser,1988; ONeil,1991; Dogu & Erkip, 2000), 3) architectural differentiation (Gärling, Böök, &

Lindberg, 1986; Passini et al., 2000) and 4) visual accessibility (Peponis, Zimring, & Choi, 1990) are important factors that help to make an environment understandable as well as legible (Nasar, 1983; O'Neill, M. J.; 1991; Cubukcu & Nasar, 2005a). In a complex environment, these elements provide easy accessibility for the users to find their way to the desired destination and also improve wayfinding experience. In a shopping complex, wayfinding is the common and fundamental task that all shoppers must go through (Dogu,1997). A proper planning and organization of the circulation system can reduce users stress and access in those environments. These may help the user to enjoy their shopping activity. As a result, a return visit will more likely happen if the shopper has a better experience. A great shopping experience can be achieved through fulfilling the 'customer functional need which is related to easy accessibility of goods, product etc. and also the behavioral need which is related to find out their way to destination easily. During shopping activity, legibility of the shopping environment helps customers to find their preferred shop within the preferred time. According to Williams et al., (1995) legibility developed when a place is able to "provide a condition to fulfill the functional needs of the people and support their behavioral goals". Previous research shows that during designing complex building, understanding of human wayfinding abilities and difficulties is important to minimize wayfinding challenges and help to reduce functional inefficiency and increase accessibility and safety (Arthur, P., & Passini, R.;1992, Weisman;1981, Dogu; 1997). According to Al juboori & Mustafa (2014); Northen, R.I, and Haskoll, M. (1977) useful planning of circulation system of any shopping environment develop legibility as well as it reflects positively on the functional performance of any shopping complex. Therefore, a shopping environment become legible if it can be easily accessible and navigable by its customers and this will empower the functional efficiency of that shopping complex.

Functional efficiency of a building mainly depends on how well it serves its intended use (Juboori A. and Mustafa F, 2014). Functional efficiency as an environmental characteristic allows users to do what they want within a building in a fastest and safest way. The objective of designing a large shopping complex is to effectively and efficiently support customer's shopping activity and improve customer experience. Here, the customers' main activity is to find out the items in an efficient way within their fixed time of shopping. In this case, useful planning and easy circulation system may be helpful to make the shopping environment legible and improve customer shopping experience in

any shopping complex. On the other hand, due to the lack of legibility in the shopping environment, the customers may face difficulties in finding their way, which may make them feel lost, stressed and insecure. Loss of time and energy due to frequent backtracking for reaching the desired destination may also create a negative impression about the shopping environment (Neill, M. J. 1991; Lawton, M. P. & Nahemow, L,1973). These inconveniences produced by wayfinding difficulties may affect the customer return visit and preferences of shopping complex. Consequently, the economic efficiency of that shopping complex will be at great risk. For designing a functionally efficient shopping complex, it is important to satisfy the customers need by developing a good wayfinding system so that they can reach a specific destination under constraints such as time, distances and customers physical strength (Juboori A. and Mustafa F., 2014). In addition, architect and interior designer should know the environmental factors that may affect customer wayfinding experience in a large scale shopping complex.

Therefore, the present research focuses on understanding customer wayfinding difficulties to improve the customers' wayfinding experience. It is expected that a more inclusive understanding of the associated environmental variables of wayfinding will enhance our understanding of customer's experience in shopping environments, and will help us make the shopping environment functionally efficient and more customer friendly. It is also expected that this study will be helpful to improve design process of large-scale shopping complexes in Bangladesh.

1.2. Statement of the Problem

The challenge of designing a shopping complex is to move its customer efficiently through the shopping environment to find their desire product. During the shopping trip, the customer looking for a specific item may visit a number of shops or the customer may visit a particular shop to get his or her desired product. In all cases, they involve with wayfinding process for locating their destination shop. According to Yoo, (1991) no matter what the reason for visiting a shopping complex is, whether it is to shop at a particular shop, to shop for a certain item, or just to browse without any intention of making a purchase, the individual has to take wayfinding decisions relating to his or her movement through the complex. In most cases, confusing circulation pattern, double loaded corridors with repetitive architectural features and unremarkable entrances to certain spaces make the wayfinding process difficult (Passini 1992; Hunter, 2010; Marquadt, 2011). In addition, due to lack of proper signage, customer becomes confused

in a shopping environment that may increase customers travel time, distance to reach their destination and increase stressed level (Lawton & Nahemow, 1973; O'Neill, 1991; Arthur and Passini, 1992). The experience of confusion, especially if it occurs frequently, may heighten spatial anxiety about performing wayfinding tasks (Lawton, 1994). Research shows that these type of wayfinding difficulties negatively affect the customer's image of the shopping complex (Dogu, 1997).

When a customer has specific intention to purchase a certain product from a specific shop, he or she always tries to choose the shortest and straight forward path as well to avoid unnecessary walking. In this case, the repetitive arrangement of shop layout always generates identical circulation system and this makes it difficulties to find one's way in a complex shopping complex. Therefore, a customer with this intention, need the proper signage and direction from the starting point to his specific destination to complete his wayfinding task within a limited time. Any kind of direction failure or loss of way can make that customer irritated very easily. Environment and its information should be designed in such a way that it can help the customer being satisfied to reach their destination in any immediate situation. Uncomplicated pathway, uninterrupted visual accessibility, proper location of the signage before taking spatial decisions, safe and clear spaces leading to the destination within time can make the customer feeling satisfied in this specific situation. On the other hand, shopping activity does not always involve purchasing. Sometimes shopping becomes a leisure activity, where customer finishes his or her whole shopping process without purchasing and simply look or browse goods on display and roam around the shopping complex as long as he or she wants. In this case, the shopping environment becomes a place where people socialize and even participate in recreation. This type of shopping activity refers to a process of the social practice of exploration and sightseeing as a form of window-shopping which may take an extended period of browsing (Shields, 1992). Any frustration and failure of executing wayfinding behavior may hinder the experience of social consequence.

Research shows that the attractiveness of any Shopping complex mainly depends on the success of their wayfinding system during any type of planned or unplanned visit (Meziani & Hussein, 2017). According to Meziani & Hussein, (2017) the popularity of the shopping complex is positively related to visitor satisfaction with wayfinding in the shopping complex. Their research also strongly indicates that wayfinding factors are highly correlated to the popularity of shopping complex. Moreover, studies have

demonstrated that the building geometry and the complexity of building layout make wayfinding more difficult and increase the feeling of "being lost "and decrease popularity. For example, a shopping complex in Montreal didn't work for its complexity in space design and complicated circulation system (Passini, 1992). Besides due to lack of proper signage system, the customer becomes frustrated and walk large amount of time during shopping (Dogu;1997). Moreover, lack of visual connectivity between different shopping zone and presence of architectural and landscaping features blocking the view of major destinations point may create wayfinding problems in large shopping complex (Galper, 1987). A lot of researchers' study reveals that wayfinding difficulties have negative effect on the users' mental health. Because of loss of time and energy to find the destination the user can feel stressed and frustrated. It can also cause users anger and humiliation during way finding process (Christoph Ho«lscher & Georg Vrachliotis, 2007). Therefore, it is important for architect and developer to consider the factor that will make the shopping complex attractive for the customer.

In Dhaka the capital of Bangladesh, shopping complexes are growing day by day and became one of the important economic sources. The recent trend of modern and enclosed shopping center development in Dhaka, attempts to imitate the internal shopping environment of the developed countries (Hossain N., 2009). Bashundhara city is one of the biggest shopping complex in Dhaka where 50,000 people from home and abroad visit daily which reaches up to 1,00,000 during festivals and special occasions (http://www.bashundhara-city.com). In Bashundhara City shopping complex, subject to visual access the floor plan depth is too long which may be out of the visual range for the users. Therefore, it is hard to find a shop visually by standing in any one position. In case of layout complexity, it has an almost symmetrical layout with an atrium at center. According to Alam et al. (2016) because of similar treatments of the interior layout it is difficult to take decisions for the user for choosing a route to find the desired shop. There is a central atrium which plays the main role to differentiate the whole environment. Though the central atrium is very significant, but all other spaces and secondary atriums are identical (Appendix). So, the shops which are not near the atrium are very difficult to find and as almost all the corridors seem similar therefore it is very difficult to orient inside (Alam et al.;2016). Moreover, the long linear corridors with limited accessibility and less variety in the tenant mix pattern fail to generate customers in the deeper part of the building (Hossain N. 2009). In case of signage system, the absence of "you are here

map", same shop numbering system on different floors and lacking in signage system in each floor make a customer confused. Some shops are still vacant in those deeper part due to customer unavailability which is obviously hampering complex management and merchandisers economic growth. However little research has been done to find out the reason for customer's unavailability and environmental factors that affect customer's wayfinding experience. This type of research is important to create a functionally efficient and legible shopping environment which can satisfy the customer's wayfinding experiences.

1.3. Aim, Objective and possible outcome of the Research

The research aim is to understand the spatial and environmental variables that help customers find their destinations in a shopping environment and to understand how these variables influence the environmental legibility and functional efficiency of the shopping complex.

The objectives are:

A. To understand the effect of signage system, spatial layout, the environmental legibility and visual access on a customers' wayfinding experience.
B. To understand the impact of environmental legibility on functional efficiency in relation to customers wayfinding experience in a shopping complex.

Possible outcome

A. This research will provide a better understanding of the spatial factors that affect the spatial legibility of the shopping environment to improve functional efficiency.
B. This research will help to propose design decision for architects, designer, and planners to improve customers' wayfinding experience in large scale shopping complex.

1.4. Limitation and future research scope

The study has several limitations indicating future research directions. Some of which are described below:

Due to time constraints of customers and as every customer does not have the ability to draw the cognitive map, this research tries to understand the customers' cognitive ability through questionnaire survey. However, sketch mapping is one of the tools used in

wayfinding research as a method of cognitive understanding of an environment (Haq, 2001). Future research can explore this tool to understand the users' perception about the environment.

To understand customer wayfinding experience, this research focuses only on the signage system, spatial layout, and legibility of the environment. However, the directional changes and the nature of intersection of the circulation system, the travel distance of the customer, characteristics of the branching points of the spatial layout may have an effect on customer's wayfinding performance, which are not considered in this research. The future research may explore these variables to improve customer's wayfinding experience in shopping environment.

In this research, data analysis is focused on customer's satisfaction based on age, gender, and familiarity of the environment only. Further analysis focusing on customer's level of education, individual differences in cognitive abilities, visiting with others or not, and the number of prior visits to this shopping complex may provide additional interpretation of customer's wayfinding experience in wayfinding situations.

For floor plan analysis, the studies only use the integration, connectivity, and intelligibility value of axial map analysis. Research has shown that measuring of depth also has the ability to predict customers' wayfinding performance (Penn. A, 2001). Further analysis based on depth may help to explain better the relationships between spatial variables, wayfinding behaviors, and customer's wayfinding experience.

1.5. Organization of thesis

The research uses the above framework to study customers experience and satisfaction in relation to wayfinding performance in the shopping complex of Bangladesh. A summary of the following few chapters presented in this thesis are given below.

The next chapter two of the thesis presents the review of previous literature related to the concept of wayfinding and the influencing factors that affect wayfinding performance. It also provides review of literature about the advantage of using space syntax theory and method in wayfinding research.

Chapter Three provides a brief description of the methodology, selection process of Bashundhara city shopping complex as a case study for this research including the characteristics of the study area and the criteria applied to selecting the case studies. The discussion of the case study focuses mainly on the study of spatial layout, selection of shop route, behavioral observation, and questionnaire survey. It also provides a detailed description of the methods used for collecting and analyzing the data for this study.

The next chapter of the thesis presents the analysis of data collected from behavioral observation and questionnaire survey. The analysis is based on customers' satisfaction in relation to age, gender, familiarity, signage system, spatial layout and legibility of the environment.

Chapter five presents the discussion about the findings. The discussion focuses on the factors associated with customers' satisfaction in relation to signage system, spatial layout, and legibility of the environment.

Chapter six, the final chapter of the thesis, provides a conclusion focusing on the effect of signage system, spatial layout, the environmental legibility and visual access on a customers' wayfinding experience. The chapter also discusses about the impact of environmental legibility and customer wayfinding experience on functional efficiency in a shopping complex.

CHAPTER 02
LITERATURE REVIEW

2.1. Introduction

Understanding of customer's wayfinding experience is fundamental for designing a shopping complex environment. A successful wayfinding system mainly depends on the legibility of that shopping environment which is also an indicator of the efficient functional layout. According to several studies, the physical characteristics of the environment are the influential factors for any environment to become legible. If the physical characteristics of the environment are easily perceived by the users, then they can build a cognitive image in their mind and make necessary decision to find their way. Research shows that, to understand the relationship between the mental structure and the environmental structure, space syntax is a useful tool that provides the necessary environmental understandings of the environment. Therefore, the aim of this chapter is to understand the concept of wayfinding, factors that influence wayfinding performance in a shopping environment and lastly the contribution of space syntax in the field of wayfinding to understand the relationship between wayfinding behavior and space.

2.2. Wayfinding

Wayfinding can be termed as the processes people go through to find their way around an environment. It represents the cognitive processes of using the spatial and environmental information to find one's way through the environment. Some people define wayfinding as how well people are able to find their way to a particular destination without delay or undue anxiety (Peponis et al., 1990). In general, wayfinding is the process of determining and following a route between an origin and destination (Golledge, 1999). According to Lynch (1960, p. 3), wayfinding is based on "consistent use and organization of definite sensory clues from the external environment." Lynch's work provided the foundation for wayfinding research. He explained that while navigating in an environment people always try to create an image of that environment in his mind with the help of the structure and characteristics of physical objects of that environment which could help them orient in the environment. He also proposed five environmental elements path, edge, district, node, and landmark that could support the acquisition of spatial knowledge during wayfinding

situations. Overall wayfinding is the term presented to describe the process of reaching a destination, whether in a familiar or unfamiliar environment, and it is well-defined as a spatial problem solving activity.

2.3. Factors that affect wayfinding performance

Wayfinding is a process that we go through in our regular life. According to previous researches, there are several factors related to the environmental and individual character that influence the wayfinding performance (O'Neill, 1991; Peponis et al, 1990; Weisman, 1981). Legibility of the environment depends on such environmental factors that also help that space to be functionally efficient for its users. Previous researches show there are several physical factors that help any environment to become legible. According to Lynch (1960) path, node, edge, district, and landmark and according to Weisman (1981) signage system, complexity in plan layout, architectural differentiation, visual accessibility of shopping complex affects customers wayfinding performance. Galper (1987) stated that, the lack of "differentiation" is one of the major causes of wayfinding problems that effect legibility in the shopping complex. Dewar & Mitchell (1984) reported that simple building design and layout is an important factor for the legibility of the environment. The study also supports that personal experience with the shopping complex is also helpful for wayfinding and orientation. The lack of proper signage system and shop numbering system makes it difficult for the customer to find their destination in time (Passini, 1984; Dewar & Mitchell, 1984; Galper, 1987). A well-planned atrium area, which provides skylight can be pointed to as a landmark, also influences the legibility of the environment (Gardestat, 1989). In addition to a shopping environment, the stairways, telephone, or even store windows with distinctive cues serve as a landmark (Galper, 1987). Lighting also affects customer behavior by providing direction, by minimizing visual weakness that is a result of the interior structure and it offers comfort for both visitors and sales people (Turley and Milliman, 2000; Areni and Kim; 1994). The appropriateness of all these features in a shopping complex helps customer to construct a mental map easily of that environment, thus improves the legibility of that shopping complex through the betterment of customers' wayfinding experience.

In summary, a wayfinding experience depends on individual ability of how they perceive, develop cognitive map and make the decision to choose the right path with the help of the environmental factors according to their age, gender, familiarity etc. The detail descriptions of possible factors that affect the wayfinding performance are given below.

2.3.1. Perception and cognition during wayfinding

The term “perception” is derived from a Latin word “perceptio*”* which can be defined as the organization, identification, and interpretation of sensory information in order to represent and realize the existing environmental information. According to Gifford (1987), perception means gathering of information by the sense modalities of the human body that works as a guide to enable one to understand the environment. In the architectural design process, it helps the people to associate the meanings, forms and spaces with each other, in order to create a meaningful architectural environment (Jules, 1974). The area in which objects are visually perceived is called the visual field. The limitation of our ability to perceive characteristics of the environment mainly depends on the visual field. It is a comprehensive term that includes all psychological factors that needed for the formation of environmental cognition (Downs & Stea, 1973). Therefore, perception is important for the cognitive process in wayfinding situation.

Cognition is a method of thinking that includes learning and memorizing (or forgetting), generalizing, feeling, problem solving, decision making, liking and disliking (Zajonc R.B,1980; Garner B.K, 2007; Cherry.K ,2018). According to Gifford, (1987) cognition is the processing of the information, gathered by perception, through storing, organizing, and recalling them. In the field of cognitive psychology and cognitive engineering, cognition is typically assumed to be information processing activity in a participant’s or operator’s mind or brain. A distinct image of the environment such as the location of shop, parks and other facilities, the distance of these facilities and the geometry of paths help to enhance the cognitive processing system. Stea (1969) distinguished between perception and cognition from a spatial point of view. According to him, cognition occurs when the perceived objects and events are larger than the field of view, so they need to organize mentally. The way we acquire, organize, store, and recall information about location, distances, and arrangements in the physical environment is called spatial cognition (Gifford, 1987:30). Spatial cognition deals with the spatial properties of the objects and events in the world which comprise of location, size, distance, direction, separation and connection, shape, pattern, and movement. In addition, Spatial Cognition can be defined as “the knowledge and internal or cognitive representation of the structure, entities, and relations of space; in other words, the internalized reflection and reconstruction of space in thought" (Hart and Moore, 1973).

2.3.2. Cognitive map

The representations that people have in their mind about their surrounding environment, is called an image or a cognitive map. Cognitive maps are mental representations of the physical environment that people use to find their way and to recall important features of the environment. In wayfinding situation, people develop a cognitive map or mental image their surrounding environment based on senses and memory (Lynch, 1960). A cognitive map is the mental representation of an individual's knowledge of an area. If we ask a person to sketch a map of a location, a cognitive map helps us to understand what salient features of the environment is important for his or her and what is less important. People always excluded unimportant information by constructing the cognitive map. For that reason, the cognitive map is always different from the actual map of places.

Cognitive mapping is a process or series of psychological transformation for solving any wayfinding task for people influenced by spatial memories collected from previous visits, generalized information, signs, maps, navigational system and information from other people (Passini; 1970; Downs and Stea,1973,).

In any environment, the cognitive map allows one to locate oneself in a familiar environment and to move from one place to another even through parts of the environment never visited before. When the mental or cognitive map is stronger, it is easier for a person to enhance his reasoning capacity about that environment and take a decision about route choice to reach the destination.

2.3.3. Spatial reasoning and decision making capabilities

Spatial reasoning

A sort of reasoning abilities that refers to the skill to think about objects in three dimensions and to draw conclusions about those objects from limited information is named spatial reasoning. In order to represent and simulate peoples process of wayfinding, it is necessary to understand how people immediately make sense of spatial situation while performing a wayfinding task (Raubal & worboys, 1999). Research shows that the central part of the reasoning activity is considered to be depended on the relation between the spatial entities (Gérard F. Ligozat, 2005). Therefore, spatial reasoning depends on the intellectual capability of the individual and the character of the

environmental object as well. Researchers have proposed models of spatial knowledge and reasoning in order to explain human spatial behavior in environmental spaces (the relatively large-scale spaces of buildings, neighborhoods, and cities). All of these models have typically included the ideas about processes of knowledge acquisition, the form of stored knowledge, and its retrieval and manipulation in working-memory. Montello (1992) proposed some models for human spatial reasoning, which are best to describe spaces that have properties like symmetry and the triangle inequality, properties that define quantitative measurement on spatial dimensions. In wayfinding situation, people use landmarks for spatial reasoning during spatial cognition to understand the communication of routes, to take spatial decisions to find their destination.

Decision making capability

According to previous researches, successful wayfinding is based on a good decision-making process that relies on information represented by different means and how they are interpreted in people's minds. In wayfinding tasks, successful decisions are generally based on the person's cognitive ability and as well as on the available information about physical characteristics of the environment. Arthur and Passini, (1992:25) state decision-making activity during wayfinding comprises threes specific but interrelated processes.

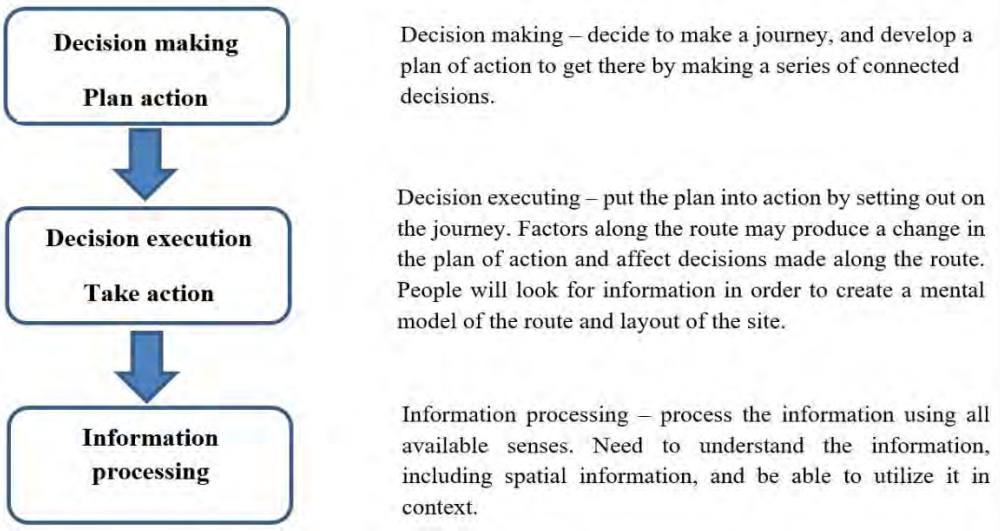


Fig 2-1: Decision making theory by Arthur and Passini (1992)

According to Siegel & White (1975), when people acquire knowledge from the environment, they usually follow a three-stage sequence. In the initial stage, people identify a place based on their knowledge of landmarks and places. As the experience

increases, in the next stage, people link their knowledge of landmarks and build their route knowledge. In the last stage, they organize and develop a mental map of that setting with the support of spatial clues. Individual's survey knowledge helps him or her to develop a two dimensional cognitive map of that environment after becoming familiar with all interconnections among different routes. This cognitive map builds an accurate and complete spatial representation of that area over time. The capability to acquire each type of knowledge is determined by the individual's experience and familiarity with the environment. These abilities play a vital role in achieving a wayfinding goal (e.g. reaching the desired destination).

2.3.4. Legibility of the environment

Legibility of an environment can be defined as an environmental condition which can be easily understood, read and perceived that helps to create a cognitive image in people's mind about the environment. In a legible shopping environment, customer can easily perceive and understand the environment through finding their way to their desired destination. The ability to find one's way into a building is a necessary requirement for improving the shopping experience of a customer. According to Lynch (1960:2), legibility denotes to "the ease with which (an environment's) parts can be recognized and can be organized into a coherent pattern". Weisman (1981) provides a definition of this construct that links the physical environment and human behavior. He defines it, as "Legibility is the degree to which a building facilitates the ability of users to find their way". Legibility influences the degree at which an environment can be learned and perceived (Lynch, 1960; Weisman, 1981). Therefore, if a shopping environment has a greater facility for obtaining and understanding the environment, it will have a high legibility factor.

The legibility of the architectural environment is a vital design issue that affects the ease of wayfinding. Different researchers have suggested a number of design features to improve the legibility of the environment. In addressing the issue of legibility of environment, Lynch (1960) stated that if the spatial organization of environments is more readily imaged, it helps to make the environment to become more legible. He identified five elements people tend to pick up from the environment to build their cognitive images. He urged that these elements are the design criteria for a highly legible environment (Fig 2-2):

- *paths*, the streets, sidewalks, trails, and other channels in which people travel;
- *edges*, perceived boundaries such as walls, buildings, and shorelines;
- *districts*, relatively large sections of the city distinguished by some identity or character;
- *nodes*, focal points, intersections or loci;
- *landmarks*, readily identifiable objects which serve as external reference points

Fig:2-2: Lynch five elements for a legible city (Lynch, 1960)

Others researchers have adapted the concept as it applies to the process of way-finding, at the architectural scale. For example, Passini (1984:110) uses the term legibility to refer to the quality of an environment, which lends itself to easily extracting and comprehending the information, which is relevant to wayfinding.

According to Warner and Kaminoff (1983), legibility significantly reduced user confusion, anger, perceived crowding, and overall emotional discomfort. Similarly, Weisman (1981:189) has stated that the legibility of an environment refers to the extent to which it facilitates the process of wayfinding. According to him at the building scale, there are four general features of an environment which contribute to determining the legibility: 1) signage; 2) plan configuration; 3) architectural differentiation; and 4) visual access.

Signage

A lot of research based studies show that effective signage system improves user's wayfinding behavior. Best (1970) found that signage placed at decision points in buildings improved wayfinding performance. Corlett, Manenica, and Bishop, (1972) applied Best's (1970) principles for signage placement to the renovation of a signage system in a university building and found that people took significantly less time to find their destinations after the signs were simplified and moved to decision point. According to Yoo, (1991) Signage is, of course, one of the most obvious forms of way-finding information which contributes to legibility by assigning a correspondence between the

name of a place and its location within a given setting. Both Passini (1977) and Weisman (1978) have stated that signage can "supplement" or act as a "surrogate" for architecturally based information. There are many types of research supporting this concept that adding signage to a particular setting can go a long way toward alleviating way-finding problems (Corlett et al, 1972; Nelson-Shulman, 1983-84; Carpman et al, 1984). Effective signage system which is clear, simple in design with not too much information, readable and perfect placement at decision point help to build legible environment. There are four main types of wayfinding signage which are given below.

Identification signs are the backbone of the whole wayfinding system and the first impression. They are the visual markers that display the name and function of a space or place. Moreover, they are functional as they can mark the transition from one place to another and can be used to convey the personality and character of a place.

Directional signs provide cues that visitors need in order to navigate a space once they are there. While the design of directional signs should harmonize with the environment they are in, they also need to stand out enough to be easily recognizable. An example of directional signs would the signs you look for as you enter a large shopping complex—signs that guide a customer to a specific block, or a specific corridor, or a specific shop number.

Orientation signs allow visitors to have a sense of where they are in relation to the entire space or place, such as directories and site maps. These signs are large, free-standing or wall-mounted units, and are often strategically located to stand out from their surroundings. Good examples of orientation signs would be large, free-standing directories typically found periodically throughout the common areas of a shopping complex.

- **Floor plan configuration**

According to previous research among all of the design features floor plan layout has the greatest influence on wayfinding and perceived legibility (Oneil, 1986; Peposis et al., 1990; Weisman, 1981). Floor configuration makes it easy for the user to build a mental map for use in wayfinding within it. According to Lynch (1960): "most significant for the discussion of environmental information is the finding that the spatial organization of some environments can be more readily imaged that those of others and, further, that path finding performance is better in these more 'imageable' or 'legible' settings". Weisman (1981) used several subjective measures during his research on university buildings as “goodness of form” of floor plan configuration which includes; simplicity, memorability,

and describability. After that, O'Neill (1991) considered in detail the influence of floor plans on way-finding and found that subjects who travelled the simplest floor plan travelled 25% more quickly, then the floor plan judged to be the most complex.

- **Architectural differentiation:**

Weisman defined architectural differentiation as for which character of the region and the landmarks within a building to generate distinctiveness thus the regions can be recognized easily. Kaplan's (1976) study explained about landmark and region that it differentiates an environment into smaller and uniquely identifiable places or areas. Within a building, spaces can differ architecturally which can be served as landmark as well. Weisman found in his study that elevators, doors, desks, plants also did serve as a landmark function. Architectural differentiation can occur at several scales within a building; these include differentiation between specific rooms or spaces, between regions or wings of a building, or between floors. His research on way-finding on ten university buildings with self-report data also indicates that way-finding performance is significantly better in those buildings which have a clear architectural differentiation between floors, typically between main floors and upper levels than in those buildings which have to lack such differentiation.

- **Visual access**

A collective measure of visibility of a setting which includes the visibility of origins, destinations and intermediate landmarks has influence on architectural legibility in indoor environment. According to Weisman (1983) visual access is a variable which involves the ability to "see ahead," that is, to see one's goal before actually arriving there by visually locating and using landmarks in the environment and it is based on the idea that it is easier to find one's way if the goal is within sight. In wayfinding literature, it is a common agreement that when the desired destination become out of sight it cause wayfinding difficulties for the users. The visual accessibility is likely to be weakened if the desired destination cannot be identified because of obstruction by some object or architectural projection or even if the destination itself blends in with the surrounding background. Garling et al. (1983) studies showed that reduced visual access significantly interfered with orientation ability. Therefore, the gradual reduction of visual accessibility may increase the difficulty of way-finding task which will negatively affect the legibility of that environment. On the other hand, success of way-finding task depends on the direct visibility of the desired destination (, Garling et al, 1983; Braakma & Cook, 1980). For assessing the degree of visual access within a building Braaksma & Cook (1980) have developed a "visibility index" and informal interviews from their study suggest a

relationship between low visibility guides for a specific location (i.e., wash rooms, departure gates, telephones) and difficulties experienced by user in locating these facilities.

From the above findings, it is embedded that these four environmental attributes of architectural legibility are necessary for solving way of finding problems. As a matter of fact, Weisman proposed that these variables, whichever individually or through collaborations with each other affect orientation and way-finding. Not only have these variables had a contribution to the understanding of wayfinding problems but also to the improvement of wayfinding strategies.

2.3.5. Individual factors

The ability to finding one's way within the spatial environment differs among individuals. According to Khan (2014), wayfinding performance depends on a person's orientation skills and spatial abilities which help to find the destination and to acquire information about the surroundings. User's wayfinding behavior varies according to their cognitive differences, individual wayfinding strategies and approaches in the process of wayfinding which depend on their age, gender, individual psychology and familiarity with the environment.

- **Age**

According to previous wayfinding research, it has been found that difference in age has an impact on spatial orientation ability. Research shows that aged people are always more satisfied than younger and middle age. Khan (2014) found that the aged patients (+60age) show higher satisfaction whereas the middle age groups (36-65) show less satisfaction with the signage system, overall layout, and design quality. Head and Isom, (2010) state that older adults have compromised spatial navigation abilities. Hunt (1984) in his research found that elderly people create the most robust mental image of the environment when they learn the relative locations of the landmark occurring at decision points. Research shows that aged people obtain a higher level of orientation strategy and lower level of anxiety, which result in a greater wayfinding experience. Besides visual memory also starts to decline after a certain age of elderly people as time progresses. Bosco and Coluccia, (2003) did a spatial orientation task by following map where they find out that due to the associate decline of visual memory skills in elderly people, their orientation performance decline.

- **Gender**

Research based on wayfinding and gender suggests that differences exist in the way that males and females carry out wayfinding and navigation. Coluccia & Louse, (2004) reported that gender differences affect wayfinding efficiency and directional accuracy. Hurts (2006) considered the effects of spatial intelligence and gender on wayfinding strategy and the amount of configurational wayfinding knowledge. The finding suggests that men tended to report more route based directions, relative to landmark-based directions than women did. According to Lawton's study (1996), gender was found to be one type of individual difference associated with wayfinding strategy, pointing accuracy, and spatial anxiety. The main reason behind this, in the patriarchy society males are socially and culturally fascinated to get themselves involved in different kind of spatial activities, actively explore the high spatial experiences from their childhood and spend much more time in such experiences than females. These kind of spatial experiences enhance spatial abilities. Besides, women are more likely than men to report anxiety about navigation (Lawton, 1994). Research shows that spatial anxiety reduces the ability to focus on cues essential to maintain spatial orientation. In wayfinding situations, females show more spatial anxiety and fear of getting lost than males do and this prevents the exploration of unfamiliar places due to a negative impact on self-confidence and on motivation to navigate in new environments (Lawton, 1994, 1996). Moreover, when people have a high level of spatial anxiety, they are not able to maintain a sense of direction and/or self-position with respect to the surrounding environment and most often tend to get lost, confused and anxious in wayfinding situations (Khan 2014).

- **Familiarity with the environment**

Research shows that an obvious and potentially influential factor upon wayfinding behavior is the degree of familiarity of an individual with a given setting (Hunt; 1984; O'neil; 1991, Weisman,1981; Dogu,1997). The amount of knowledge that one has about the surrounding environment is known as familiarity. Researchers point out that familiarity with a building has a substantial impact on wayfinding performance and based on the degree of familiarity with the environment, people make the strategic decision of varying complexity. A person with an environment which is new for him or her has very slight knowledge of it whereas a familiar environment is well known, and after frequent exposure or practice, a new environment can turn into familiar. Cognitive demands for

both new and familiar environments can be very different, which are most likely linked to the use of the internal representation or cognitive map proposed by O'Keefe and Nadel (1978). According to Dogu & Erkip, (2000), the spatial information about the layout of a building cannot be mentally represented until the building is repeatedly navigated and the wayfinder becomes familiar with the built environment. Therefore, as the familiarity with the environment increase the wayfinder's spatial orientation develops and along with that wayfinding problem also starts to reduce. Also, the other factors that influence wayfinding difficulties of the environment become less significant. There have been studies designed to examine various effects of building familiarity in conjunction with other variables. Garling et al. (1983) found that accuracy in 34 locating building targets was positively correlated with familiarity and with free viewing access.

2.4. Wayfinding behavior

Wayfinding can be described as the process of the problem- solving to reach a destination through a complex environment (Passini, 1992). According to Khan (2014), through this process, people use different types of spatial or non-spatial strategies which reflect in their behavior through the movements of head and body. She explores patients travel experience using three types of wayfinding behavior during finding their way in a hospital setting. After that Mandel (2016) used information seeking behavior and stopping behavior to evaluate users' wayfinding behavior in library facilities. A short description of three types of wayfinding behavior is given below.

Searching behavior: Alibali, (2005) states that body movements or gestures, also called searching behaviors, play a great role during the initial phase of wayfinding. During wayfinding, people make a decision plan based on the visual and written clues that they find through look around.

Stopping behavior: In the second phase, to make a decision plan, people often stop their movement. This can be termed as stopping the behavior. Stopping behavior helps people focus on spatial information and process that information. Based on the decision plan, people move ahead and repeat the actions of the earlier phases until they find their destinations.

Help seeking behavior: When people do not find all the information in a consistent way they get lost. At that moment, they produce help-seeking behavior to get help from

others to find their way. It is assumed that when customers produce more wayfinding behaviors they are more dissatisfied with the signage system, the overall layout and with the perceived travel time that can `negatively affect the environmental legibility.

2.5. Wayfinding and space syntax

In the early 1970's, an active research group, led by Professor Bill Hillier developed Space syntax to understand the proper description of the environment. It characterizes places that are potentially relevant to a variety of social and psychological responses such as for behavioral affordance, orientation and disorientation, spatial knowledge acquisition, emotional responses like stress and fear, privacy and social interaction, and quality of design judgments (Montello, 2007). Space Syntax theory evaluates the social formation and behavior, especially in 'natural movement', wayfinding, traffic patterns, economic distribution, workplace productivity, shopping behavior, visitor interactions, and so on (Haq. S, 2001; Dogu & Erkip, 2000; Khan, 2014). The properties of interconnected paths generated from space syntax analysis provide the information about how people use these paths while moving through them. By using space syntax method, the influential environmental factors can be identified through an individual movement decision and movement pattern (Peponis et al, 1990; B. Hillier, A. Penn, et al ,1993; Haq S. ,1999, 2001; Haq & Zimring, 2003; Peponis et al, 1990; Hillier & Hanson, 1984).

Pervious researches show that space syntax has the ability to predict and assess the legibility and functional efficiency of spaces (Haq, 1999; 2001.Pen A. 2001; Natapov. A et al 2010). It has the ability to understand how humans actually perceive and use their surroundings (Dara-Abrams, 2005). According to Haq (1999) space syntax provides the necessary environmental understandings to study the relationship between the mental structure and the environmental structure. Haq (1999) explained that in a legible environment people can develop a mental map of those routes which are more integrated and during wayfinding situation they try to use those routes.

Literature suggest that space syntax is a useful tool to study wayfinding problem in the built environment. The first research on wayfinding using the space syntax technique was done by Peponis, Zimring, & Choi, 1990). They used space syntax methodology to examine spatial search behavior. In 1999, Haq replicates and extends Peponies studies (1990) through analyzing behavior and environmental variable and explores more local and relational value. In his research, he tries to understand the properties of the spatial

layout as a predictor of wayfinding performance. Haq & Girotto, (2003) did a comparison of sketch map and an axial map of space syntax to explore the setting, completed wayfinding tasks, pointed to unseen destinations, estimated difference between them. Haq and Zimring, (2003) tried to find out how people's topological knowledge changes when they get to know a setting in wayfinding situation. Tzeng & Huang, (2009) use axial map analysis and isovist analysis to analyze the influence of wayfinding design point, spatial form and signage on the wayfinding behavior. More recently Khan (2014) , tried to understand the effect of hospital layouts, signage systems, design quality, and visibility of the environment on wayfinding experience in hospital environment.

Hillier argues that intelligible layout can contribute to the intuitive understanding of spatial configuration (Hillier, 1996). According to Conroy, (2001) people movement become shorter, quicker, and more efficient through spaces with high intelligibility value. In shopping complex (Mustafa.F, al jubbori, 2014), hospitals (Haq, 2012), houses (Mustafa.F and Hasan.A, 2010), in mosque layout design (FA Mustafa - 2013), space syntax is used to evaluate the functional efficiency of the layout. Thus, the degree of efficiency of any space can be predicted through space syntax. In a complex shopping environment to understand wayfinding difficulties and functional efficiency of the layout, space syntax methods can be a useful tool to find out the environmental attributes which can be implemented to make a legible functionally efficient shopping environment.

2.6. Theoretical framework

A theoretical framework (Fig:2-3) has been developed after reviewing the literature which is related to wayfinding research for understanding the relationship between individual factors, environmental factors, spatial behavior, spatial variables and customer's wayfinding experience and satisfaction. According to the literature review, customers' wayfinding performance depends on customers individual factors and spatial factors like signage system, spatial layout, architectural differentiation and visual access (O'Neill, 1991; Peponis et al, 1990; Weisman, 1981; Dogu & Erkip, 2000) which also affect customer wayfinding behavior (Khan, 2014). In a legible environment, the spatial factors help a customer to perceive and build cognitive image about the environment, which enhance customers' wayfinding experience with satisfaction (Lynch, 1960; Weisman, 1981; Oneil, 1991). A legible environment increases customers satisfaction through efficient

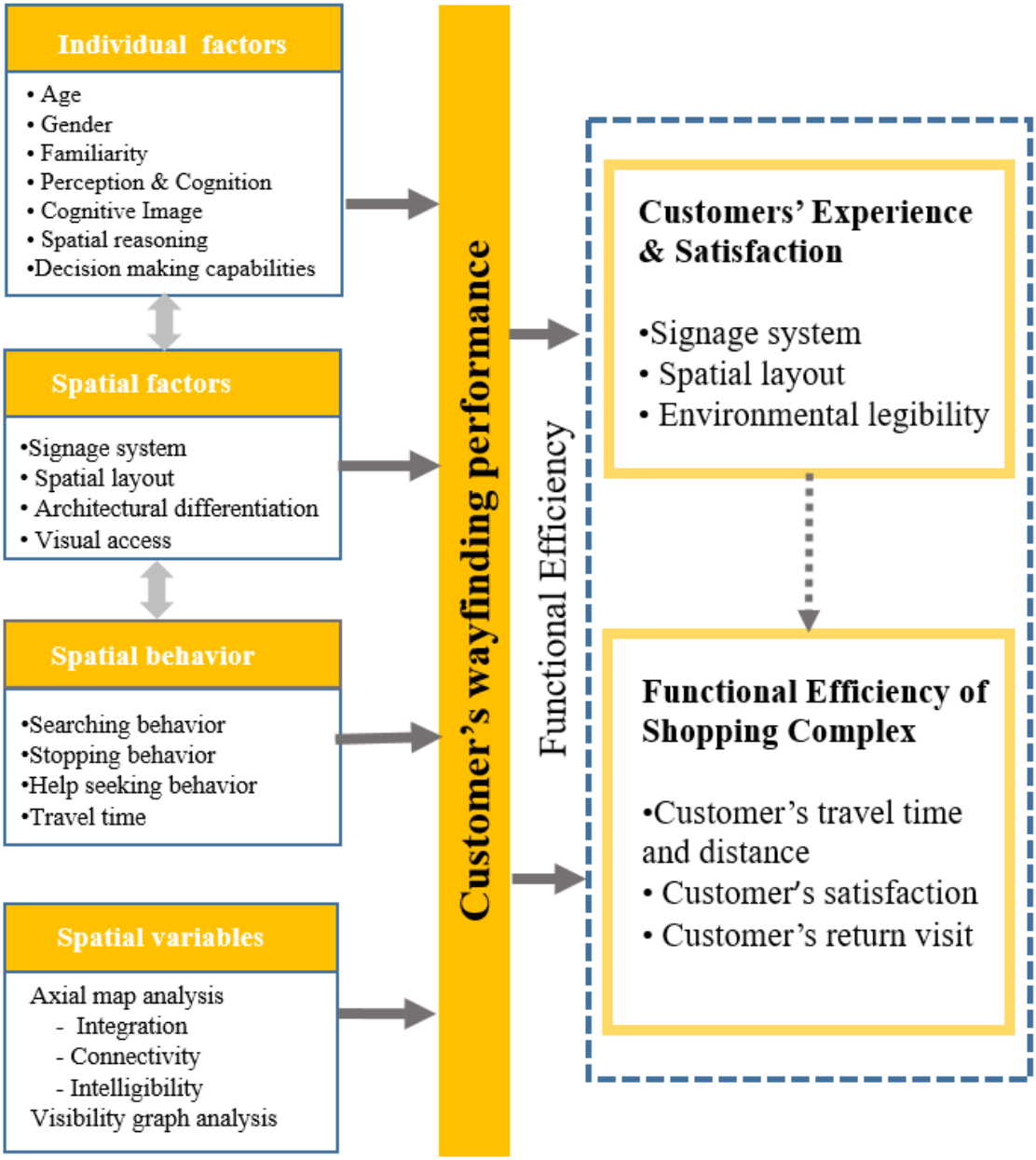


Fig 2-3: Theoretical framework

movement within short period in the shopping complex (Juboori A. and Mustafa F.,2014). Literature suggest that space syntax is a useful tool to study wayfinding problem in the built environment (Peponis, Zimring, & Choi, 1990; Haq & Girotto, 2003; Haq and Zimring (2003). It is also evident from literature, the degree of functional efficiency of any space can be predicted through space syntax(Mustafa.F, al Jubbori,2014; Haq, 2012; Mustafa.F and Hasan.A 2010). Therefore, after reviewing all literatures, it can be stated as a hypothesis that individual factors, spatial factors, spatial behavior, spatial variables

of floor plan have an effect on customers wayfinding performance. Through improving customer wayfinding performance, it is possible to increase customer's wayfinding experience and functional efficiency of the shopping complex.

2.7. Conclusion

The aim of this chapter was to understand the concept of wayfinding, factors that influence wayfinding performance in a shopping environment and the contribution of space syntax in the field of wayfinding to understand the relationship between wayfinding behavior and space through literature survey. A theoretical framework was also developed after reviewing the literatures in this chapter.

CHAPTER 03:
METHODOLOGY

3.1. Introduction

The aim of this chapter is to report on the overall research approach and its' methods and techniques. From the previous chapter, it is evident that understanding customers wayfinding experience is important to improve the functional efficiency of the shopping complex. If the environmental variables do not support the wayfinding process, customers get lost in a large shopping complex, and get stress and show their dissatisfaction with the shopping environment. Therefore, to understand what are the factors affect customer wayfinding experiences, a single case study research was designed following a mixed method where both qualitative and qualitative research method was used for data collection and analysis. In the quantitative part, data were collected for the following variables: (1) The amount of time needed for a customer to reach a destination shop; (2) the number of times a customer stopped, looking around and ask for direction on his or her way to destination; (3) spatial data of floor plan analysis using space syntax technique. For qualitative part, data were collected for the following variables: (1) data collected from architectural floor plan through document review (2) the physical design features of the shopping complex through the observation; (3) the self-reported survey data on the customers' experience and satisfaction through a structured questionnaire survey.

3.2. Research Methodology

This chapter provides a description of the research methodology consists of four phases. After reviewing the literature related to wayfinding and legibility at the first phase, a case has been selected to collect data for the second phase. Customers' behavioral data were also collected in the second phase through systematic observation of wayfinding behavior such as stopping the behavior, asking behavior, searching behavior and travel time. In the following phase through a structured questionnaire survey, the study tried to understand customer satisfaction in relation to signage system, spatial layout, and legibility of the environment. At the last phase space, syntax analysis was done to collect the syntactic properties of the layout. The methods are further discussed in detail below.

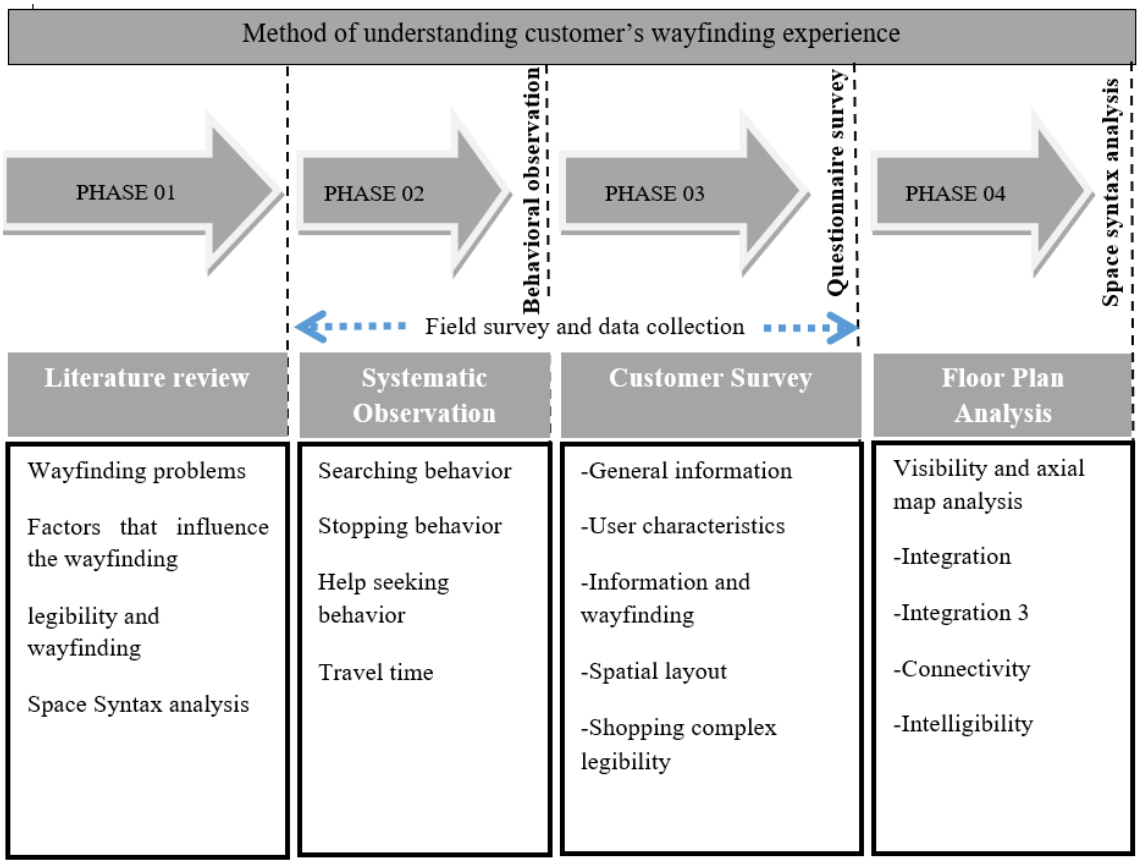


Fig 3-1: Research Methodology

3.3. Selection of Case study

In this research, a single case study method is used to understand the wayfinding experience in the shopping environment. A single case study is a useful method, which is less expensive and less time consuming and has the ability to describe the existence of a phenomenon (Baxter & Jack S., 2008; Siggelkow, N., 2007). It also gives a deeper understanding of the exploring subject. Therefore, to understand the existence of wayfinding problem and to produce deeper knowledge about customer wayfinding experience, this study selects a single case study. The selection process of the single case study is based on the complexity of the layout, multi-functional activity, and location of a shopping complex in an urban context. Because of the inadequate example of completely running large-scale shopping complex in Bangladesh and limited resources on reported wayfinding problem in a shopping environment, Bashundhara city shopping complex is selected as a single case study. Bashundhara city shopping complex is the first largest multifunctional shopping complex in Bangladesh constructed in 2003, is now in

complete running phase. It is situated at the Panthapath, Dhaka that is the capital of Bangladesh (Fig 3-2).

Fig 3-2: Location of the study site in Dhaka city

Fig 3-3: Bashundhara city shopping complex

3.3.1. Description of the Study Setting

The built-up area of Basundhara City Shopping Complex is 177,700 sqm. The basic concept of designing Bashundahara city shopping complex is to create a city within a city with four distinctive identifying blocks (Khalid, 2018). The basic layout is consisting of 4 blocks. Block A and D is almost mirror like block C and D (Fig 3-4). It has almost symmetrical planning. Two-axis is created to divide these blocks. The main entrance is

located at the main axis, which is directly inserted into the main atrium. Secondary entries and stairways stand at the sides of the complex to merge circulation within a symmetrical layout. Each

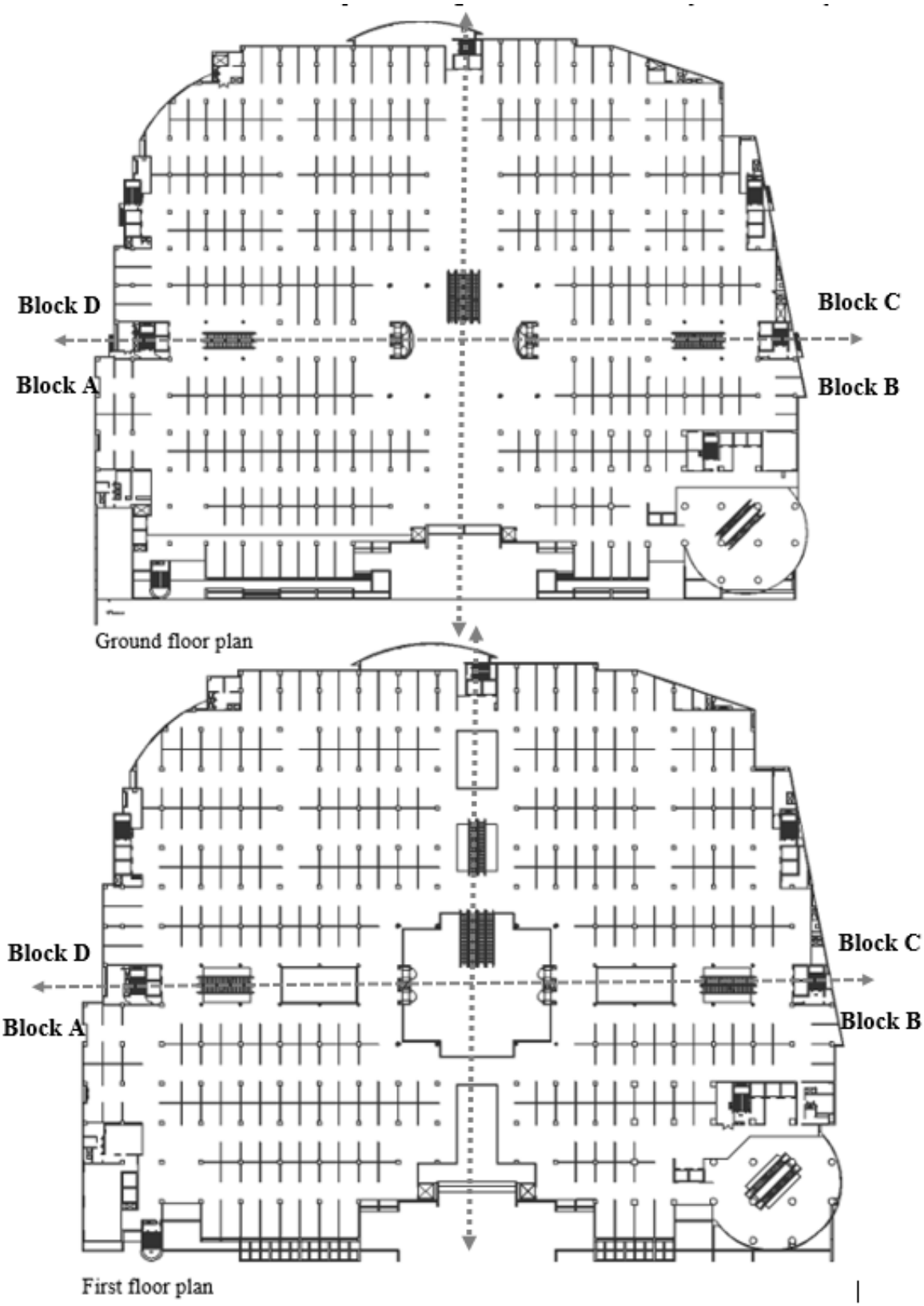


Fig 3-4: Floor plans of Bashundhara city shopping complex

Main entry and information desk

Main atrium lobby

Main atrium

Vertical circulation at main atrium

Secondary atrium

Fig 3-5: Entry, main circulation lobby& secondary Atrium

block is almost similar in size and connects with each other through streets like corridors and converges into a central atrium. The main central atrium is very significant, but four other secondary atriums are similar and smaller than the central atrium (Appendix). There

are total eight floors with a different tenant mix pattern. The central atrium connects all the floors by vertical mode of circulation (fig 3-5). First six floors are consisting of different retail shops (Appendix).

In Bashundhara city number of shops at level 01 according to block A, B, C & D are 90, 61, 100 and 119 and in level 02 are 91, 62, 99 & 117. Total floor area is 16351 sq.m with the length of 141.39m and width of 115.65m. There is a large atrium lobby in level 1 from where maximum vertical circulation is connected. At level 01 there is a mixture of retail shops whereas in level 02 the shops are only for clothing (Appendix).

It is reported in previous research that due to the complexity of the layout and similar corridor treatment, and organization of multiple functions in different floor, most of the time the customer gets confused and lost in the Bashundhara city shopping complex **(**Alam et al., 2016**)**. Because of the long linear corridors with limited accessibility in the rear part of the shopping center and less variety in tenant mix pattern, it also fails to generate customers in the deeper part of the building (Hossain N. 2009). In addition, the absence of "you are here map", similar shop numbering system in different floors and lack of signage system in each floor make difficult to find their destination.

3.4. Research method

The research tried to understand the effect of signage system, spatial layout, and legibility of the environment on customers wayfinding experience. Multimethod data collections were used in this study, including literature review, systematic behavioral observation, questionnaire survey, and the floor layout analysis. A reconnaissance survey was first conducted in Bashundhara city shopping complex to understand the spatial layout, signage system, and the actual wayfinding situation of these two floors. All Floor plans of Bashundhara City shopping complex were collected from the respective architect's office. All locations of sign and symbols and the vertical connection points were identified (fig:3-4). For data collection, eight (08) shops from the ground floor (Level 01) and eight (08) shops from the first floor (Level 02) were pre-selected for systematic observation.

- **Selection criteria of shopping floor**

For a selection of shopping floor, the purposive sampling method was used where the sample is chosen by the judgment of the researcher. There are total eight floors in the Bashundhara City shopping complex. From the reconnaissance survey, it was evident that

customers have better accessibility within ground floor (Level 01) and first floor (Level 02). In addition, these two floors have the presence of maximum signage system, the

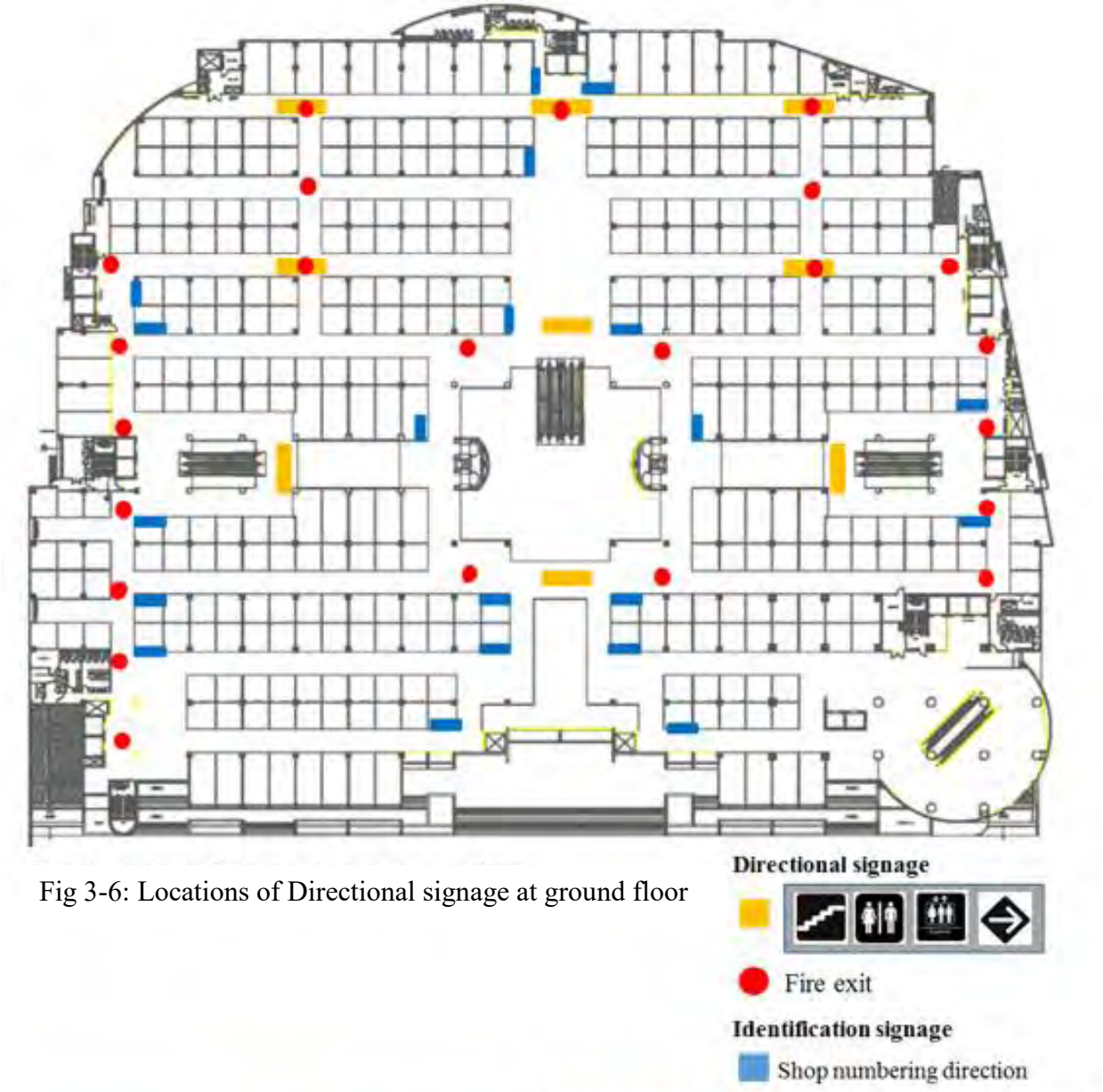


Fig 3-6: Locations of Directional signage at ground floor

Fig 3-7: Directional signage

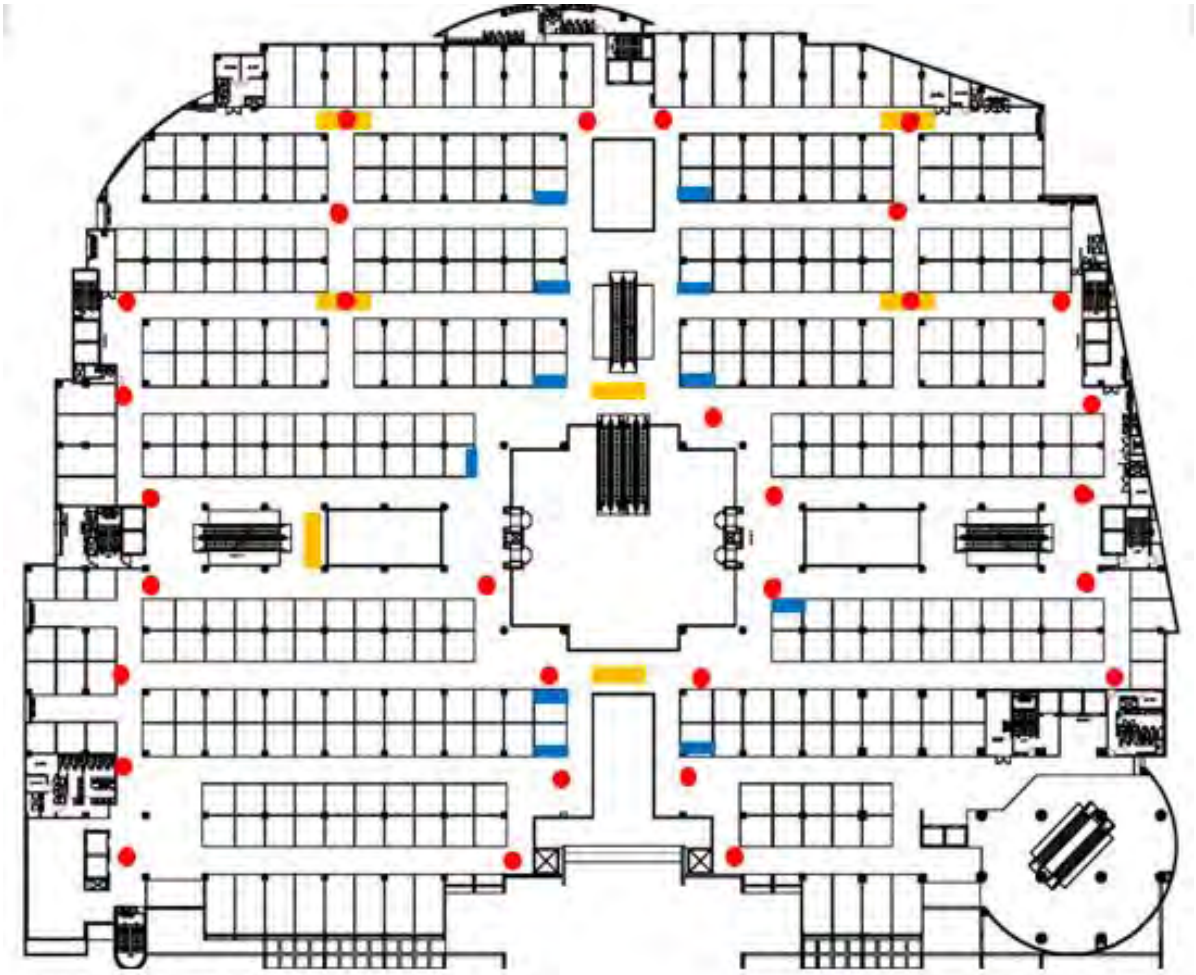


Fig 3-8: Location of directional signage at first floor

Fig 3-9: Floor identification signage (left) & shop identification signage (right)

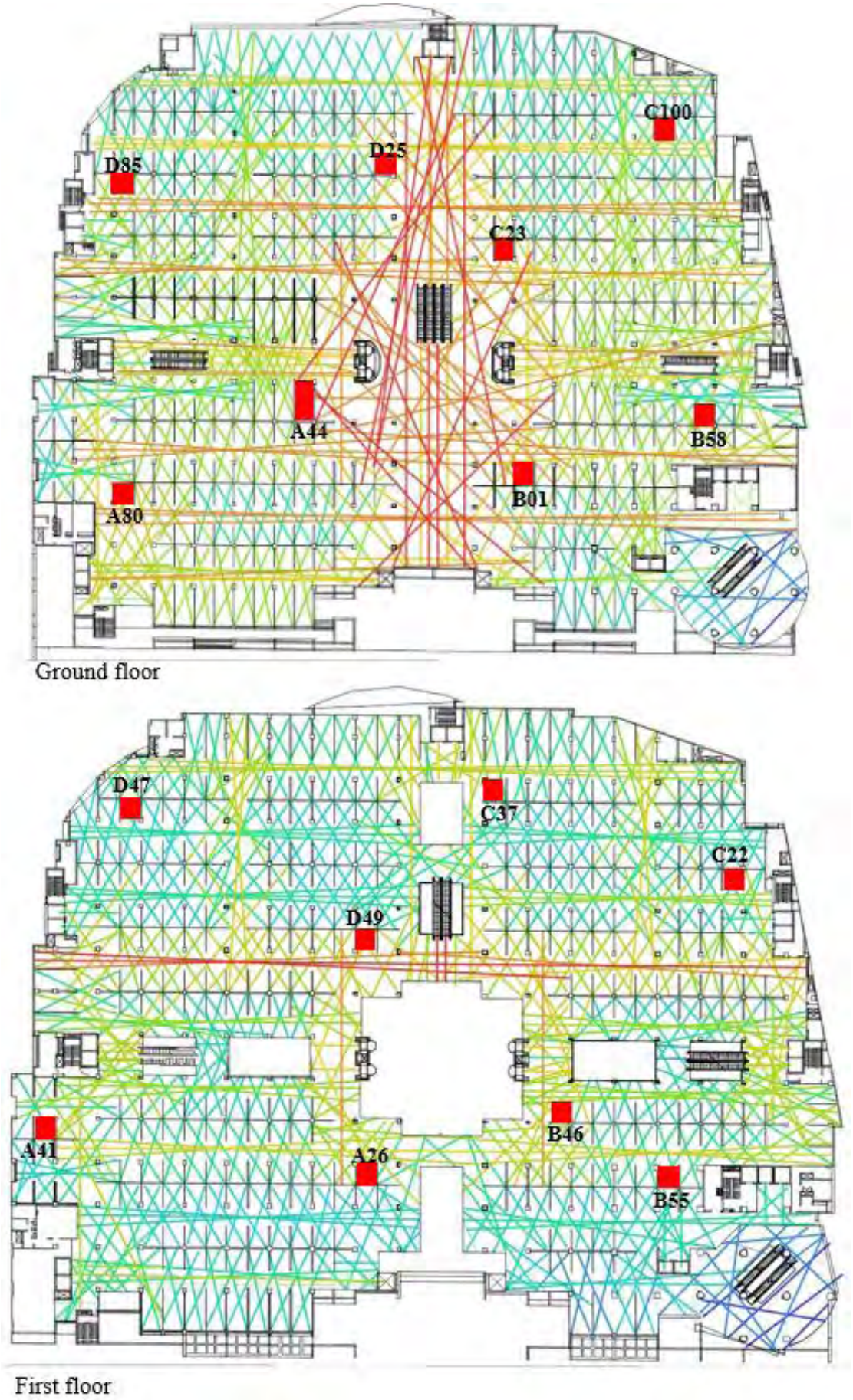


Fig 3-10: Selected shops at ground floor (upper) & first floor (lower) according to integration value

maximum number of shops, which are actively running, therefore the ground floor (Level 01) and first floor (Level 02) is selected for primary data collection to understand customer wayfinding experience in the Bashundhara City shopping complex.

- **Selection criteria of shops in each block**

For a selection of shops in each block, Space syntax technique was used to compute the integration, connectivity and visibility value of each floor plan. Based on an integration value of circulation system, two shops from each block were selected randomly in level 01 and level 02. Emphasis was given to select one shop from high integration value and one shop from low integration value from each block at each level (Fig 3-10).

- **Selection criteria of participants**

In this single case study research, the unit of measurement is a customer. In this multi-method research, participants are selected as per convenience sampling to observe wayfinding behavior. In this data collection process, a first available customer who gives us consent to participate in this research is selected for systematic observation and questionnaire survey. According to Roscoe (1975), sample size larger than 30 is appropriate for understanding the correlation between two variables in any study. Therefore, in this research due to time constraints and unavailability of resources, 60 participants who enter the shopping complex from the main central entry were selected. Participants were being asked to do the task from the preselected entry point.

3.4.1. Literature review

The first phase starts with a literature review that helps to develop a theoretical framework for this study. In this phase, the literature related to the concept of wayfinding, wayfinding experience along with the factors that influence wayfinding behavior, legibility of the environment and customer's satisfaction were studied. Besides, the literature related to legibility and functional efficiency of the shopping environment in relation to wayfinding were reviewed. The literature related to wayfinding and space syntax as well as the advantage of using space syntax in wayfinding research were reviewed which are given in detail in chapter two.

3.4.2. Systematic behavioral observation

At this data collection phase, a systematic behavior observation instrument was used to observe the customer's behavior in wayfinding situation. The objective was to generate data on how shopping environments support or hinder customers' wayfinding behaviors and, at the same time, how these environments affect their wayfinding experience and satisfaction. According to Ziesel (2005, p.193), the systematic observation method is empathetic and direct, deals with dynamic phenomena and allows researchers to vary their intrusiveness in a search setting. The customer was asked not to talk with anyone and try to fulfill their task following the environmental cues only. Wayfinding tasks were as follows

- The starting point was the same for each route which was the entry lobby. They had to start finding all 8 shops one after another from this starting point.
- The half of the participants who were randomly selected were asked to find out the shop number A44, A80, C23, C100, D49, D47, B46, and B55. The rest of the participants who were asked to find the shop number B01, B58, D25, D85, A41, A26, C37 and C22.
- After finding the first destination the participants were asked to find the next one. By repeating the procedure, each participant had to find out 08 destinations within 2 levels. There were no time limitations for the task so the procedure was repeated until each participant had found all of the selected locations of the route.

The researcher followed each participant with data collection sheet and marked and identify each position where the participants face difficulties to find their destination and collect those entire behavioral patterns data on the data collection sheet while finding their destination. During this task, each of the participants was tracked from origin to destination to determine his or her wayfinding difficulties. The researcher with a synchronized watch and data collection sheets conducted the observation. All observations were recorded on the floor plan through manual hand drawing (Figure:3-11). In addition, the individual participants' route and wayfinding behavior, such as the number of stops to make a decision, the number of times he or she looked around to find the way and the number of times he or she asked for directions, were recorded on the data collection sheet. A notation system was developed to record the above-mentioned behaviors. Recording participants' wayfinding behavior and travel route on floor plan

helped the researcher to get a better sense of how customers used environmental information. The observations occurred over a 4-week period. In this study, 60 participants were observed within 75 hours of data collection.

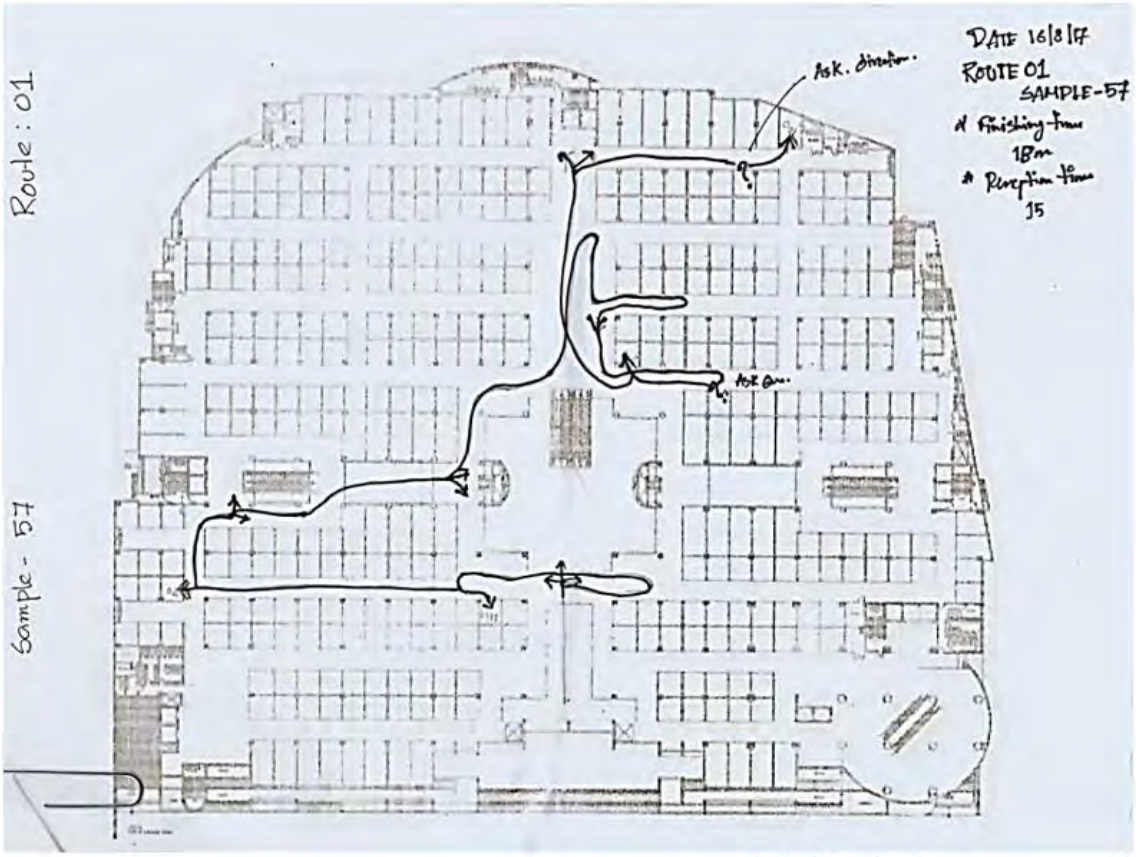


Fig 3-11: Behavioral observation sheet

3.4.3. Customer survey procedure

In this phase, data has been collected by surveying the participants through a questionnaire (Appendix). Every consenting participant was asked to fill out a survey concerning his/her wayfinding experience and satisfaction at the time he ended the task. The questionnaire has been developed from the literature review (Weisman's, 1981; O'Neil, 1989; Yoo, 1991; Dogu & Erkip, 2000; Mandel, 2012; Khan, 2014). The questionnaire consists of five parts. The first part of the questionnaire asks general information about gender, age and the number of visits. The second part asks about the user characteristics, the third part consists of questions related to wayfinding and graphics information. This phase asks questions related to graphic information, such as the usefulness of the signs directing people to different parts of buildings, how helpful You-

Are-Here maps are, whether door numbers and information desks were found to be useful, whether numbers were generally noticed, and whether the numbers were sufficient or not. The fourth part consists of questions regarding travel experience and satisfaction related to the spatial layout. Fifth part consists of customers' satisfaction and travel experience regarding the legibility of the shopping environment.

3.4.4. Floor plan analysis procedure

In this phase, the floor plan analysis has been done under the theory of space syntax. Here "Depthmap" software was used for understanding the syntactic properties of the layout.

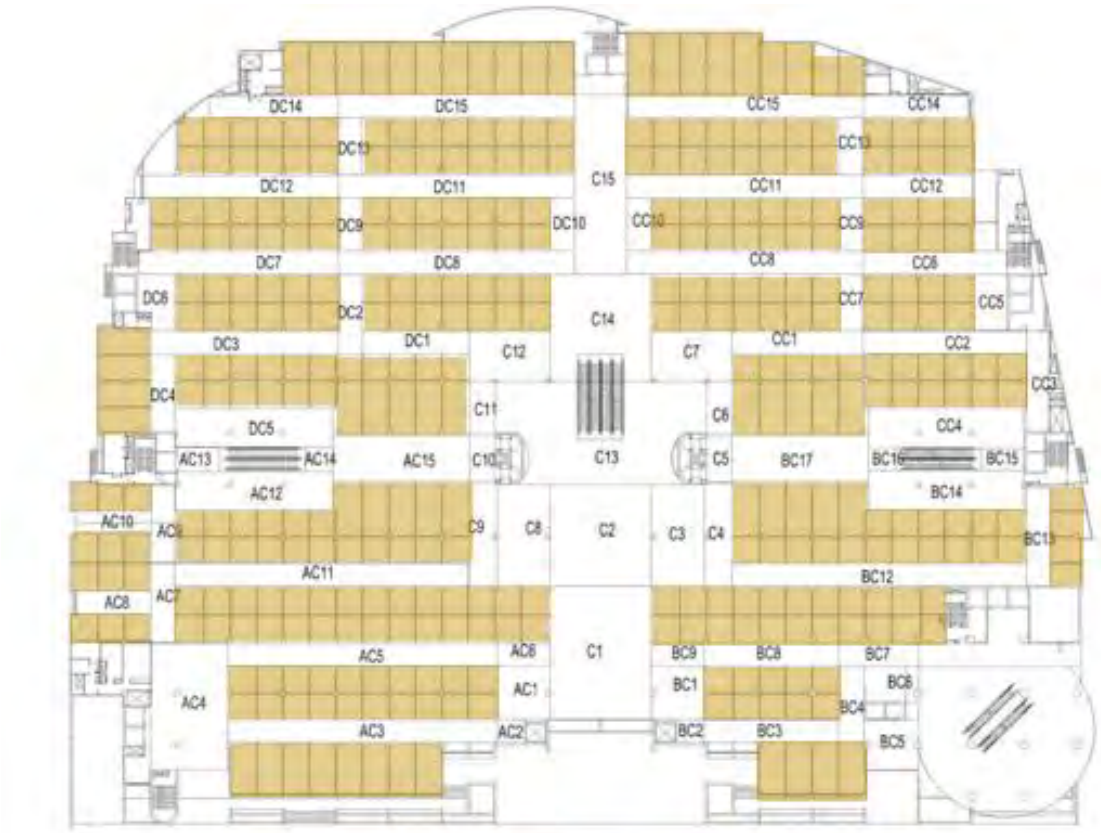
- **Corridor segment for collecting syntactic value**

Before depth map analysis the corridors of both floor plan layouts are segmented and titled for ease of collecting data (Fig:3-12). The syntactic value of each segment is taken after an axial map and visibility graph analysis. The syntactic value of segmented corridor that each participant use to find their destination shop from both level 01 and level 02 are collected and added. All these data of each corridor are collected from graph-based measure integration, integration 3, connectivity, visual integration, and visual connectivity and interpreted in statistical analysis.

- **Floor plan analysis**

These syntactic analyses of the floor plan consist of two parts. One is the axial map analysis (Hillier & Hanson, 1984) and other is visibility graph analysis (Turner et al., 2001). An axial map, which represents a set of the minimum number of longest sight lines that cover every circulation space in the layout, was produced for the whole spatial system of the study floor levels. The "whole spatial system" includes all the circulation spaces on the study floor levels that were used by participants. The axial map analysis has been done on multiple levels (Fig:3-13). Multilevel analysis in axial map represented vertical interconnections by means of weighted links between floors (Chang & Penn, 1998). In order to make the connection and continuation between two floors, the links are used as the integrating element through the vertical circulation.

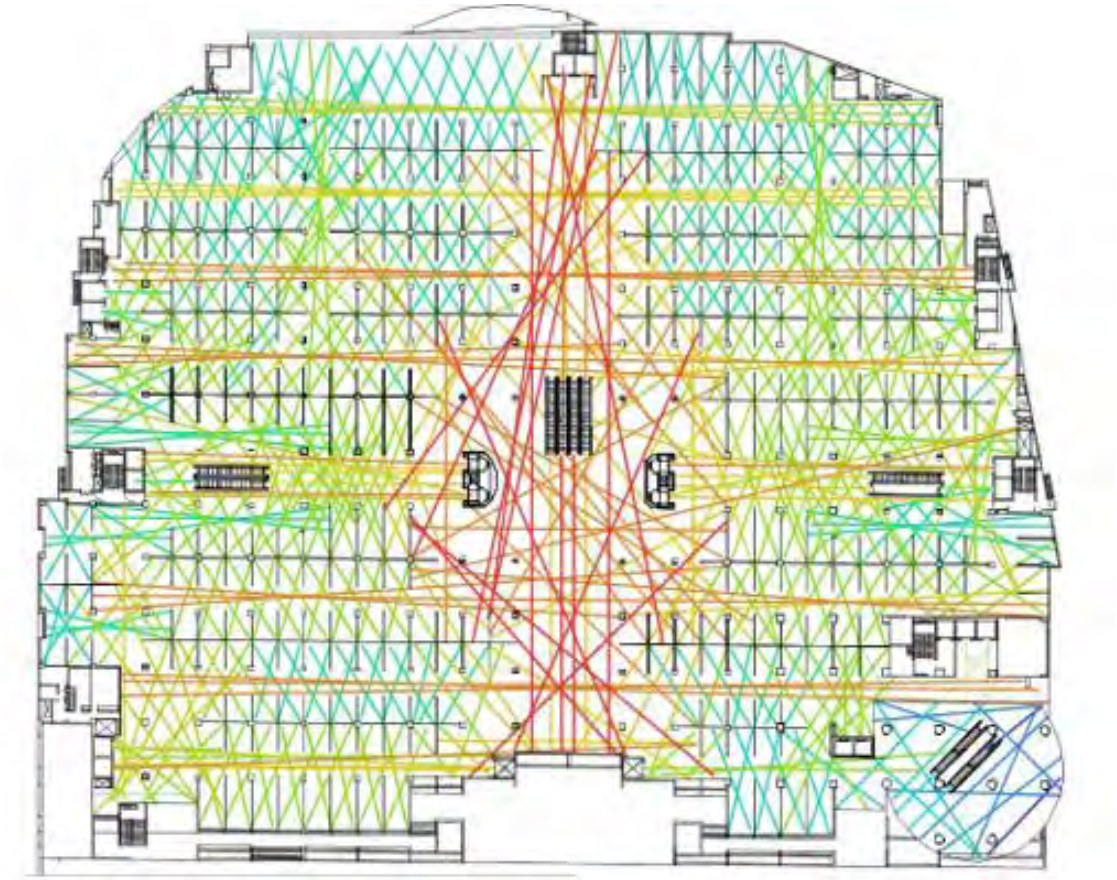
The study also used visibility graph analysis(VGA) linking between two study levels (Fig:3-14). According to previous studies VGA is a useful method to study the visual fields of the interior circulation spaces by linking all the floors to transform the multilevel system



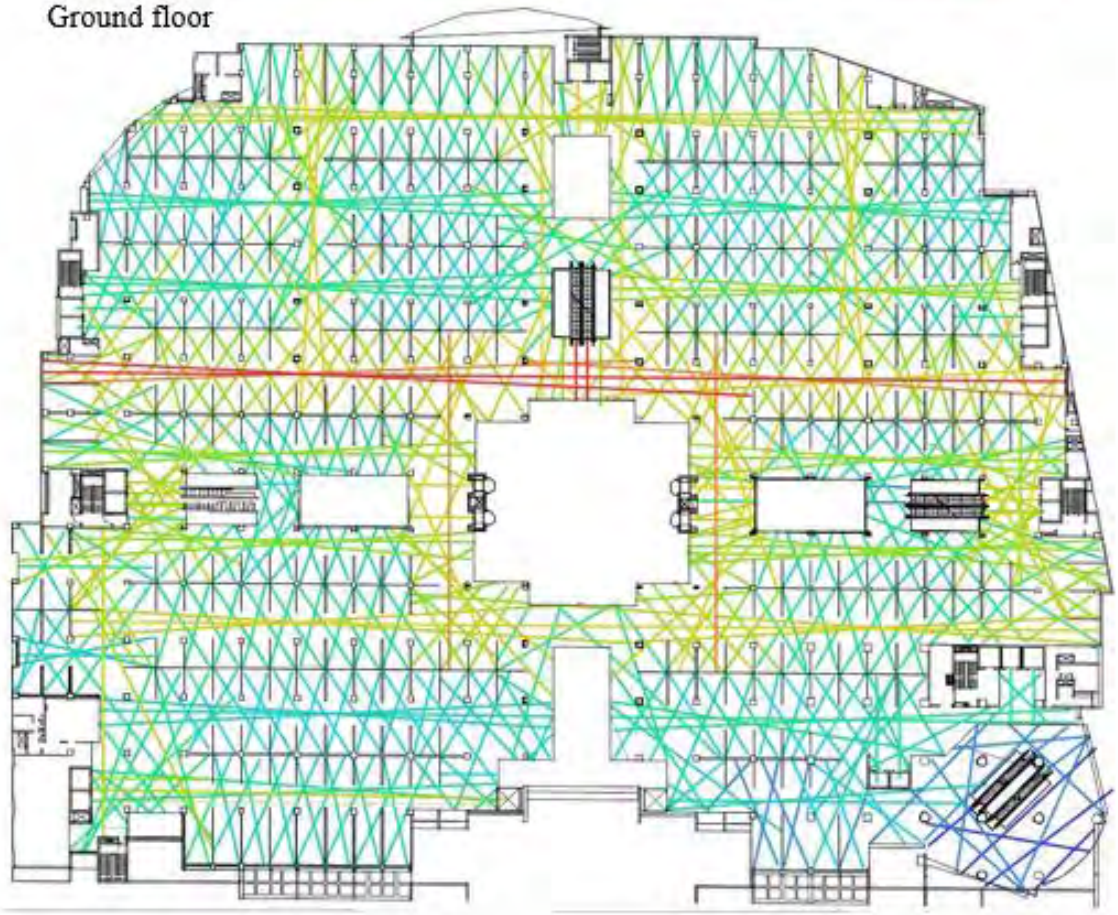
Ground floor

First floor

Fig 3-12: Segmentation system of corridor to collect data from graph analysis.

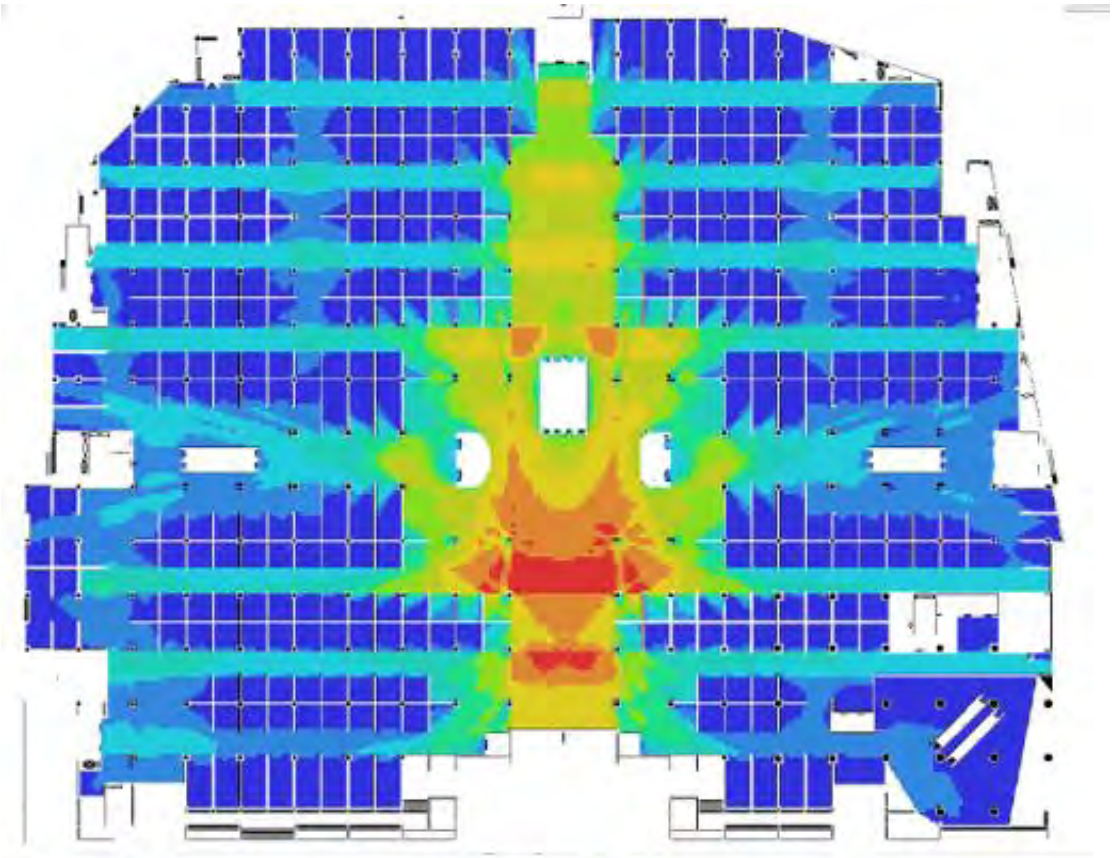


Ground floor



First floor

Fig 3-13: Axial map Analysis



Ground floor

First floor

Fig 3-14: Visibility graph Analysis

into a graph of one spatial system (Desyllas ,1999, Turner, et. al.,2001; Holscher C & Brosamle M,2007; Parvin et al,2007). In this study before analyzing the VGA, two levels are manually linked to converting the multilevel spaces into one continuous system. In this study, integration, connectivity, visibility and the intelligibility measure of space syntax were used to measure the properties of the layout. These are described below.

a) Integration

According to Hillier & Hanson (1984), the integration value of a line is a mathematical way of expressing the depth of that line from all other lines in the system. The integration value measures the relative position of any space or axial line with respect to all space and lines in the building's layout. Higher integration values represent better accessibility to and from axial lines. "Integration-radius n" represents the relationship of each space with every other space in shopping complex layout as a whole. "Integration–radius 3" is the local measure that represents the relationship of one space to others up to three steps or turns away from it.

b) Connectivity

Connectivity is another graph-based measure which gives a simple local measure of connection. It refers to the number of links associated with a given space. Connectivity is measured by counting the number of lines or spaces that are directly connected to a line or space. Connectivity is the local measure that represents the relationship of each space with its immediate neighbor. Haq and Zimring (2003) were able to show that for the exploration task, local connectivity features were the best predictor of routes observed. It provides the degree of choice on the line: higher Connectivity values represent more choices of movement for axial lines.

c) Intelligibility

This value of intelligibility refers not to individual environmental units, but to the entire system. Intelligibility represents the correlation between local and global syntactic measures, such as between connectivity and Integration-radius-n, or between Connectivity and Integration-radius 3. Intuitively, in a more intelligible system, information about local connectivity allows a person moving through the system to comprehend the overall structure of the configuration more easily (Hillier, Hanson, &

Peponis, 1987). It has been argued in the literature that more syntactically legible layouts have higher intelligibility values (Hillier, 1996).

3.4.5. Data interpretation measure

All the data from field survey and the data generated from depth map 10 were analyzed in statistical software SPSS 20 to evaluate the following hypotheses: (1) Visibility and accessibility of the layout affect customers' travel time and wayfinding difficulties; and (2) Customers' wayfinding experience and satisfaction can help to determine the environmental legibility. To understand the correlations between customers' satisfaction and other variables during analysis, this research used the Pearson correlation coefficient (r) that calculates a linear relation concerning two measures of variables using the SPSS20 software. According to Dancey & Reidy (2004) in most of the cases, when the correlation coefficient or r = 0.7 - 0.9, that correlation is well thought-out to be a strong correlation; when r = 0.4 - 0.6, the correlation is well thought-out to be a moderate correlation; and when r = 0.1 - 0.3, the correlation is well-thought-out to be a weak correlation. Nolan, (2007) states that previous research has shown the correlation between two variables in social and behavioral science very rarely exceeds 0.4 in absolute value. Therefore, according to Cohen (1988), the Pearson correlation value was considered r = ±0.5 as strong; r = ±0.3 as moderate and r = ±0.1 as weak correlation (Weinberg, 2001). In this present study, the analysis is well thought-out (r= ±0.4 to ±0.5) as strong; (r = ±0.2 to ±0.4) as good or moderate, and (r= ±0.1 to ±0.2) as weak correlation.

3.5. Conclusion

The aim of this chapter was to give an understanding of the environmental condition of the Bashundhara city where the research was conducted. Bashundhara city shopping complex was selected based on its location, size, and complexity of the layout. All floor plans were collected from its respected architectural office. This chapter described the overall data collection method in the study site. Data were collected during the field survey, behavioral observation, questionnaire survey, floor plan analysis through the axial map and visibility graph analysis. Lastly, data interpretation measurement was determined. In the next chapters, through statistical analysis, the research will determine the effects of signage system, spatial layout, and legibility of the environment on Customers' wayfinding experience.

CHAPTER 04
ANALYSIS

4.1. Introduction

The aim of this chapter is to understand the customer wayfinding experience in the shopping environment in relation to signage system, spatial layout, and legibility of the environment. The analysis of the data was done in three stages to study customers' satisfaction in relation to signage system, spatial layout, and legibility of the environment (fig:4-1). In each stage, the analysis investigated the correlations between customers' satisfaction with signage system, spatial layout and legibility in relation to various factors (1) individual character (age, gender and familiarity), (2) syntactic properties of the layout (3) customers' wayfinding behavior and (4) environmental legibility as described below.

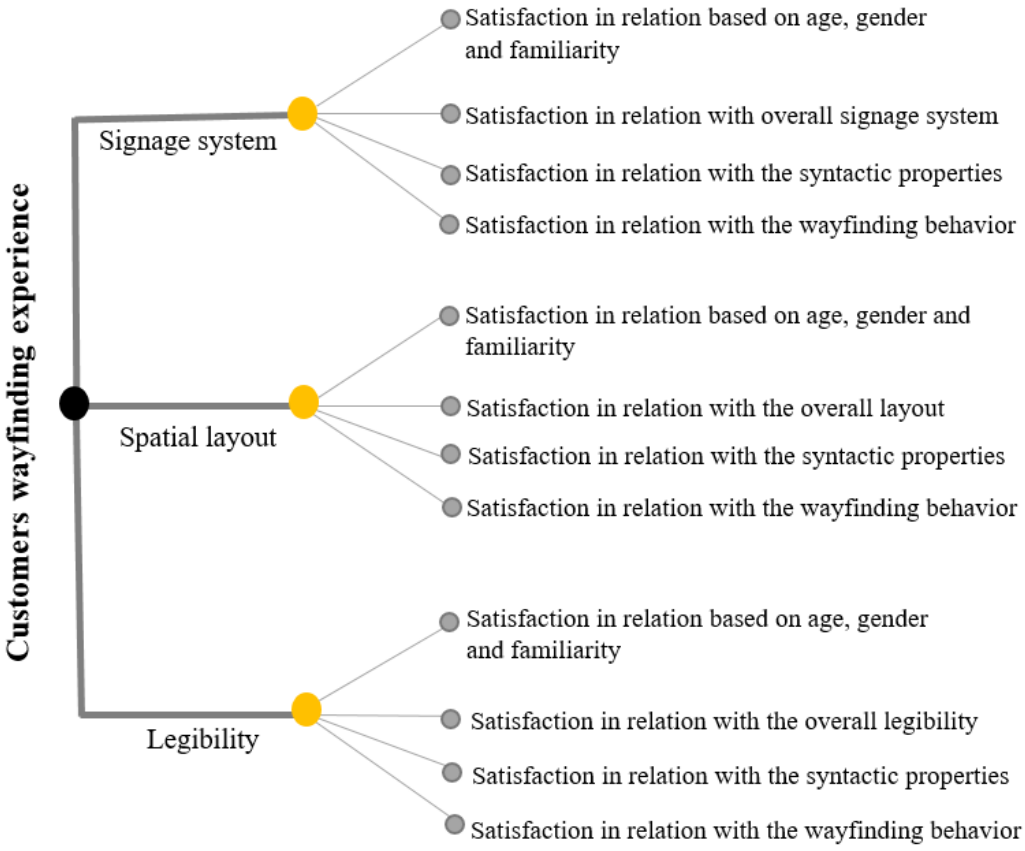


Fig 4-1: Customers' wayfinding experience

4.2. Customer's satisfaction in relation with signage system

Previous literature shows that customers satisfaction related to signage system depend on various factors such as customers, age, gender, familiarity (Weisman, 1981; Peponis, Zimring, & Choi, 1990; O'Neill, 1991; Dogu & Erkip 2000; Khan 2014), the size and location of signage (Passini, Weisman 1981; Khan 2014,) where they have to take decision to choose route. The appropriate signage system makes customer satisfy by reducing customers travel time during wayfinding situation (Peponis et al.,1990; Passini, 1992; Wiseman,1981; Carpman et al., 1993). Thus the intention of this section is to analyze the data regarding signage system in relation to customers' satisfaction according to their age, gender familiarity, satisfaction with overall signage system, syntactic properties of the layout and how the signage influence their wayfinding behavior in Bashundhara city shopping complex.

4.2.1 Satisfaction with signage system based on age, gender and familiarity

Research shows that customers' demographic characteristics have an influence on customer's satisfaction in relation with signage system. In this section, the study tried to understand the customers' satisfaction in relation with signage system based on age, gender, and familiarity.

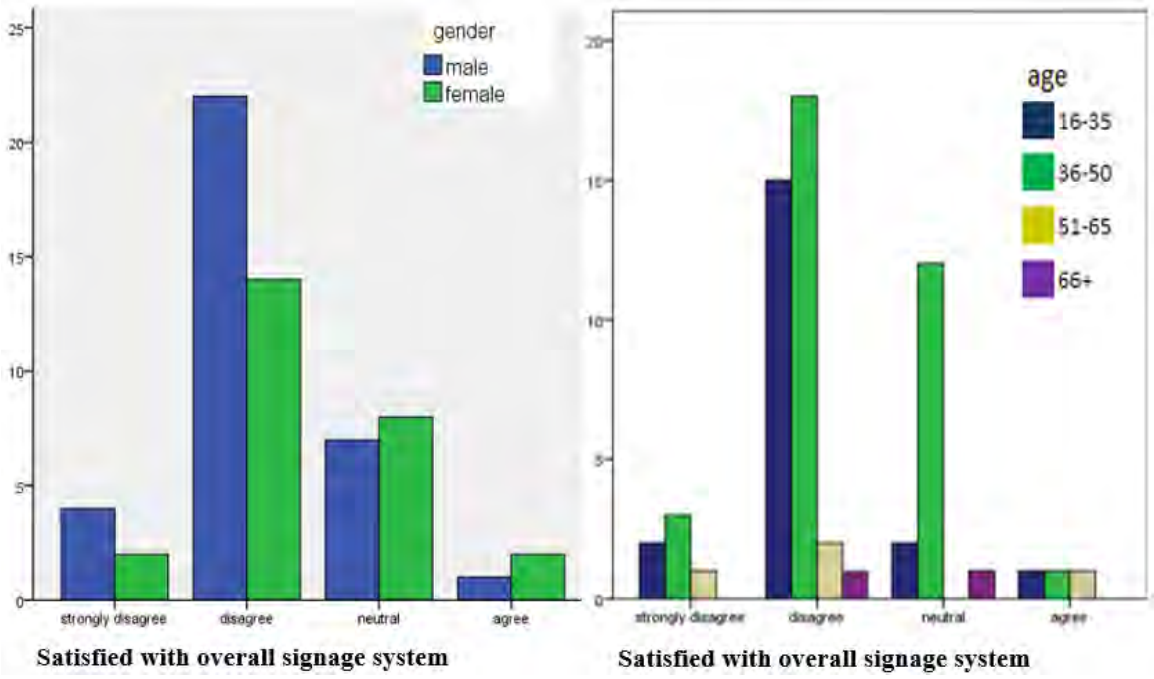


Table 4-1: Analysis between satisfaction and signage system based on age and gender

- **Satisfaction with Signage System based on Gender**

Among 60 customers, male customers are 57% in comparison with female customers (Table 4-1). The findings show that 79.41% of male customer and 61% of the female customer disagree with the satisfaction with overall signage system. Among them 11.76% of male and 12.5% of female shows that they are strongly dissatisfied with the overall signage system. Whereas 7.7 % male and 2.94% female are satisfied with the signage system. The analysis also shows that male customers are less satisfied than female customers in relation to the signage system of the shopping complex.

- **Satisfaction with Signage System based on age**

The study shows that 72% of customers who are between 16-35 age are dissatisfied and 12% of customers are strongly dissatisfied with the overall signage system (Table 4-1). customers who are aged 36-50, 42% of them shows dissatisfaction, and 9% of them shows that they are strongly disagreed with the satisfaction with overall signage system. 50% customers of 51-65 age group also dissatisfied with overall signage system.

- **Satisfaction with signage system based on familiarity**

The study shows that wayfinding experience depends on the frequency and number of

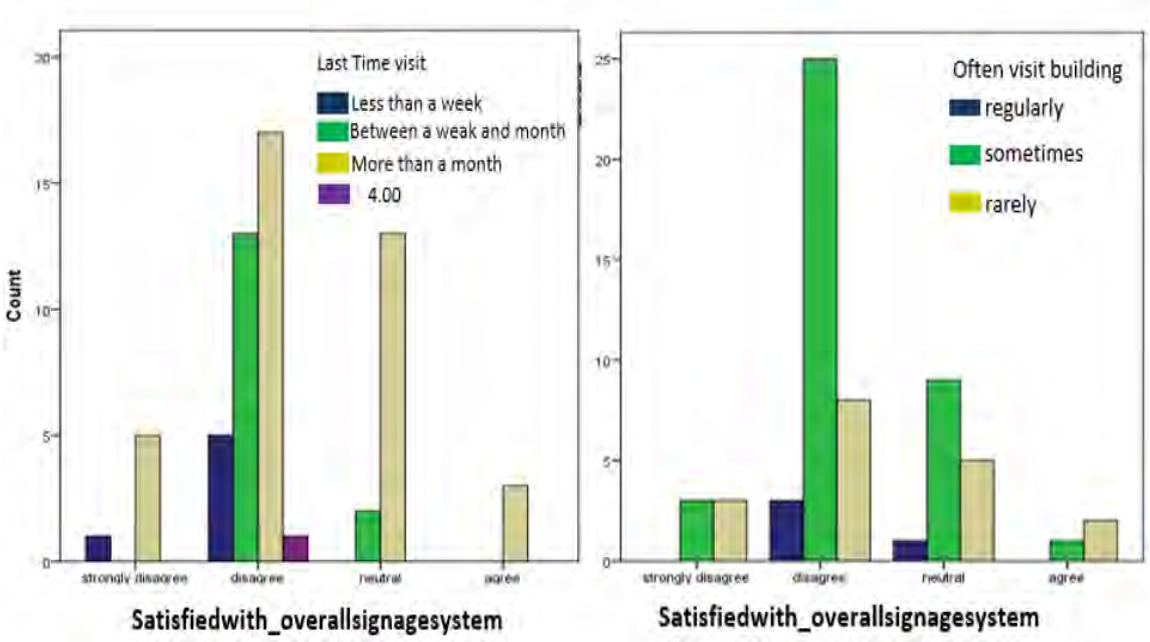


Table 4-2: Satisfaction with signage system based on familiarity

visits. 43%customers who visited the shopping complex more than a month ago are more dissatisfied with the signage system in comparison to the customers who visited between a week and month and less than a week (Table 4-2). This is possible that due to a long gap the customers become distant with its environment and became stressed to complete

their task. 72% of the customers who lastly visited this shopping complex less than a week are less satisfied with the overall signage system. This study also shows that 74% of customers who visit the shopping complex sometimes are less satisfied with the overall signage system.

4.2.2. Satisfaction with Signage System based on overall signage

In the correlational analysis, the orientation signage, “you are here" map shows strong and significant correlation (r =.429**) with customers’ satisfaction in wayfinding situation (Table 4-3). The analysis also shows the strong positive correlation between the size of the signage (r = .426**) and customers satisfaction in wayfinding situation. The directional signage “sign showing different blocks are useful to me” shows a good and significant positive correlation (r =.416**) with the customer’s satisfaction with the overall signage system. The question “the shop numbering system follows the floor number” regarding identification signage shows a moderate positive correlation (r = .368**) with the customers’ satisfaction with the overall signage system. The findings suggest that presence of “you are here” map; directional signage, identification signage in the shopping environment, and size of the signage are an important factor to improve customer wayfinding experience.

	Individual cognitive ability				Directional signage		Orientation signage	Identification signage		Size of signage
Pearson correlation	Difficult to understand the direction	Keep in mind the direction of enter	Confident about giving direction	Presence of someone is easy for me	Sign showing different blocks are useful to me	Sign pointing out different paths or direction are useful for	You are here map is useful for me	Floor numbering system is easy enough the direction	The shop numbering system follows the floor number	Size of the sign is appropriate and easy to read
Satisfied with the overall signage system	.202	-.178	.00	-.039	.416**	.178	.429**	.097	.368**	.426**

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-3: Correlation between customer satisfaction and signage system

4.2.3. Satisfaction with signage system based on syntactic properties of the layout

To measure accessibility and visual access of the space, the syntactic properties of the layout are considered in this analysis. The correlational analysis between "The floor numbering system is easy enough for me to get a destination" and visual connectivity of the layout shows a significant and positive correlation (r=.347**) (Table 4-4). The analysis shows a negative correlation between the size of the sign (r=. -256*) and intelligibility. Similarly, the analysis also shows a negative correlation with satisfaction with overall signage system and

intelligibility-3.

Pearson correlation	Sign showing different blocks of the building are useful to me	Signs pointing out different paths and/or directions are useful for me	The size of signs is appropriate and easy to read	You are here map showing my location within the building are useful for me	The floor numbering system is easy enough for me to get a destination	The shop numbering system follows the floor number and large enough for me to find my destination easily	Satisfied with signage system
Integration (I)	.120	-.083	-.190	.092	.270*	.164	.115
Integration-3 (I3)	.122	-.084	.187	.096	.259*	.164	.127
Connectivity (C)	.114	-.078	.144	.104	.324*	.175	.119
Visual integration (VI)	.126	-.079	.181	.098	281*	.163	.107
Visual connectivity (VC)	.109	-.048	.089	.071	.347**	.172	.101
Intelligibility (I_I3)	-.025	.059	.077	-.068	.246	.007	-.279*
Intelligibility-3 (I_C)	.92	-.068	-.256*	-.014	-092*	.024	.046

**. Correlation is significant at the 0.01 level (2-tailed

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-4: Correlation between Syntactic properties and signage system

4.2.4. Satisfaction with signage system based on wayfinding behavior

Pearson correlation	Sign showing different blocks of the building are useful to me	Signs pointing out different paths and/or directions are useful for	The size of signs is appropriate and easy to read	You are here map showing my location within the building are	The floor numbering system is easy enough for me to get a destination	The shop numbering system follows the floor number and large enough for me to find	Satisfied with signage system
Stopping behavior	..070	.202	-.186	-.071	-.122	-.048	-.258*
Searching behavior	-.233	.195	.073	.129	-.226	.013	.217
Help seeking behavior	-.058	-.221	-.210	.222	.099	.246	.015
Travel time	.046	.00	.001	.176	-.259*	.095	.044

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-5: Correlation between customers' wayfinding behaviors and signage system

The correlational analysis shows significant but negative moderate correlation (r=-.258*) between stopping behavior and satisfaction with signage system (Table 4-5). It Indicates that when customers stopping behavior increase it may negatively affect the overall satisfaction with the signage system.

4.3. Customer's satisfaction in relation with spatial layout

Customers satisfaction in relation to spatial layout depends on the customers' cognitive ability which is influenced according to their age, gender and familiarity (Hunt,1984; Oneil,1991; Dogu &Erkip, 2000; Lawton,1994; Khan, 2014). In wayfinding situations, the customer feels more comfortable when they make more frequent visits to the shopping complex (Weisman, 1981; O'Neill, 1991; Dogu &Erkip, 2000). On the other hand, a simple and regular spatial system can make the building easy to understand in wayfinding situations and can improve the experience of movement through the environment (Weisman 1981; Peposis et al., 1990; O'Neill, 1991). Thus the intention of this section is to analyze the data regarding spatial layout in relation to customers' satisfaction according to their age, gender familiarity, satisfaction with the overall spatial layout, syntactic

properties of the layout. the study also tried to understand how the spatial layout influences their wayfinding behavior in Bashundhara city shopping complex.

4.3.1 Customer's satisfaction with spatial layout based age, gender, and familiarity

Research shows that customers demographic characteristics have an influence on the customer's experience. In this section, the study tried to understand the customers' satisfaction with the spatial layout in relation to age, gender, and familiarity.

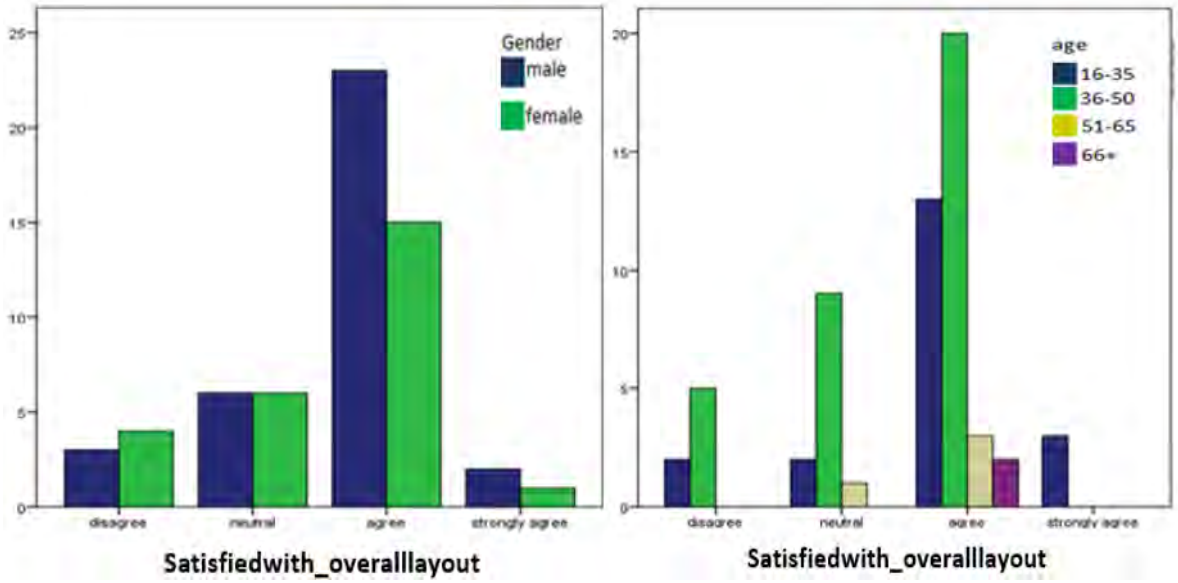


Table 4-6: Analysis in relation to age and gender

- **Satisfaction with a spatial layout based on Gender**

The analysis of satisfaction with the spatial layout and customers' demographic character shows that males customers are more satisfied with the overall spatial layout than female customers. 8.8% of total male customers' and 11.76% of total female customers' are less satisfied with the overall layout system (Table 4-6). whereas 67.64% of male and 57.7% of female customers are satisfied with the overall layout.

- **Satisfaction with a Spatial layout based on Age**

The customers who are aged 36-50, 20% of them are less satisfied and 40% of them were neutral with the overall layout (Table 4-6). Customers' over 66+ years show more satisfaction than another aged group with overall layout system.

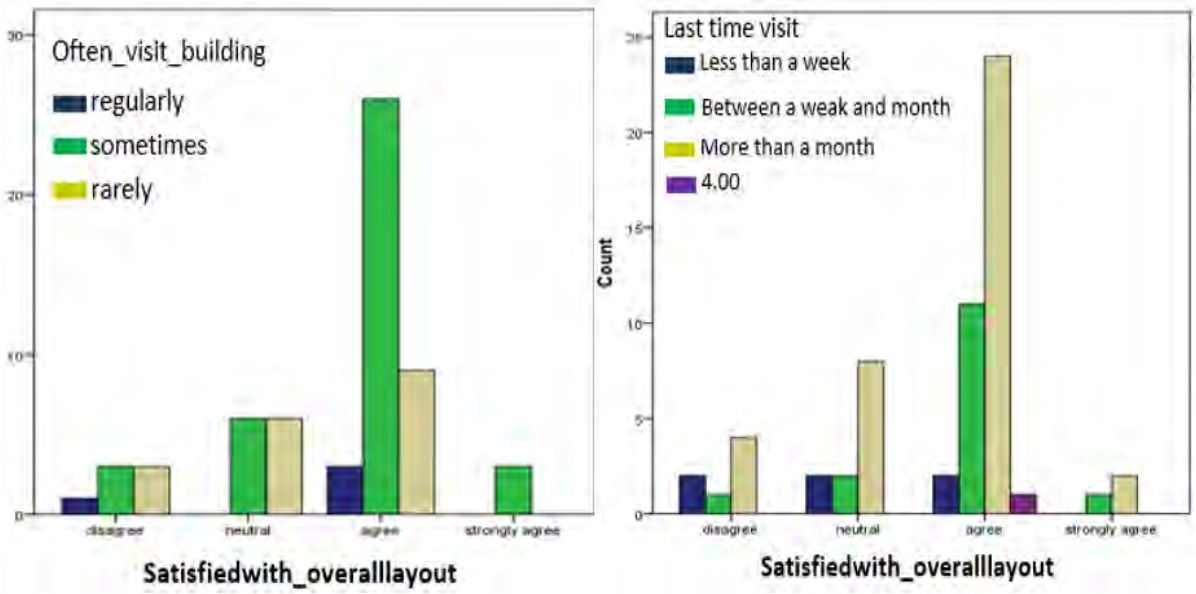


Table 4-7: Analysis in relation with familiarity

- **Satisfaction with a spatial layout based on familiarity**

The analysis shows that the customers who visit the building frequently are more satisfied than others. 50% of the customer were neutral and 22% of them disagreed with the satisfaction with overall layout who visit the shopping complex rarely (Table 4-7).

4.3.2. Satisfaction in relation to the overall spatial layout

Pearson correlation	Information desk easy to find	Entry door is well designed	Elevators and staircases are easy to find	All parts of the building can be identified	Easy to locate atrium from all parts of building	Corridors are free of obstruction	Corridors are wide enough	Symmetrical planning help to find the destination	Get lost For symmetrical layout	Spent more time on walking
Satisfied with overall layout	.154	.360**	.213	.313**	.283*	-.056	.202	.186	-.415**	-.420**

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-8: Correlation between customers' satisfaction and spatial layout

The correlational analysis shows significant strong negative correlation (r = -.420**) between "spent more time on walking" and customers' satisfaction (Table 4-8). The analysis also shows significant strong negative correlation (r =-.415**) between "get lost

for symmetrical layout" and customers satisfaction. This indicates that customers' satisfaction decreases if the customer spends more time for shopping and get lost in the shopping environment due to the symmetrical layout.

The analysis shows that there is a significant but moderate correlation (r = .360**) between "entry door well designed" with customer satisfaction with the overall layout. It indicates that in wayfinding situation customers' satisfaction increase when they find a well-designed entry in a complex shopping complex. In addition, customers' satisfaction with "All parts of the building can be identified" shows a significant but moderate correlation (r =.313**) and "easy to locate atrium from all parts of the building" have significant but weak correlation (r =.283*) with customers' satisfaction level. It indicates that customer's satisfaction increase when all parts of the building and location of the atrium can be easily identified.

4.3.3. Satisfaction with the spatial layout in relation with syntactic properties of the layout

Pearson correlation	Entry door is well designed	Information desk easy to find	Elevator staircase easy to find	All parts of the building can be identified	Easy to locate main atrium	Corridors are free from obstruction	Corridors are wide enough	Notice if there any Symmetrical layout	Symmetrical layout helps me to find	Get lost for symmetrical layout	Satisfied with overall layout design
Integration (I)	.049	-.124	-.132	.178	-.212	.237	.125	.125	.192	.252	-.091
Integration-3 (I3)	.044	-.129	-.144	.175	-.218	-.231	-.129	-.122	-.193	-.172	-.193
Connectivity (C)	.053	-.095	-.138	.161	-.170	.194	-.166	-.097	-.172	.242	-.083
Visual integration (VI)	.052	-.119	-.124	.178	-.201	-.231	-.126	-.132	-.192	.251	-.089
Visual connectivity (VC)	.087	-.040	-.111	.140	-.113	-.119	-.185	.027	-.125	.194	-.054
Intelligibility (I_I3)	.132	.122	.284	.081	.095	-.168	.116	-.099	-023	.095	.082
Intelligibility-3 (I_C)s	.017	-.187	-.043	.158	-.265*	-.291*	.117	-179	-.185	.156	-.085

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-9: Correlation between syntactic properties and spatial layout

The analysis did not show any significant correlation between syntactic properties of the layout and customer's satisfaction in relation to the overall spatial layout. The study shows significant weak negative correlation with "corridors are free of obstruction" (-.291*) and "easy to locate atrium" (r= -.265*) with intelligibility (Table 4-9). This indicates that if the corridors are not free from obstruction and the atrium is not easily identifiable, it is hard for a customer to understand the whole spatial configuration of the layout.

4.3.4. Satisfaction with a spatial layout based on wayfinding behavior

The correlational analysis shows significant but negative moderate correlation(r=-348**) between "notice if there is any symmetrical layout" and searching behavior. Similarly, the analysis shows significant but negative moderate correlation(r=-.331**) between "easy to locate atrium" and help-seeking behavior (Table 4-10). The analysis also shows significant but negative weak correlation (r=-.288*) between "entry door well designed and searching behavior. The findings suggest that that searching behavior increases if customers find the layout symmetrical. Likewise, any trouble in locating atrium have a negative effect on their help-seeking behavior and if the entry door is not well designed it also increases their searching behavior.

Pearson correlation	Information desk easy to find	Entry door is well designed	Elevator staircase easy to find	All parts of the building can be identified	Easy to locate main atrium	Corridors are free from obstruction	Corridors are wide enough	Notice if there any Symmetrical layout	Symmetrical layout helps me to find destination	Get lost for symmetrical layout	Satisfied with overall layout design
Satisfied with Travel time	-.152	.283*	.387**	.149	.216	.411**	.202	.301*	.186	-.159	.403**
Stopping behavior	-.014	-.174	-.126	.012	-.121	-.197	.095	.080	.083	-.096	-.157
Searching behavior	–.064	-.288*	-.202	-.021	-.181	-.226	,128	-.348**	-.207	.111	-.207
Help seeking behavior	-.046	.257*	-.036	-.225	-.331**	.008	.045	-.072	-.222	.121	-.054

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-10: Correlation between spatial layout and wayfinding behavior

4.4. Customer's satisfaction and legibility

Customers satisfaction in relation to the legibility of the environment also depend on how they perceive the environment and can create a cognitive map depending on their age, gender and familiarity (Weisman,1981; Oneil,1991; Dogu & Erkip, 2000; Lawton,1994). A legible environment help customer to build a cognitive map and find their way within their desired time which make customer satisfied and improve customers experience (Lynch,1960; Weisman,1981, Oneil 1989; Gardestat, 1989). Thus the intention of this section is to analyze the data regarding customers' satisfaction in relation to the legibility of the environment based on age, gender familiarity, overall spatial layout, syntactic properties of the layout and wayfinding behavior in Bashundhara city shopping complex.

4.4.1 Customer's satisfaction with environmental legibility in relation with age, gender, and familiarity

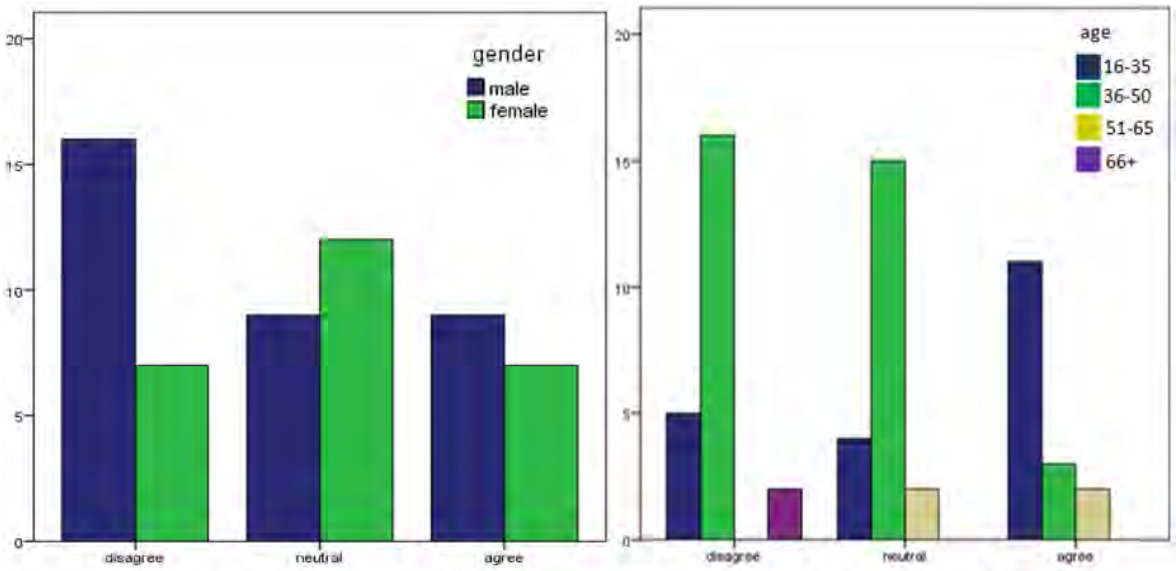


Table 4-11: Analysis satisfaction in relation with age and gender

- **Satisfaction with environmental legibility based on Gender**

The analysis between customers' demographic character and satisfaction with overall environmental legibility shows that 47% of male customers are not satisfied with the overall environmental legibility whereas 20% of female customers disagree with satisfaction with the overall environmental legibility (Table 4-11). 26.47% male and 20% female customer were satisfied with overall environmental legibility.

- **Satisfaction with environmental legibility based on Age**

The age group 36-50, 47% of them are more dissatisfied with overall environmental legibility than other groups (Table 4-11). The customers who are aged more than 66+,100% of them shows dissatisfaction with overall environmental legibility. Whereas customers who are aged between16-35, 50% of them shows satisfaction with overall environmental legibility (Table 4-11).

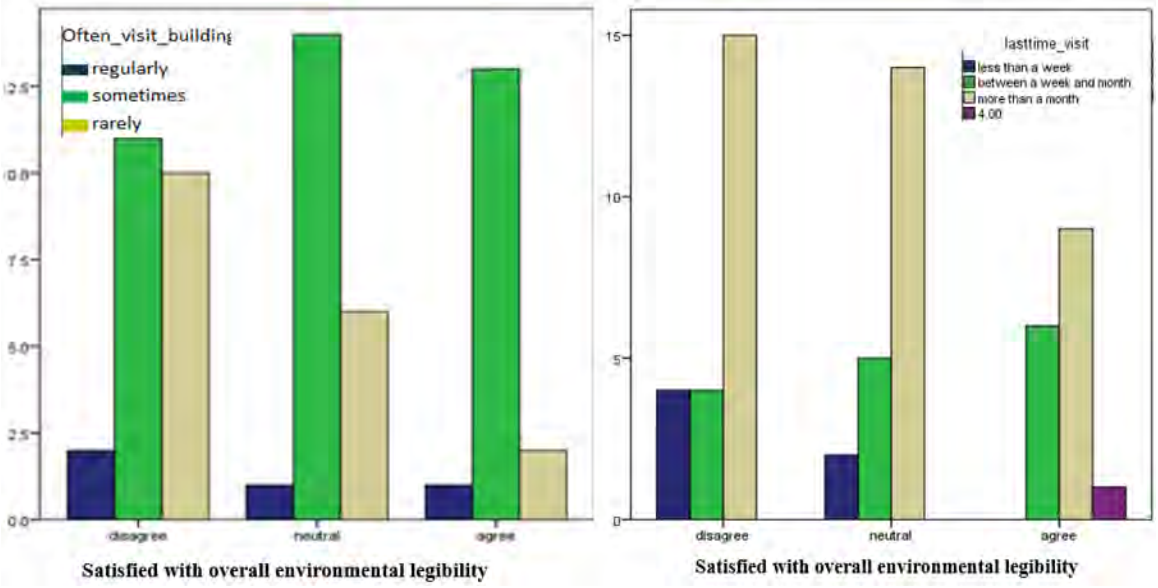


Table 4-12: Analysis satisfaction in relation with Familiarity

- **Satisfaction with environmental legibility based on familiarity**

Customers who visit the complex rarely, 54% of them are more dissatisfied with overall environmental legibility. Similarly, the customer who visits the complex regularly 42% of them is less satisfied with environmental legibility.

4.4.2. Satisfaction in relation with environmental legibility

The correlational analysis between "spent more time walking" and satisfaction with the amount of time taken to reach the destination shows strong significant negative (r =-.628**) correlation. Similarly, the analysis shows significant negative correlation (r =-523**) between "spent more time on walking" and satisfaction with the legibility of the environment. This analysis indicates that increase more time on walking may decrease the customers' satisfaction in relation to the amount of time to reach the destination.

The analysis between "landmark helps me to find the destination" with satisfaction with environmental legibility shows a strong positive (r =.511**) correlation. This indicates

that if landmark help customer to find the destination it helps the customer to reach his destination with shorter time and increase customers satisfaction in relation with the legibility of the environment.

Besides “secondary atrium was helpful” shows positive strong (r=.495**) correlation with satisfaction with overall environmental legibility. This suggests that when customer find secondary atriums are useful to find their destination; customers’ satisfaction with the overall legibility of the environment increase.

Correlation between, “very often get lost” and customers satisfaction shows significant negative (r=-.461**) correlation with overall environmental legibility and positive moderate (r=.304*) correlation with the satisfaction with the amount of time to find the destination. These indicate that if customer very often gets lost within the environment it also increases the time he spent to find the destination shop and decrease the satisfaction with the overall legibility of the environment.

The analysis between “main circular atrium was helpful” and satisfaction with overall environmental legibility shows moderate positive correlation (r =.329*). Similarly, the analysis between “main circular atrium was helpful” and “satisfaction with the amount of time to find the destination” shows moderate positive (r = .371**) correlation. It indicates that when the main circular atrium is helpful for wayfinding it increases the customer satisfaction in relation to the amount of time to find the destination and customers satisfaction with the overall legibility of the environment. In contrast “feel disoriented for secondary atrium” shows negative moderate correlation (r=-303*) with overall environmental legibility.

Pearson correlation	Spent more time on walking	Satisfied with the amount of time	Landmark helps me to find destination	Main circulation atrium was helpful	Secondary atriums were helpful	Feel disoriented for secondary atrium	Very often I get lost	Could able to draw a quick diagram	Satisfied with overall environmental legibility
Satisfied with overall environmental legibility	-.532**	.504**	.511**	.329*	.495**	-.303*	-.461**	.301*	1
Satisfied with the amount of time to find destination	-.628**	1	.269*	.371**	.197	-.113	-304*	.187	.504**

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-13: Correlation between customers' satisfaction with legibility

4.4.3. Satisfaction with environmental legibility based on syntactic properties of the layout

The correlational analysis shows "could able to draw a quick diagram" has a significant strong negative correlation with connectivity C (r=.-.501**), local integration I3(r=-.476**) and global integration I (r=-.475**). This suggests that when a customer moves through a more integrated and connected route it decrease the ability to draw a quick diagram. Similarly, the analysis shows "could able to draw a quick diagram" also negatively connected with visual integration VI (r=-.480**) and visual connectivity VC (r=-.480**). This indicates that when visual integration and visual connectivity increase the ability to draw a quick diagram decrease. The analysis also shows moderately significant positive (r=.231*) correlation between "secondary atriums were helpful" and the intelligibility value of the layout. It suggests that the secondary atrium is helpful if the customer can see the whole spatial system of the layout from the secondary atrium.

Pearson correlation	Spent more time on walking	Satisfied with the amount of time	Landmark helps me to find destination	Main circulation atrium was helpful	Secondary atriums were helpful	Feel disoriented for secondary atrium	Very often I get lost	Could able to draw a quick diagram	Satisfied with overall wayfinding system
Integration (I)	.174	-.069	-.207	-.059	-.101	.150	.011	-.478**	-.143
Integration (I3)	.170	-.072	-.211	-.065	-.113	.153	.014	-.476**	-.149
Connectivity (C)	.198	.083	-.194	-.047	-.119	.169	.026	-.501**	-.132
Visual integration (VI)	.180	.068	-.199	-.056	-.100	.151	.011	-.480**	-.135
Visual connectivity (VC)	.224	.107	-.157	-.051	-.107	.176	.049	-.480**	-.079
Intelligibility (I_I3)	.95	.062	.076	.064	.261*	-.101	-.055	-.105	.143
Intelligibility-3 (I_C)	.013	.001	-.168	-.076	.034	.00	-.037	-.147	-.114

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-14: Correlation between syntactic properties and legibility

4.4.4. Satisfaction with environmental legibility based on wayfinding behavior

The analysis shows searching behavior has a significant negative moderate correlation with “could able to draw a quick diagram” (r=-.323*), “landmark help me to find the destination” (r=-.298*), and “main circulation atrium was helpful” (r=-.256*). These indicate that customers’ ability to draw a quick diagram of the whole layout of the shopping complex, decreases the customers searching behavior. The analysis also shows that if a customer finds that the landmark and main circulation atrium is helpful to find his or her destination, it will decrease customer’s searching behavior. The analysis also suggests stopping behavior has significant negative moderate (r=-.279*) correlation with “landmark help me to find the destination”. It suggests that if the landmark help customer to find the destination, the stopping behavior decrease. However, help-seeking behavior doesn’t show any correlation with environmental legibility.

Pearson correlation	Spent more time on walking	Satisfied with the amount of time	Landmark helps me to find destination	Main circulation atrium was helpful	Secondary atriums were helpful	Feel disoriented for secondary atrium	Very often I get lost	Could able to draw a quick diagram	Satisfied with overall wayfinding system
Stopping behavior	.196	-.110	-.279*	-.236	-.108	.039	-.049	-.019	-.073
Searching behavior	.097	.007	-.298*	-.256*	-.040	-.178	.032	-.323*	-.208
Help seeking behavior	.080	.050	-056	-.021	.123	.229	.247	-.115	-.200

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4-15: Correlation between customers' behavior and legibility

4.5. Conclusion

The above chapter analyzes all data regarding customers' Satisfaction according to their demographic characteristics, wayfinding behavior, syntactic properties of the layout in relation to signage system, spatial layout, wayfinding behavior, and environmental legibility. The study shows several significant correlations between customers' satisfaction and other spatial and behavioral attributes. The analysis also shows significant and strong correlation between customers wayfinding behavior and syntactic properties of the layout. The following chapter discusses the outcome of these analyses.

CHAPTER 05
DISCUSSION

5.1. Introduction

Understanding of customers' satisfaction is essential for designing a shopping complex. There are several studies on retail development stated that the physical design features of the complex shopping environment have impact on customers' wayfinding performance (Dogu & Erkip, 2000; Yoo, 1991; Temel, Marina & Inalhan., 2010). Studies have also shown that difficulties in wayfinding can lead to a loss of time and a decrease in safety, and an increase in environmental stress (Zimring, 1981; and Nelson-Shulman, 1983-1984) which may lead to lower the customers' satisfaction level. In most cases, differences in personal characteristics, signage system, spatial layout and legibility of the environment reflect in spatial behavior and movement within a shopping complex setting that generate stress and weaken the performance of wayfinding. Therefore, the intention of this chapter is to discuss the possible determinants of customers' wayfinding experience in relation to the findings of this study.

5.2. Customers' experience in relation to signage system

It is widely accepted in the literature that a proper signage system, can help users find destinations and can maximize their performance in wayfinding situations (Peponis et al. ,1990; Passini, 1992; Weisman,1981; Carpman et al., 1993). The findings suggest that three types of signage systems–the identification, directional, and orientation signage systems are very important for customers' wayfinding experience in the Bashundhara city shopping complex. During wayfinding situation, the directional signage helps customer by providing necessary information that customers need to move on. In case of Bashundhara city shopping complex, the layout is divide into four block. This research finding suggest that customers' satisfaction will increase if different blocks are directed by the signage. Therefore, the improvement or fixing of directional signage can increase customer satisfaction as well as their experience during wayfinding situation. In case of orientation signage, "you are here map" significantly influence the ability of the people to successfully complete wayfinding task (Levine ,1982). This research also shows that

orientation sign “you are here map” may influence customer’ wayfinding experience. As there is no “you are here map” in Bashundhara city shopping complex, therefore, installation of the “you are here map may increase customers’ satisfaction. In a shopping complex, the identification signage act as a locational determinant for the customers whether they are in the proper location or not. Proper placement of identification signage helps a customer to find out destination in complex shopping environment. In this research, the findings show that identification signs of shop numbering system influence customers’ wayfinding experience (Table:4-3). The numbering system of shops according to the floor number can improve customers wayfinding experience.

In this study the syntactic properties of the layout are considered to measure the accessibility and visual accessibility of the layout. The findings show that, if visual connectivity of the layout increase, the floor numbering system can be noticed easily to the customer. It is possible that it helps them to find their destination in time. According to previous study, the legibility of the signage also influences customers’ satisfaction (Dogu, 2000). In wayfinding situations, people face difficulties with illegible signage systems which are too small to be seen and recognized from the reading distance (Passini, 1992). The findings also indicate that, if the size of the signage is not appropriate and easy to read for the customer, the intelligibility value decrease (Table 4-4). Therefore, improvement of size of the signage may help to increase the intelligibility value of the spatial layout in the shopping complex as well as customer satisfaction

In addition, the analysis shows that stopping behavior increase because of not finding the signage system at their desired location and appropriate floor numbering system makes it easy for the customer to get their destination in desired time.

5.3. Customers’ experience in relation to spatial layout

Several number of previous studies suggests that the layout complexity primarily influence the wayfinding performance (Dogu & Erkip, 2000; Weisman, 1981; O’Neill, 1991; Peponis et al., 1990). A simple and regular spatial system can make the building easy to understand in wayfinding situations and can improve the experience of movement through the environment (O'Neill 1991; Weisman 1981). In case of customers wayfinding experience and spatial layout of Bashundhara city shopping complex, the finding shows that customers satisfaction with overall layout increases when entry door is well designed and when all part of the building can be easily identified (Table:4-8). Similarly, when it

is easy to locate atrium and easy to find stair and elevator for the customer it also increases the satisfaction level with overall spatial layout. However, if customer get lost for symmetrical layout and spent more time on walking it decreases their satisfaction with overall spatial layout. These findings suggest that by avoiding symmetrical layout and by optimizing the spatial layout of the shopping complex may reduce amount of walking time to find the destination shop and can improve customer's wayfinding experience.

According to previous research visual accessibility appears to be crucial in influencing the way in which people experience the spaces (Turner, Doxa, O'sullivan, & Penn; 2001) and in facilitating one's spatial orientation and wayfinding (Gärling, Böök, & Lindberg; 1986). Higher visual accesses in the spatial layout give a greater sense of spatial orientation in wayfinding situations (Montello; 2007). The findings show that any obstacle in corridor and if customer face difficulties to locate the atrium, it negatively affects customer ability to understand the spatial configuration of the layout (Table:4-9). It is possible that if customer find their route without any obstacle in corridor and locate the atrium easily they can build a cognitive map that helps them to find their destination in time.

The findings of customers wayfinding behavior and spatial layout suggest that when an entry door is not well designed and if there is any symmetrical layout which is not noticed by the customer it increase their searching behavior (Table:4-9). Likewise trouble in locating atrium increase customer help seeking behavior. It is possible that in symmetrical layout and where atrium cannot be identified the customer become lost, confused or consume more time on finding the destination have negative effect on their wayfinding experience.

5.4. Customers' experience in relation to environmental legibility

Environmental legibility can be defined as the degree to which the designed features of the environment help people in creating an effective mental image, or "cognitive map" of the spatial configuration of the layout and improve wayfinding within the environment (Lynch, 1960; Passin, 1977; Weisman, 1981; Oneil, 1989; Gardestat, 1989). It is difficult to construct a cognitive map or form a mental image of that overall layout if different parts of the building look same. This research shows (Table:4-10) that if customer take more time to find the destination it makes them less satisfied with overall legibility of the environment. On the other hand, atriums and landmark help customer to orient them

within the shopping environment and make the customer satisfied by decreasing their travel time to identify their destination quickly

Customers experience in relation with syntactic properties and legibility of the layout shows that when customer move through a more integrated and connected route the ability of the customers to draw a quick diagram decrease. It is possible that during wayfinding situation customer use the well-integrated and connected route. Research suggest that more people move through a well-integrated route, and due the presence of more circulation system customer cannot build the mental map of environment (Khan,2014) and it decreases their ability to draw a quick diagram of the environment. Identical corridor in symmetrical layout along with the similar lighting and floor finish can make the customer feel disoriented and confused (Wright, Lickorish, and Hull, 1993; Dogu 1997). Therefore, when they asked about the ability to draw a quick diagram they disagree that they could not draw the exact route. On the other hand, the finding suggests that when the secondary atrium is helpful to customer, it increase the intelligibility of the layout (Table:4-11). It is possible that when customers are in wayfinding situation the secondary atrium help them to construct cognitive map and customer easily orient themselves within the shopping environment. It also helps to reduce their travel time. Therefore, a well-designed secondary atrium can improve customers wayfinding experience.

The findings of environmental legibility and wayfinding behavior suggest that if landmark, main circulation atrium help customer to find the destination it reduces their stopping and searching behavior (Table:4-12). Moreover, the findings also suggest that if the environments become more readable and legible it will reduce their searching behavior. Thus it is possible that a well located landmark, atrium can make an environment readable as well as legible which can reduce the stopping and searching behavior. Through these the customers travel time can be reduced and improve customers wayfinding experience.

5.5. Conclusion

From the above discussion it is clear that signage system, spatial layout and legibility of the environment have effect on customers' experience in wayfinding situations. In wayfinding situation, when the physical environments of shopping complex provide adequate information about the spatial configuration of the layout, it helps to increase customers' wayfinding experience. Research findings show that during wayfinding when

customers face difficulties in finding their way because of the inadequacy of orientation, directional signage and the improper size of signage system, they produce more searching behavior, and that affects their satisfaction with signage negatively. On the other hand, due to layout complexity, customer face difficulty in finding their destination, spend more time in walking, and produce searching behavior, which decrease their satisfaction with the shopping complex. The findings also suggest that when a customers satisfied with their travel time to find the destination then the customer become satisfied with the signage system, the overall layout, and the legibility of the environment in the Bashundhara city shopping complex. In contrast, the findings also suggest that the negative feelings due to presence of more people in the layout may lead dissatisfaction in wayfinding situation.

CHAPTER 06
CONCLUSION

6.0. Introduction

Customers' satisfaction with legibility of the environment is an important factor for overall customers' wayfinding experience. In wayfinding situation, the shopping environment is considered as efficient when everyday customer and visitors involve in various activities, can find or locate their destination without having any difficulties. In Bashundhara city shopping complex symmetrical layout with long corridors and similar treatment in interior space make it difficult for customer to orient inside. Moreover, the lack of providing necessary wayfinding information at appropriate location make the customer confused during finding their way to the destination shop. According to Khan (2014), any experience that creates pleasure could increase satisfaction. Accordingly, if the environmental variables help to find the way in desired time, then the customers become satisfied with the wayfinding system of the environment and it also increase wayfinding experience. Therefore, the present study tried to understand customer wayfinding experience in relation with signage system, spatial layout, and the legibility of the environment to improve functional efficiency of the shopping complex.

From the perspective of wayfinding, functional efficiency depends on how well a space with functional purpose fits into the environment of shopping complex. During the visit in a shopping complex, when customer find all functional space corresponding with what they expect to find in efficient and effective way, their experience is improved. For designing a functionally efficient shopping complex, it is important to satisfy the customers need by developing a good wayfinding system so that they can reach a specific destination under constraints such as time, distances, and customers' physical strength. The present research findings suggest that a well design signage system, appropriate location of atrium and circulation system, visibility and legibility of the layout are important for efficient customer movement within shopping environment and ensure customers better wayfinding experience.

The signage system of the shopping complex has effect on customers' wayfinding experience. During wayfinding situation, customer face difficulties in finding their way

because of inadequacy of orientation and directional signage and improper size of the signage system which make their travel time lengthier and affect their satisfaction negatively. When a shopping environment provides legible and readable signage system, customer become satisfied with the amount of time to reach the destination. Installation, fixing, and improvement of directional and orientation signage system with appropriate size and location can decrease customers travel time and increase customers' satisfaction.

In case of spatial layout, a well-designed entry door and easily located atrium decrease customers travel time. Corridor with obstruction and symmetrical layout increase searching and help seeking behavior, which make customers travel time longer and decease customers satisfaction. When customer become satisfied with the time they spend less time to find their destination, they also become satisfied with overall layout. Thus efficient spatial layout design also confirms customer's efficient movement as well as increase functional efficiency. Landmark, atrium, secondary atrium which help to differentiate environment help customer to build cognitive map. As a result, they can find their destination on desired time. When the customer become satisfied with their travel time the environmental legibility increase. On contrary symmetrical and similar atrium layout can create confusion that increase the travel time as well as decrease the functional efficiency of the layout.

According to previous researches the visibility also affects the legibility and functional efficiency of any environment. Though this study did not find any direct relation of visibility and customers satisfaction but found that in more integrated route which are more physically and visually accessible, the customers stopping, searching behavior increase which affect their wayfinding experience and satisfaction. Therefore, these behaviors increase their travel time and stress to find the destination shop, which also affect the functional efficiency of the shopping complex. According to Gärling, Lindberg, & Mäntylä, (1983), visual access facilitates the processing of information in wayfinding situation and in crowding situations, people lose their control over processing information from the environment due to less visual access (Khan, 2014). Therefore, presence of more people in more integrated corridor affect the legibility of the environment and also the functional efficiency of the shopping complex as well.

From the above discussion it is evident that the functional efficiency of a shopping complex mainly depends on how well the shopping environment support customer

wayfinding performance If a shopping environment is legible, customer need less time and distance to reach their destination and it improve customers' wayfinding experience. Through designing a legible wayfinding system, a customer's satisfaction and expectation of return visit as well as economic efficiency of that shopping complex can be attained. Hence, to design a legible and functionally efficient shopping environment it is important to design the shopping environment from the wayfinding point of view and this issue should be considered in the early stage of design.

6.1. Recommendation for architects and designers

According to this study, a proper signage system can make an environment legible and functionally efficient through increasing customers' satisfaction and reducing travel time. Effective spatial layout and legibility of the environment help customer to build cognitive image which ensures customers' efficient movement and satisfaction during wayfinding. Based on the research findings of this study, the following approaches can be taken as future wayfinding solution to improve functional efficiency of the shopping complex:

- Installation of orientation signage "you are here map" at the entry level with sufficient information about the shop located at different level.
- Appropriate location of directional signage with proper sizes to ensure customers efficient movement.
- Identification signage "Shop numbering system" should follow the floor number for designing multilevel shopping complex.

- Main entrance should locate and design such a way that it helps customer to easily identify all parts of the building and ensure customers' efficient movement.
- Symmetrical layout with repetitive corridor pattern should be avoided in the design of the shopping complex.
- Different color, material and lighting, and floor finish can be used to make difference within symmetrical plan layout.
- Central atrium should be included in the floor plan to orient customer within the shopping environment.
- Apart from main atrium, multiple secondary atriums at appropriate position should be included in the floor plan to differentiate the environment and reduce customers travel time and increase satisfaction.

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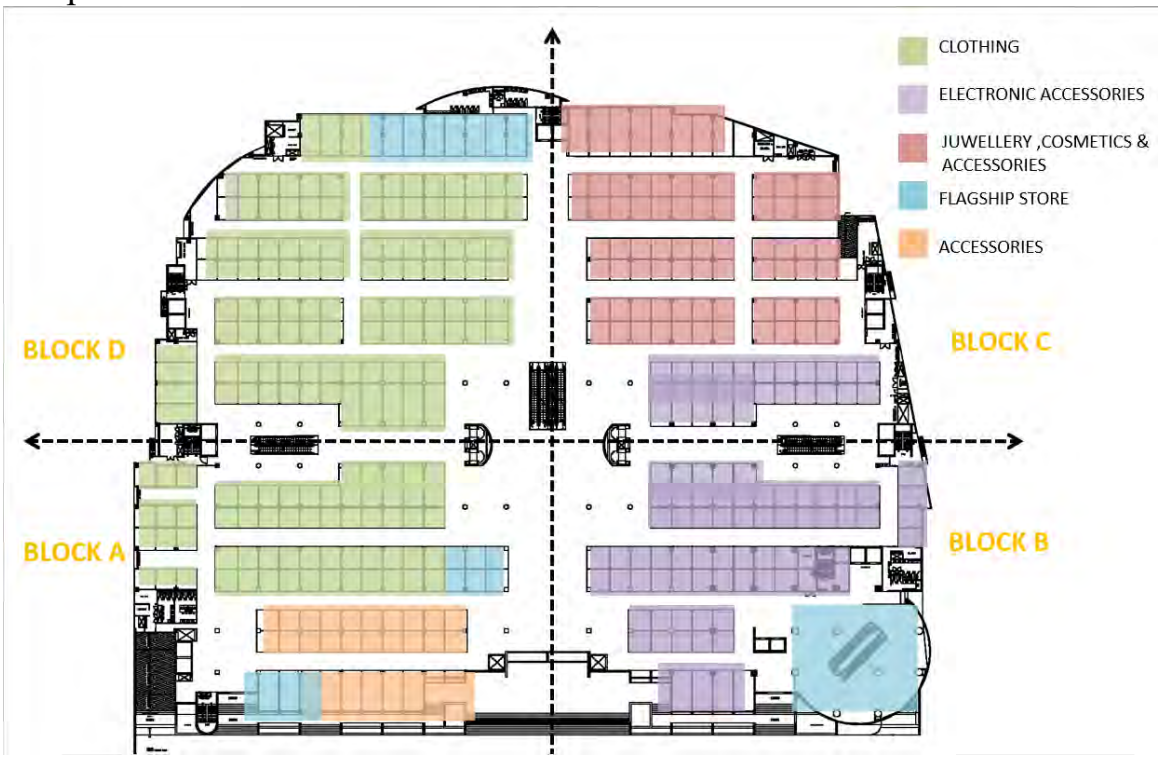
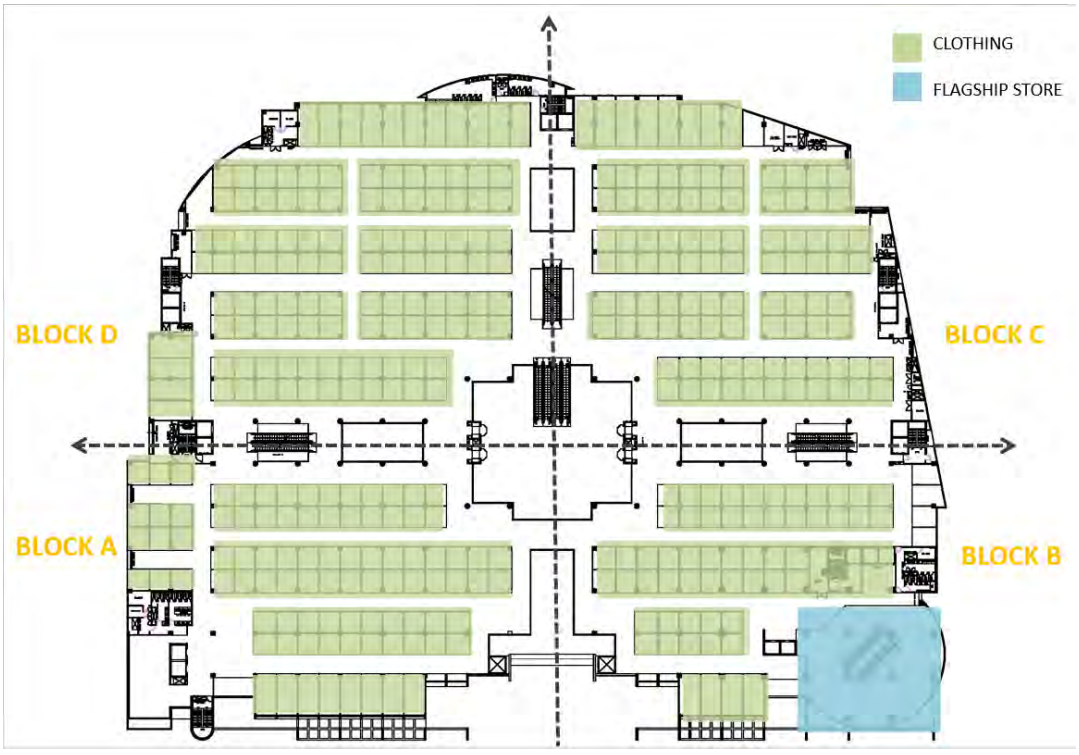
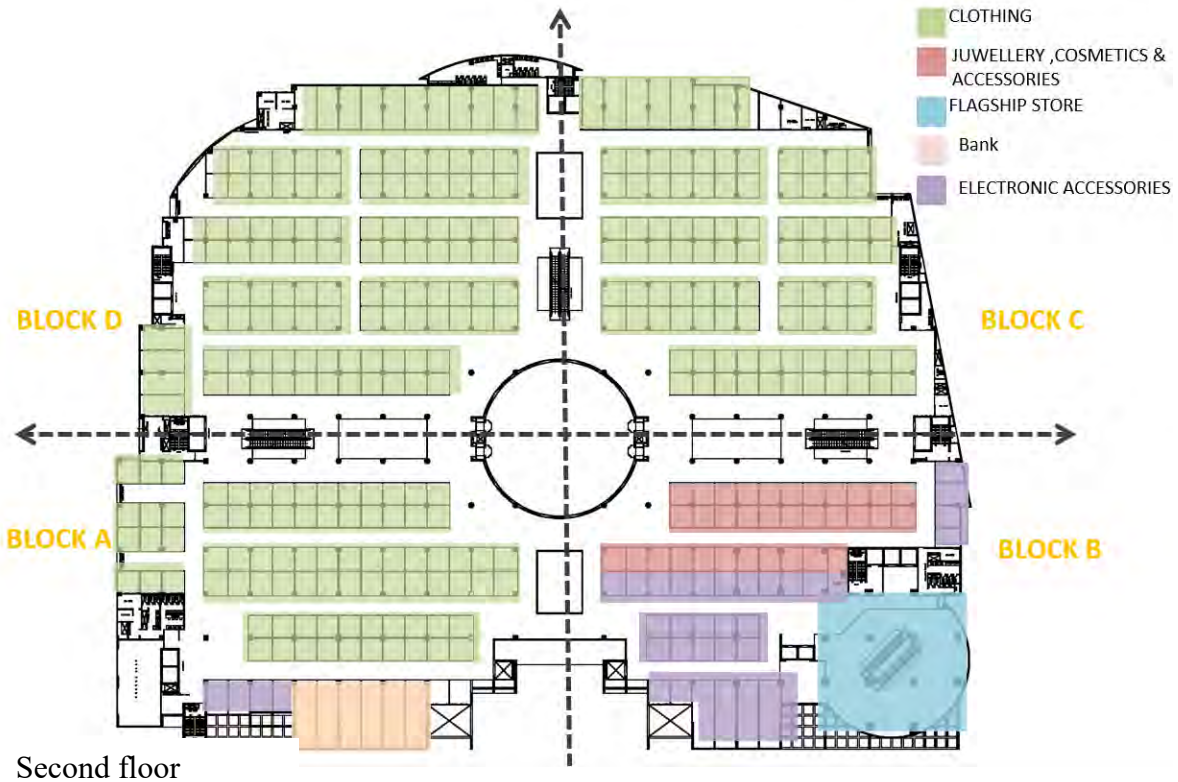
APPENDIX:01 Land use plans of floors Bashundhara city shopping complex



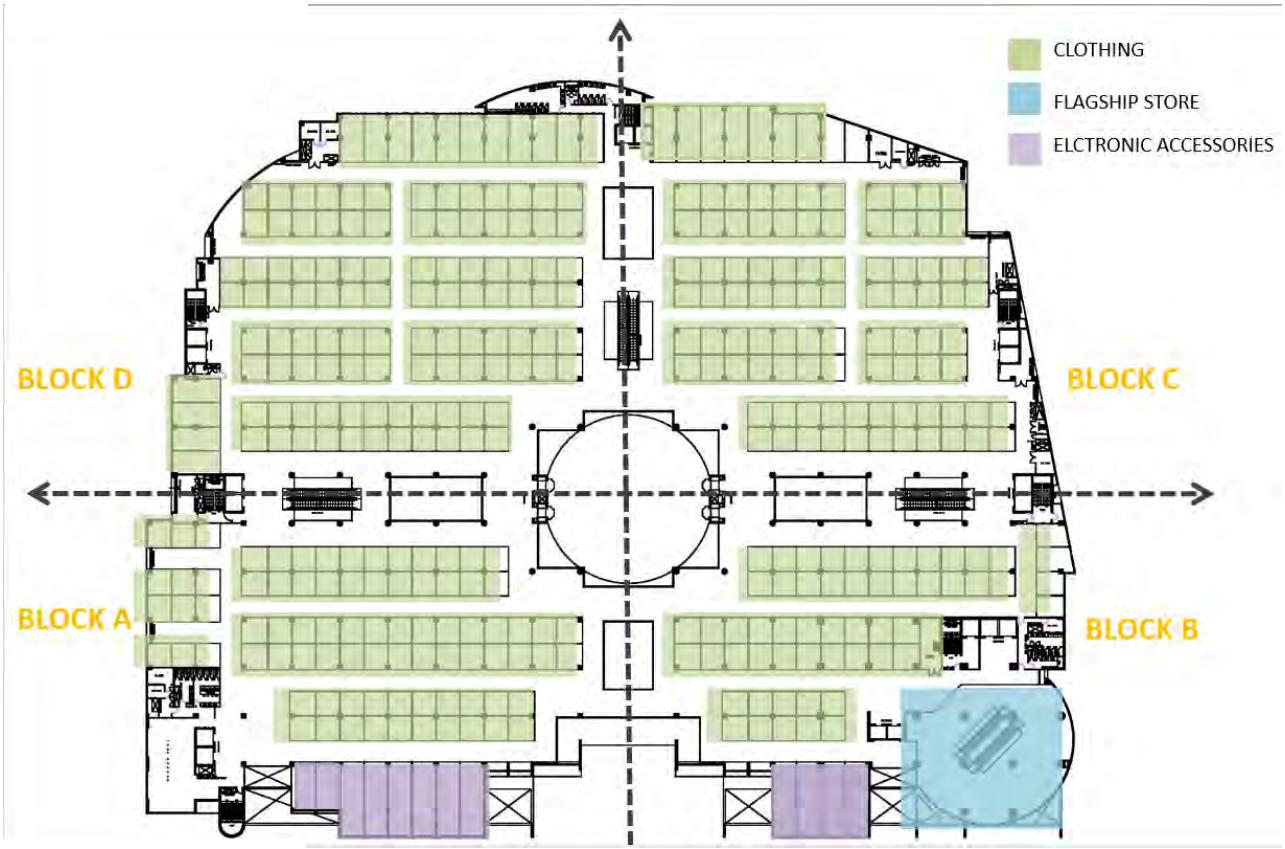
Ground floor



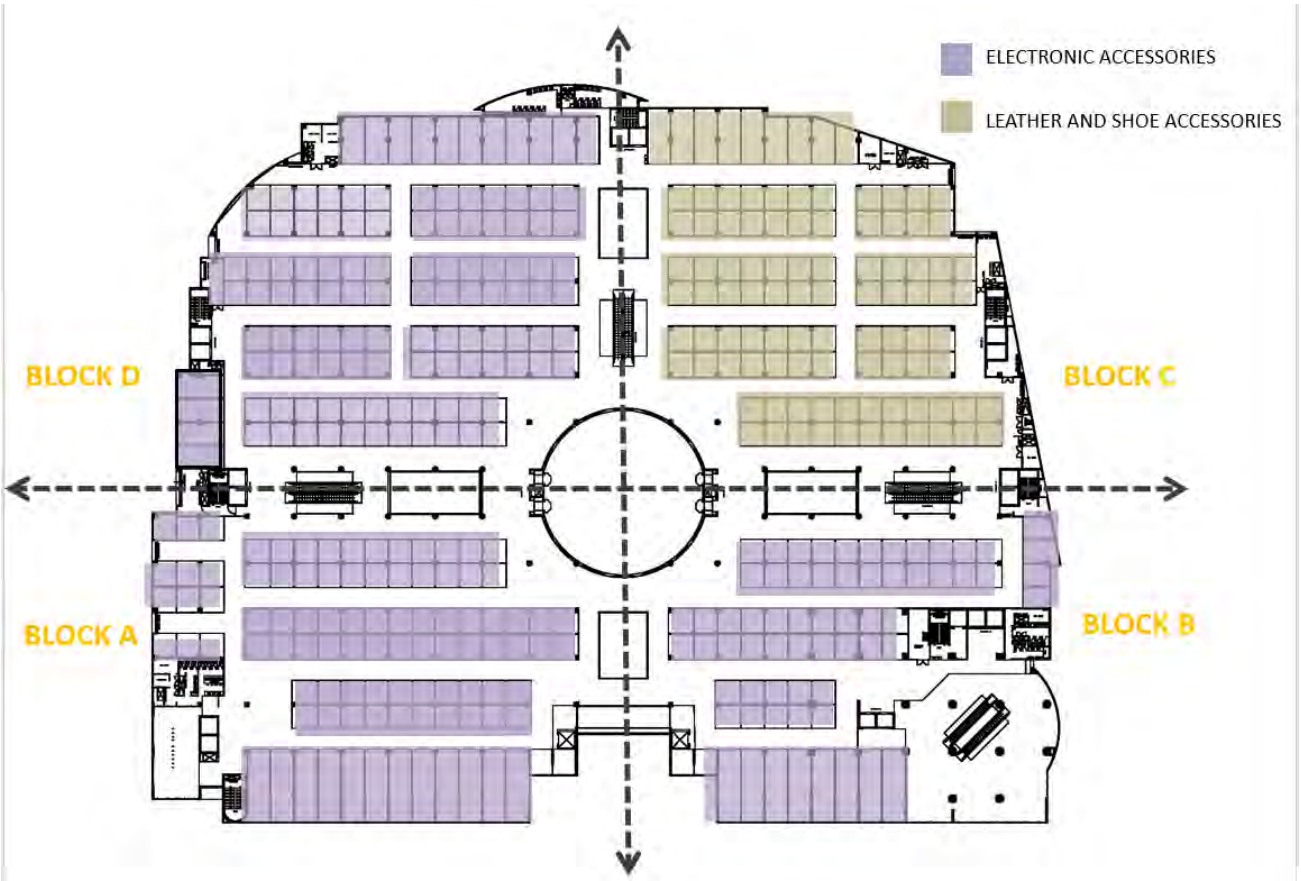
First floor



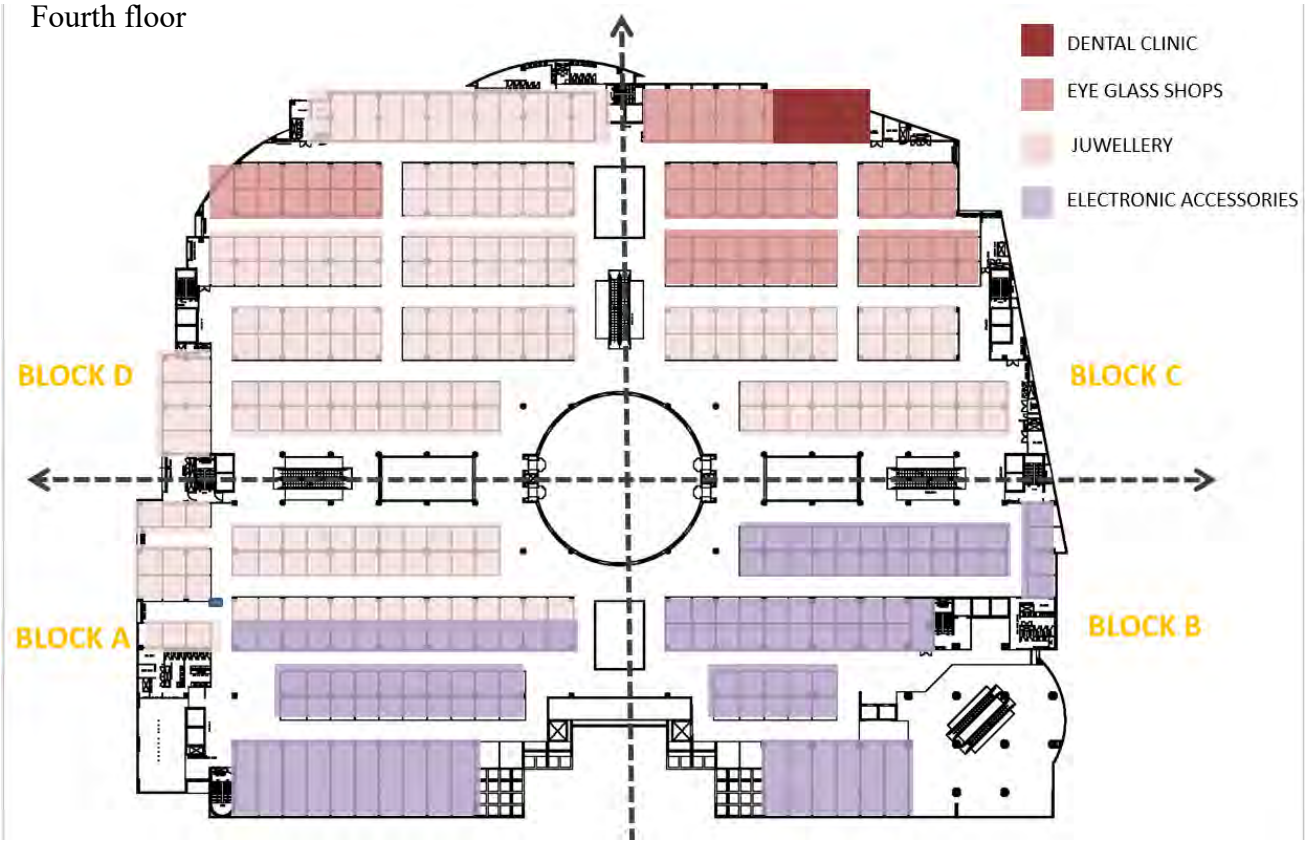
Second floor



Third floor

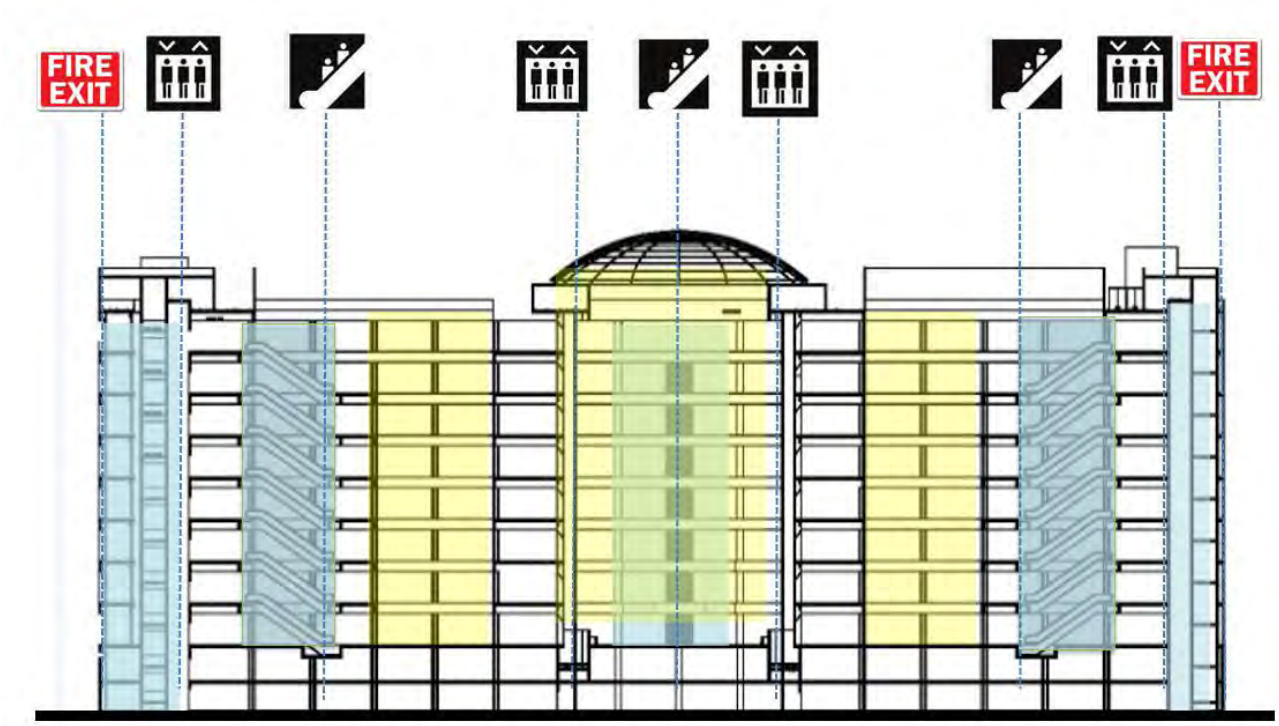


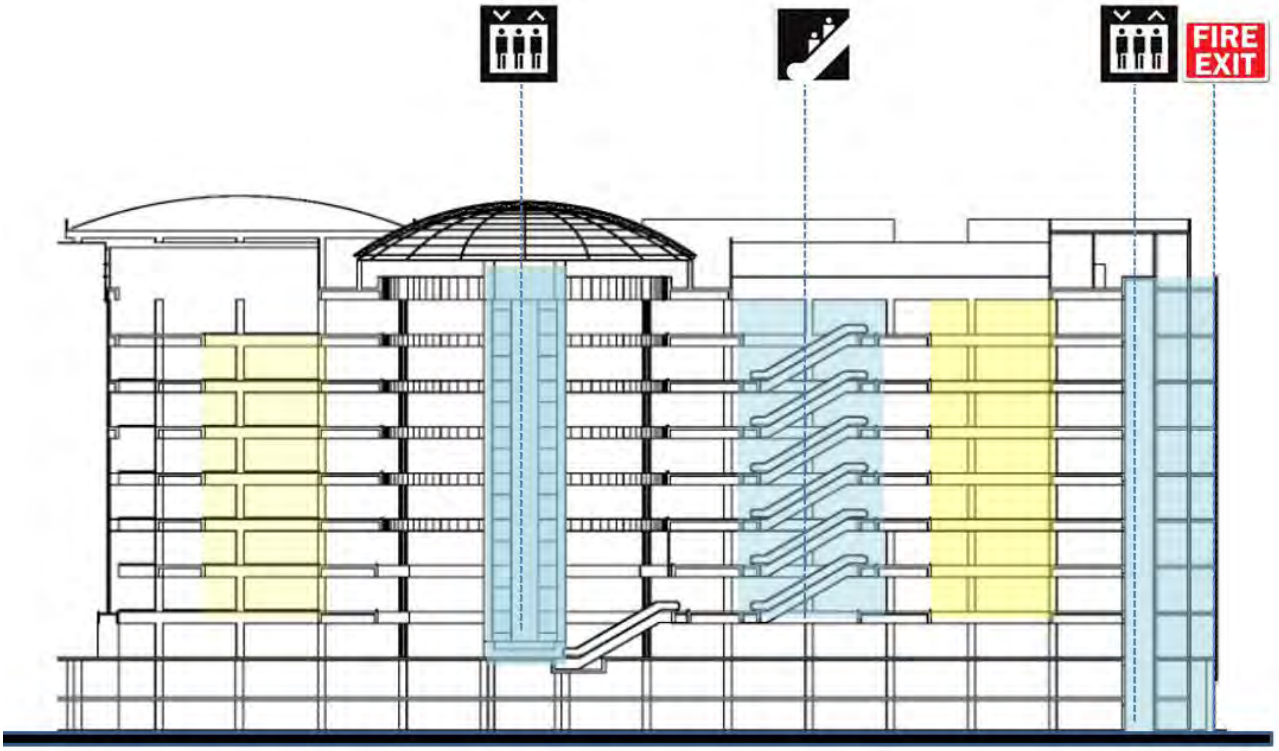
Fourth floor



Fifth floor

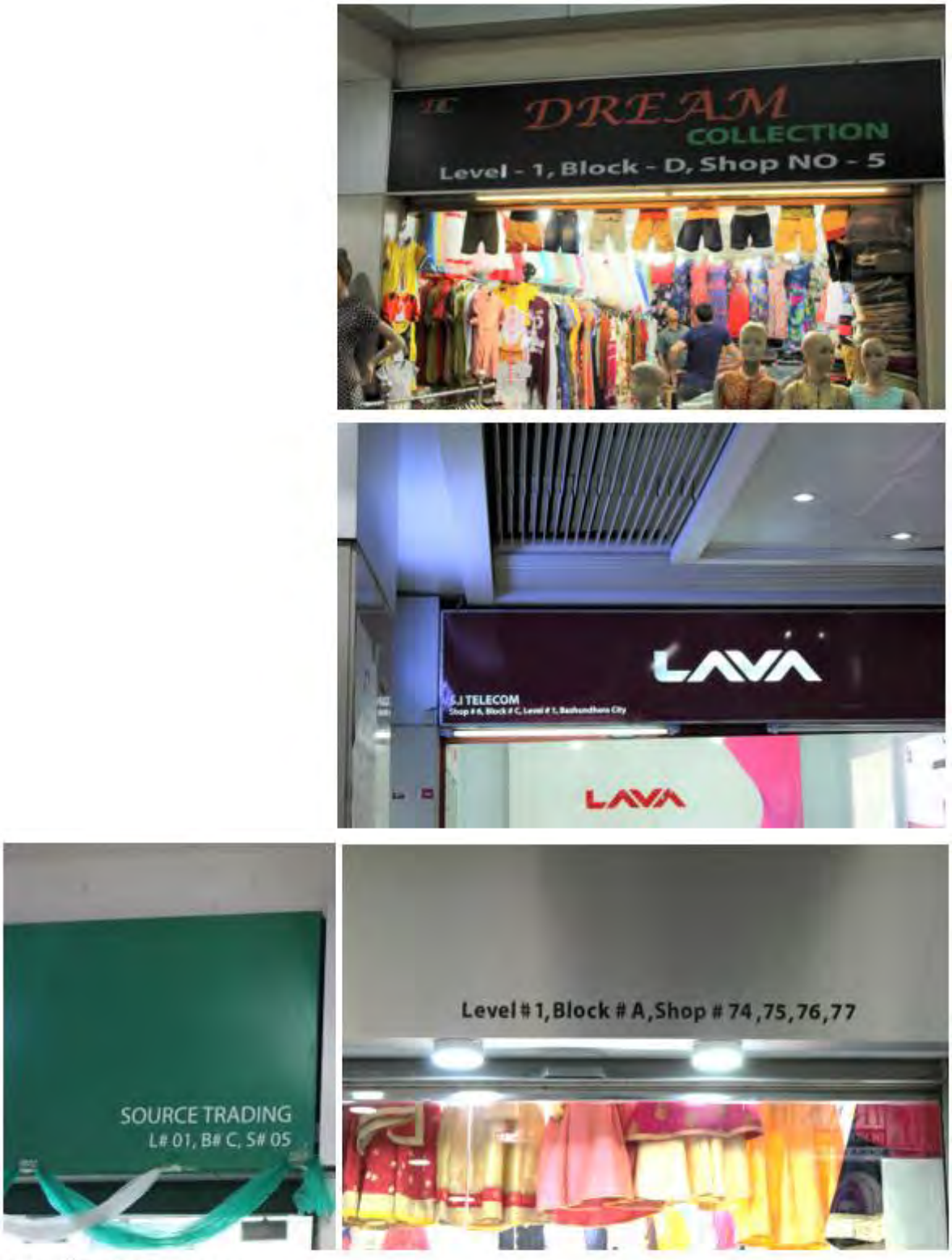
APPENDIX:02 Location of vertical circulation





APPENDIX:03 Sample of Questionnaire Survey

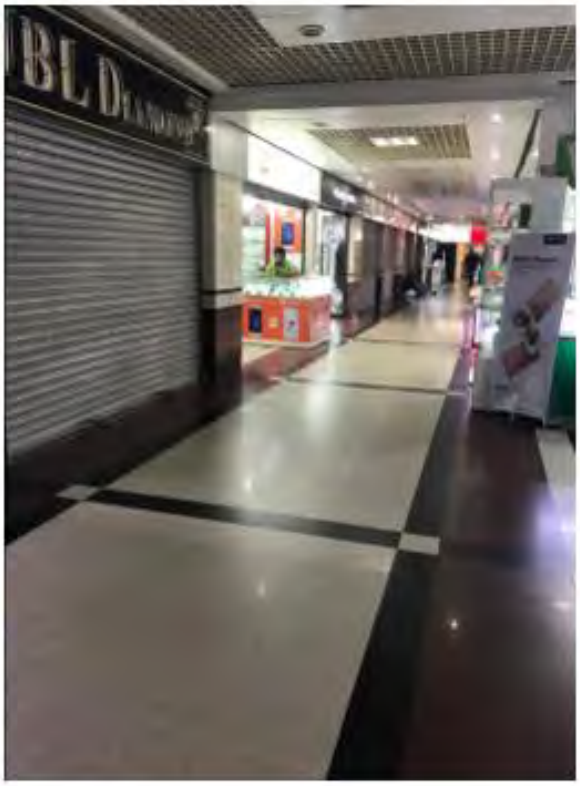
APPENDIX:03 Photographs of identification signage



Identification signage

APPENDIX:04 Photographs of Secondary atriums

APPENDIX:04 Photographs of corridors



APPENDIX:04 Questionnaire

Questionnaire Survey: Customers' WayfindingExperience and Satisfaction Study

Date: _____ Sample no: _____ Time need for finishing the task: _____

Part I: General Information				
1. Your destination shop route:	A._____	B._____		
2. Did you ask the volunteer for direction?	□ Yes_ _ _(Times)	□ No		
3. Gender	□ Male		□ Female	
4. Age	□ 16-35	□ 36-50	□ 51-65	□ 66+
5. How often do you visit the building	□ Regularly	□ Sometimes	□ Rarely	
6. When was the last time you visited this building?	□ Less than a week	□ Between a week and a month	□ More than a month	

Part II: User Characteristic	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I could keep in the mind which direction of the building I enter from	□	□	□	□	□
2. It is difficult for me to understand the direction I am facing in the building	□	□	□	□	□
3. The presence of someone to give direction is easy for me	□	□	□	□	□
4. I notice whether the corridors meet at right angle or not while walking in a building	□	□	□	□	□
5. I pay attention to "landmarks" while walking in a building	□	□	□	□	□
6. I pay attention to changes in the lighting system of a building while walking	□	□	□	□	□
7. I pay attention to changes in the floor finish of a building while walking	□	□	□	□	□

Part III – Information and way finding: These statements refer to customers' satisfaction and travel experience regarding Information and wayfinding.

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Sign showing different blocks of the building are useful to me	□	□	□	□	□
2. Signs pointing out different paths and/or directions are useful for me	□	□	□	□	□
3. The size of signs is appropriate and easy to read	□	□	□	□	□
4. You are here map showing my location within the building are useful for me	□	□	□	□	□
5. The floor numbering system is easy enough for me to get a destination	□	□	□	□	□
6. The shop numbering system follows the floor number and large enough for me to find my destination easily	□	□	□	□	□
7. I am satisfied with the overall signage system of the building	□	□	□	□	□

Part IV – Layout: These statements refer to customers' satisfaction and travel experience regarding the spatial layout of the shopping complex

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Upon entering, it is easy for me to find the information desk	□	□	□	□	□
2. The entry door is well designed and have visual access to the atrium	□	□	□	□	□
3. Elevator and staircases are easy to find	□	□	□	□	□

4. All parts of the building can be identified from the lift or the escalator during wayfinding	☐	☐	☐	☐	☐
5. It is easy to locate main atrium from all parts of the shopping floor	☐	☐	☐	☐	☐
6. Corridors are free of obstruction	☐	☐	☐	☐	☐
7. Corridors are wide enough to move easily and comfortably	☐	☐	☐	☐	☐
8. I notice if there is symmetry in the building	☐	☐	☐	☐	☐
9. Symmetrical layout planning help to find the destination	☐	☐	☐	☐	☐
10. I get lost on my way to a destination in the building because of the symmetrical planning layout	☐	☐	☐	☐	☐
11. I am satisfied with the overall layout of the building	☐	☐	☐	☐	☐

Part V – Environmental legibility and wayfinding: These statements refer to customers' satisfaction and travel experience regarding the legibility of the shopping environment

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.Spent more time walking to find the destination	☐	☐	☐	☐	☐
2. Satisfied with the amount of time it took me to get my destination	☐	☐	☐	☐	☐
3. Landmark help me to find the destination	☐	☐	☐	☐	☐
4. Main circular atrium was helpful to get the direction	☐	☐	☐	☐	☐
5. Secondary atriums were helpful to get the direction	☐	☐	☐	☐	☐
6. Feel disoriented for similar secondary atrium	☐	☐	☐	☐	☐
7. Very often I get lost in this building	☐	☐	☐	☐	☐
8. Could able to draw a quick diagram of the route i have gone through?	☐	☐	☐	☐	☐
9. I am satisfied with the overall wayfinding system of this building	☐	☐	☐	☐	☐