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Analysing Legibility of Space in Office Buildings: Case Studies in Kerman, Iran.

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ABSTRACT
Most people spend a substantial amount of time at work. Despite this significant role, office buildings incur some functional and environmental problems for users, one of the most critical of which is to access and move easily through them regarding their mostly complicated spatial configuration. The aim of this study is to understand the relationship between legibility and different building typology in addition to achieving some design patterns by comparing them. In this connection, the role of physical context and different design typology of some office buildings in Kerman have been investigated with the aim of analyzing interior legibility and way finding. Accordingly, observation and interviews were conducted to complete the evidences found from VGA results of the space syntax software along with self - administered questionnaires of employees and clients. The results based on the analysis of the strengths and weaknesses of these office buildings in terms of legibility and way finding suggest some recommendations and guidelines so that they can contribute to promoting the future of office buildings design.
Keywords: Office Buildings, Legibility, Way finding, Space Syntax, Spatial Configuration

I. INTRODUCTION

In today's modern world, people spend an integral part of their life in workspaces. Accordingly, the quality of the built environment by which they are surrounded can have a direct influence on their quality of life, one of the most indispensible of which in is way finding and accessibility. Movement circulatory system in office buildings is one of the basic principles of functional attributes. A successful circulation in such buildings can improve the way finding of users, and reduce user confusion in the building (Slone, Burles, Robinson, Levy, & Iaria, 2014; Mazumdar & Geis, 2003). Legibility of space can make the audience a memorable journey through the building, and can provide good information about the layout and spatial arrangement of the building (Kolb, 2008). People who recourse an office building due to the urgency of their work need a quick comprehension of their location and spatial organization of setting. Remembering the space and creating a strong, cohesive mental image of space also help the users diminish the sense of confusion. The question addressed in this research is to understand the impact of physical attributes on space understanding, and legibility in office buildings in conjunction with achieving some patterns and approaches that can provide office environment more efficient and legible.

Kevin Lynch proposed legibility as the ability of environment to organize and build a coherent mental pattern(Lynch, 1960). Thus, the degree of legibility depends on the ability of space to form a clear mental image. He also introduced legibility as the character of a space that can create cohesive cognitive maps; consequently, it helps people's way finding(Herzog & Leverich, 2003). Legibility is important at two levels: the physical forms and the activity patterns. To take full advantages of the potential of a space, the awareness of the physical forms and activity patterns should complete each other. This is particularly important for outsiders because they require the environment to be apprehensible quickly (Bentley, 1985).Two main factors that affect the perception and understanding of space are: space attributes and user characteristics. Users perceive and understand space through the psycho-cognitive processes in the human mind and user characteristics affect both the information and its process. Therefore, legibility of space is affected by the type and arrangement of spaces in plan, its complexity and the amount of the three-dimensional elements in the environment (Hunt, 1984; Koseoglu & Erinsel Onder, 2001; O'Neill, 1991)

II. LITERATURE REVIEW

Architectural way finding focuses on finding the way and orientation in the built environment and urban settings, and its strategies in a natural outdoor settings are different (Hillier &

Hanson, 1984; Loomis, Klatzky, Golledge, & Philbeck, 1998).Carpman and Grant define way finding as a multistage trip from one's home to the facility's reception area. Multiple factors and various solutions have been introduced to facilitate orientation and legibility in the interior space. Weisman emphasizes the indispensible role of spatial configuration of way finding(Weisman, 1981). Based on passini's studies buildings with central open spaces are usually more comprehensible, and create clear cognitive maps in people's mind. This space makes it possible to provide a general understanding of the building or at least areas forming around it. Understanding the spatial organization plays an important role in spatial orientation; when people can read the principles of spatial organization of a building, they can have a clearer mental map; consequently, they have a more coherent cognitive map, so the result will be more accurate way finding(Carpman & Grant, 1995; Downs & Stea, 1973). Garling studied visual access in a building. He showed that if any part of the building is visible from other parts, it facilitates way finding. According to this study, depending on the distribution of spaces in a building and decreasing or increasing people's optimum way finding the quality of legibility can be defined(Gärling, Lindberg, & Mäntylä, 1983). Other elements of the environment that influence way finding are the edges and boundaries of a context. Lack of coherent boundaries of a building with its spatial organization, encounters the mental imaging process with more problems. Spatial continuity is another factor influences the understanding of a setting, and thus way finding. The environment from which people receive information to create the cognitive maps enables them to reach their desired destination. To achieve this goal, the cognitive map should represent a sequential spatial system. However, sometimes features of the environment do not let the cognitive maps provide appropriate information (Passini, 1992).For instance, when there is no continuity between the environments' indicators, partial cognitive maps are made with no associated images that integrate the setting as a whole, so it becomes difficult to detect the way.When it is difficult to understand the relationship between different spaces, lack of continuity can be observed in the building (P Ortega, Jimenez, & Estrada, 2005). There are many other attributes on which impact way finding performance such as ambiguous circulation patterns, repetitive architectural features, contradictory articulation of interior and exterior spaces, and numerous entrance sun distinguished from one another (Passini, 1992).

Space Syntax: Integration in relation to Way finding

Space syntax, developed in the late 70s and early 80s by stead man in London, is a theory and a tool for the analyzing architecture and urban contexts (Hillier, 1996; Hillier & Hanson, 1984; Montello, 2007; Steadman, 1983). Space syntax provides an assortment of tools to analyze and describe the spatial configuration of settings (John Peponis & Wineman, 2002). This provides another level of architectural discourser effecting on the sociology of buildings and how the spatial configuration affects accessibility and way finding(Batty, 2004; Hillier, 2003; Ratti, 2004).Through the evolutionary process of the theory, the mathematical techniques were established in order to generate results in graphic manifestations and correlations (Hillier & Hanson, 1986). The parameters of the space syntax are connectivity, global and local integration, and control value(Jiang & Claramunt, 2002).Studies have explored whether the different measures that space syntax provides can be related to way finding. One way to measure spatial relations is through the integration measure. Integration quantifies the level in which spaces are related directly or indirectly among each other. When few spaces are crossed to get from one place to another, a connection between two spaces is direct, or shallow (Penn & Turner, 2003). Several studies have shown that being familiar with the building, people tend to pass through more integrated spaces, and places with a desirable range of visibility from the others(Haq, 1999; j. Peponis, Zimring, & Choi, 1990). As the reviewed studies have showed, researchers are able, by the integration value, to link the spatial characteristics of settings to way finding performance (P Ortega et al., 2005).

III. METHODOLOGY

In this study, both qualitative and quantitative methods were considered for analysis the final results so as to extract guidelines for design by evaluating the weaknesses and strengths of the case studies in terms of legibility. Four case studies were selected to analyze through description, software simulation and comparative analysis with regarding to their differences in morphology, size and circulation system. These cases were visited for field data collection. Following, two separate questionnaires were developed for both employees and clients. A number of questionnaires were collected in each case, and the results were compared in all of them. Subsequently, the plan layouts of each building were analyzed by UCL Depth map software in

order to deliberate the influence of way finding and legibility. In the process of space syntax software simulation two methods were used: VGA (visual graph analysis) and agent-based analysis (Table 1).In the final analysis, the results extracted from the field studies, which addressed the study's question from users' points of views, compared with the results of space syntax analysis so as to verify both groups of results.

[Table 1]

[Study steps. Source: Authors]

Visibility graph analysis approach examines the analysis of the main indicators of space syntax approach. This map creates a colored graph and illustrates successfully connected areas. Warm tones represent easily accessible or integrated (shallow) areas, and cold tones (deep) signify segregated or less connected areas. Agent-based analysis anticipates movement within the plan based on two main assumptive simulations. Avatars have proper information of the environment, and the movement is purposeful. Behaviors are planned according to stopping for conversation, looking around, and also crowding (Penn & Turner, 2003).

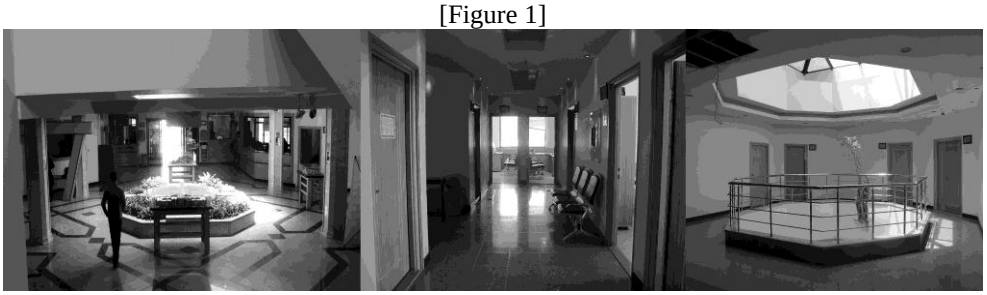
IV. RESULTS

Case 1: Road and Urban Development Organization building of Kerman

The four-storey office building of Road and the Urban Development Organization is located in Kerman, and its area is 4110 square meters. Its clients are mostly companies and other related agencies.

Radially organized circulation of the building has made the various parts accessible through the central void. Stairways and elevator are also accessible and visible from the central space, especially upon entering the building. Different departments of this office have been organized in cellular system arrangement and each separate room has been designed for working groups of up to three persons.

[Figure 1]



[Road and Urban Development Organization building of Kerman- Interior Space- source: Authors (2014)]

Observation and Questionnaires

The exterior of the building has the necessary coordination with internal organization and circulation system which creates an appropriate image for the audience. The main route from the entrance to the staircase is a strong and legible direction, which provides a good all-around visibility. The central open space has led to the creation of less corridors. The two-side corridors have been designed in a fracture shape; cutting the visual accessibility with the end of the corridor has reduced intelligibility. The central open space, with a large proportion in height, maintains the visual access to the upper levels of the building, but formation of rooms on both sides of the corridors has made it difficult to identify the boundaries of the building (Figure 1).

The results of the employee questionnaires show that most of the ground floor employees are satisfied with way finding and legibility qualities. The lowest levels of satisfaction were reported from the employees who work at a higher level of the building and at the end of corridors (located after the fracture of the aisles). Most employees found it easier to get out of the building than to enter it, and this is due to the recognition of the direction of arrival. There is less satisfaction in sections and rooms with little visual access to other parts. These people found it difficult to address others to achieve their work station.

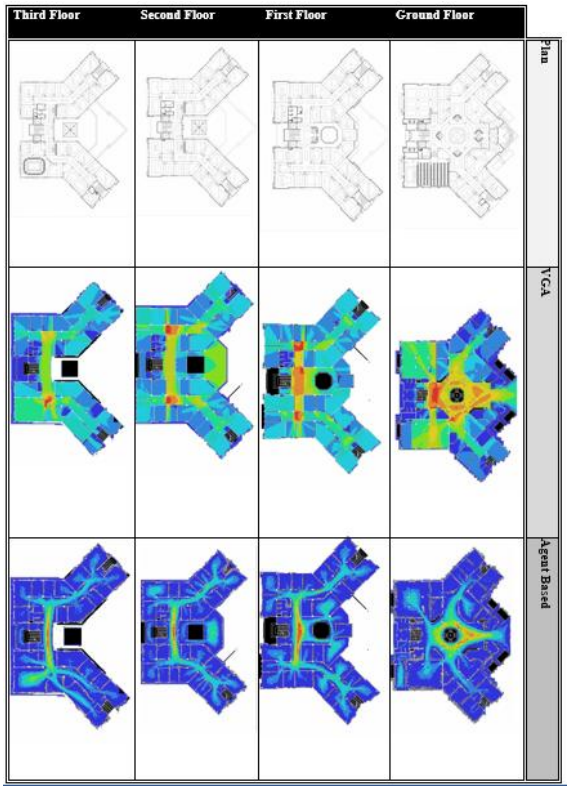
This argument is somewhat different from the client's perspective. A large number of clients reported confusion at the first referral as one of the most important problems in this building. Next, directions to the desired rooms and departments

were selected as major problems. This question was confirmed in the following questions by reporting the lack of follow-up guidance and the absence of symptoms and help signs. According to the clients, the entrance, the exit, the stairs and the elevator are the most recognizable parts of the building, and next parking and restrooms, and at last the management department and employees welfare parts were chosen.

Space Syntax Analysis

Based on the VGA graphs (Table 2), as also found in field research, the most integrated areas are stairways and elevator. The route between the entrance to the staircase is strong in terms of connectivity and integration. The central open space in the buildings appears as shallow and can therefore be interpreted as promoting ease of way finding. The end parts of the corridors are placed in the blue areas, which mean less legibility for way finding. Other levels of the building have the same interpretation and analysis because they are similar and symmetrical. However, arrangement of different departments does not accommodate with this potential of hierarchy. The VGA graphs of other levels of the building show two red zones at the joint between the corridors and central space, and two other red areas at the intersection of two corridors with main axes, which means a strong integration and connectivity although these areas do not have an appropriate functional usage. Agent-based analysis also confirmed this by showing high rate of movement. These maps show less movement congestion at the central joint of two corridors, so they have become less inviting; however, there is some resort department located there, which reduced the legibility and makes it difficult for way finding. Escape stairs are also located in the area with appropriate connectivity and movement. However, in the interior, because of their width and transparency, escape stairs are not seen clearly from another part of the building, so they are not recognized well.

[Table 2]



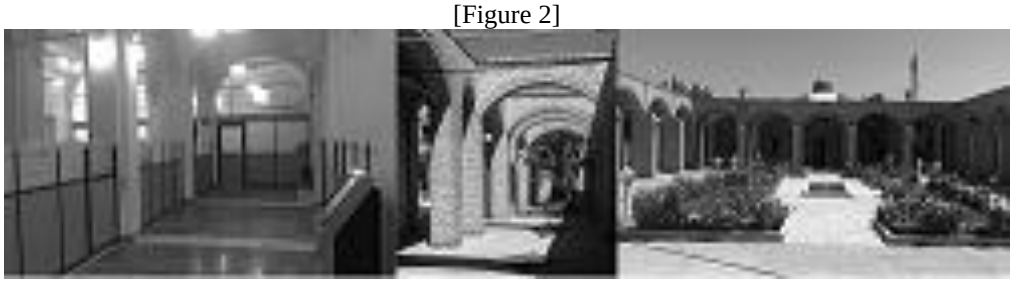
[Space Syntax analysis for Road and Urban Development Organization building of Kerman- Interior Space- source: Authors (2014)]

Case 2: Cultural Heritage Organization building of Kerman

The function of this 2180 square-meter-area building, located in Kerman, has been changed in 2004 to the Cultural Heritage Organization. The main building was built in the first Pahlavi period, and has changed in the interior and the facades, and also some new parts were added to it. Most of this organization's clients are students, researchers, and other related organizations. Old pattern and

structure of the building are important distinctions in comparison to other samples (Figure 2).

[Figure 2]



[Cultural Heritage Organization building of Kerman, Source: Authors (2014)]

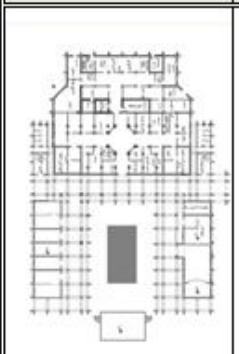
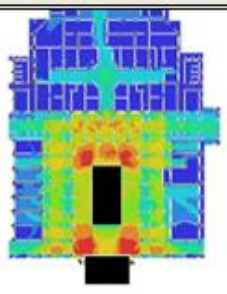
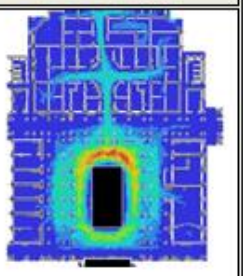
Observation and Questionnaires

This building consists of three separate buildings. The Entrance porch guides people to the main building entrance. The buildings are shaped around three sides of a central courtyard. The open hall of basic structure has been divided into some private parts, which are separated by partitions and panels. Using partitions of the same shape and color has made it difficult to distinguish between the various sectors. Two other buildings in front of south and north side of the courtyard have been assigned to the parts with less references; thus, there is a relative hierarchy. Linear circulation and organization of different parts of the building have increased corridors and porches. Most of the employees of the southern building evaluated it difficult to get to their work space. The employees of the additional sections of the building on the east side reported it difficult to address to other people for getting to their workplace. Most of the clients were also dissatisfied with confusion in this part of the building. Since most of the clients of the eastern building and the next southern and northern buildings are strangers, so regarding the references the arrangement and configuration of various parts could be based on it.

Space Syntax Analysis

VGA results for the four lateral sides of the central courtyard are quite strong; however, from observation, it appears not to be crowded and, there is no correlation in western areas because of the location of entrances. These results support stronger integration in main entrance route and the eastern building. Different tones of red color in various parts of this graph demonstrates the hierarchical structure type of the building. The agent-based analysis show an equal pattern of movement in four central routes at interior space of a main building, and this was not reflected in the observations; clients were also usually confused in choosing their way (Table 3).

[Table 3]

Plan	VGA	Agent Based
		

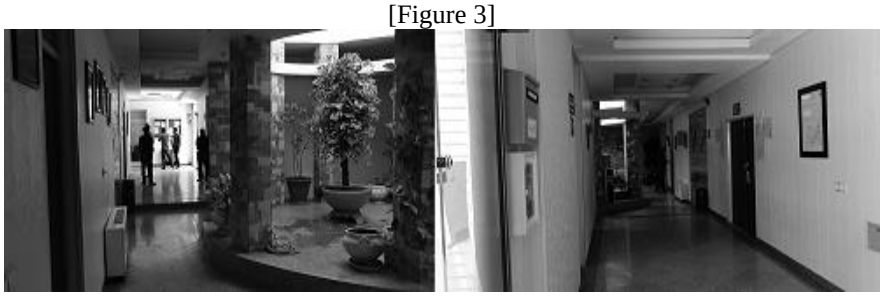
[Space Syntax analysis for the Cultural Heritage Organization building of Kerman, Source: Authors (2014)]

Case 3: Jahad-e- Nasr Office Building of Sirjan

Jahad-e-Nasr of Sirjan office building, as many examples of offices in Iran, originally was a residential building, which after changes in interior space, has become an office building. This building has only one floor, and its area is 1035 square meters. This sample is substantially different from

the previous cases in area, size, method of circulation system, and recourses (Figure 3).

[Figure 3]



[Jahad-e- Nasr Office Building of Sirjan – Interior Space – Source: Authors (2014)]

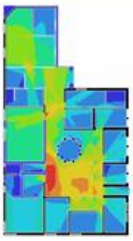
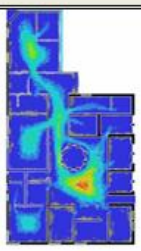
Observation and Questionnaires

Due to the small size of the building, less complexity, and location of all parts on one floor, there is no complicated way finding and legibility challenges, but studying this sample for comparison with other more complex samples can be helpful to understand various aspects of the issue. Based on field research, clients who refer to this office for the first time have the most way finding problems with the building. The similar shape of the rooms and the doors along with the same material and colors used in interior have caused confusion of clients. In this building, especially at the beginning, there are no signs of wards guide. A large percentage of clients pointed out the lack of follow-up work, which matches with the observation, so it has led to lack of clear hierarchy. Besides, the entrance is not clear neither from exterior nor from interior.

Space Syntax Analysis

According to the space syntax analyses, congestion in movement patterns are in the central space from which most of rooms are accessible. However, the location of the skylight greenhouse in this area has low mobility patterns of users due to the less visual access. In the original design, furniture and waiting space are located in the red zone (high traffic) of the agent-based graph, but in fact, as the agent-based analysis confirms, this place due to frequent movement is not a suitable place for repose. Later, the waiting area located in a place, which is specified by dark blue color (low traffic).This can emphasis on the use of graphic maps in space decorating. The waiting area and the entrance of the auditorium are in a strong connectivity area, so they are more accessible and intelligible. Location of the resting areas in the blue parts of the map shows providing greater privacy for employees. Although, the VGA graph shows a medium connectivity and integration at the main entrance, this area was reported as low legible and low integrated (Table 4).

[Table 4]

Plan	VGA	Agent Based
		

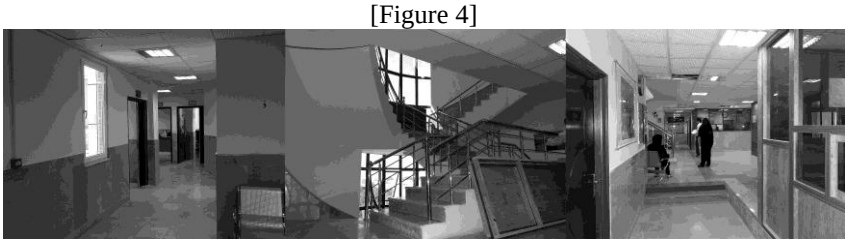
[Space Syntax analysis Jahad-e- Nasr Office Building of Sirjan, Source: Authors (2014)]

Case 4: City Hall building of Sirjan

The newly constructed building of city hall, sited in the town of Sirjan, is a three-storey building with an area of 1820 square meters. The main difference between this case and other cases is the high number of public references. The overall shape of the building is visible from the main roadway. The entrance was designed to be readable and inviting although location of the stairs in this area has reduced permeability and accessibility. Placement of the building on the site has not defined appropriate entering hierarchy.The organization of the building form is composed of two main rectangular elements, which are connected by a circular joint. Accessibility of

different sections and levels of the building also are provided through this joint (Figure 4).

[Figure 4]



[City Hall building of Sirjan – Interior Space – Source: Authors (2014)]

Observation and Questionnaires

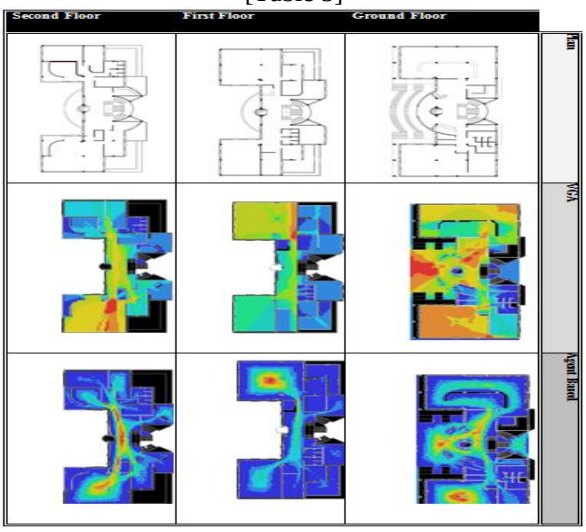
Regarding the large size of the work stations, and using the combination system in interior arrangement, combining both cellular and open plan office (Offices, 2005), the employees of each level, especially those on the ground floor, reported the ease of getting to their workplace from the central joint. However, Giving instructions to another person in order to find their workplace is considered complicated. Most clients who came to the ground floor evaluated way finding easier, and those in upper levels evaluated this difficult. A substantial amount of clients mentioned confusion on the first referral to the building as one of the most important problems. This could be due to lack of proper guidance signs and architectural elements. The entrance lobby does not seem appropriate to the number of clients and their density at a concurrent time (Figure 4).

The problem of overcrowding and congestion also was reported in the client questionnaires. Besides, the lack of significant entrance space also has a negative effect on satisfaction and way finding. For clients the most recognizable parts of the building in order for choosing are the stairs, the entrance, the exit, the information station, and the following services, as welfare of employees, management and parking.

Space Syntax Analyses

Based on Space Syntax analyses the ground floor, especially the entrance is one of the most integrated areas, but field observations did not verify this because the location of the elevator has divided the entrance space and made it smaller. Strong color tone in this sector can be due to the open staircase. In fact, despite the strong connection of external intelligibility of the entrance, it has had no effect on legibility or internal intelligibility. The path to the left of the stairs has also a strong integration; which due to the placement of the most visited departments on the left, and low visited departments on the right (the blue parts), better legibility and effective hierarchy is created. Placing the welfare part in the blue areas of the map shows the proper function of way finding, which controls unnecessary trips to the sector. Agent-based analysis shows an equal movement between two path sides of the stairs on the first floor; however, in the building the recognition of right way is more difficult than the left way. Right side of the map is more integrated and connected than the left side, and has created a proper hierarchy because of locating the departments with more reference in the right side, and management department and most private parts in the left side (Table 5).

[Table 5]



[Space Syntax analysis for City Hall building of Sirjan, Source: Authors (2014)]

The overall results of both clients and employees' questionnaires are provided in the following tables (table 6, table7).

[Table 6]

	Case 1	Case 2	Case 3	Case 4
Ease of getting to one's workplace	53	35	66.7	55.9
Ease of addressing their workplace to other people	23	65.5	78.5	43.7
Work station connection with other parts of the building	68.7	42	36	30
Visibility of workplace	25	40.7	76	35
Ease of getting out of the workplace	82.5	78	87	82.5
Accessibility of other people to the workplace	51	42	52	56
Ease of moving through the building in order to reach the workplace	74	70.8	87	80.6

[Comparing the results of the employees' questionnaires- these questionnaires codified based on: (P Ortega et al., 2005)]

[Table 7]

	Case 1	Case 2	Case 3	Case4
Comprehension of way finding in the first referral of the building	25.5	53	19.6	34.9
Synchronization of the environment facilities with work proceeding	33	18	62	40
Clarity of the work flow	43.5	34	43.5	24
Necessity of asking someone to find the way	73	84	87.5	68.5
Ease of getting to the sightly parts	69	54	80.7	73
Exiting of the building	91	87	91	87
Recognition of different parts of the building	19	12	83.5	29.7
Ease of addressing the sightly part to the others	29.7	21	92.7	37.5

[Comparing the results of the clients' questionnaires- these questionnaires codified based on: (P Ortega et al., 2005)]

V. DISCUSSION

The results of this study show a strong correlation between spatial configuration of office buildings and way finding. The studied spatial elements such as spatial configuration, visual access, central open space, boundaries, and spatial continuous have generally significant role in improving legibility of space and way finding.

Regarding to the specific characteristics of each case and comparison of their differences in form, spatial organizations, and circulation system in addition to the results derived from Table 6 and 7, the following approaches can be interpreted as the most important lessons to advance the legibility of office spaces in future designs:

- Using elements and landmarks that are able to build a coherent and clear mental image facilitates understanding of spatial organization
- Visual, semantic and structural salience of a building and its entrance have an important role in creating more intelligible space in order to memorize them more efficiently.
- Linear circulation that provides access through the monotonous corridor leads to more confusion.
- Visibility of stairs and elevators should be considered to be suitable to the need of movement and communicate with different levels of the building.
- Using spaces with different restriction, spatial proportions, dimensions and different spatial qualities can be helpful to create an integrated mental image.
- In large-scale buildings in which arranging the linear circulation is inevitable, use of signs on the main routes can be helpful, especially for clients who reference building for the first time.

- Considering more attention to the natural light can contribute to creating spaces with greater clarity and legibility.
- Making a recognizable difference in buildings with symmetrical plan layouts or typed ones in interior design by using various colors and elements is very essential in people's mental images.

Spatial elements and physical factors have a direct influence on legibility, and partially way finding. But there are some layers and dimensions of legibility that should be considered in each specific context. In office buildings, legibility should also be evaluated from the perspective of both employees and clients. These issues can be summarized as follows.

Clients have a short-term presence in the building, and usually their work procedure is associated with emergency. It is essential to attend to these followings:

- Having a welcoming perspective at the first moment can have an positive effect on their mental images, and consequently their judgment of the building.
- Using semantic elements that induce them to recall memories or specific images.
- Using familiar patterns and clear hierarchy that can help the clients guess some events or activities, and reduce their sense of alienation and missing.
- Regarding the occurring events, activity patterns and how to design and arrange them can manage the consequences of creating mental images.

For Employees, being familiar with the building, and spend a substantial amount of time in it decreases the challenges of way finding and orientation. One of important attributes for them is to make that place a familiar place which evokes home condition for them(Soltani, NaserAlavi, & Ghasr, 2015). These are some solutions that can be discussed about them:

- The existence of some qualities that make the workspace a familiar environment and increase a sense of belonging to them.
- The existence of affordances for personalizing; thus, their work space will be more legible by being specific.
- Familiar Elements and patterns that employees can make deeper relation with them.
- Propriety of work space, visibility with the work type and privacy needs of clients.
- Differing each section from other sections. (Using same shaped partitions makes it difficult to have an effective relationship with the environment and reduces its legibility).

VI. CONCLUSION

The results confirmed the way finding strategies and factors affecting legibility, which were studied in the literature review. Moreover, these solutions should be considered for two separate office space users: employees and clients. Since the collision, need, and relation to the building for them are different and the level of satisfaction of these buildings can be increased by providing different qualities of legibility, it is important to note that legibility is a scaled quality, and should be followed according to the required situation. For employees, semantic aspects of legibility related to a sense of belonging, identity and memorable attributes become more necessary. However, for clients, in addition to semantic aspects, physical dimensions and spatial mechanisms are of great importance. By considering the different needs of these two groups, more effective approaches for legibility and orientation can be provided.

The space syntax approach can be modified during controlling design. It can be an important hand software for designers. In this study, space syntax method was used as a parallel measurement to complete the understanding of correlations and integrations of the studied buildings. These analyses provide desirable information about the legibility, way finding, and accessibility, which are used for evaluation of the extracted results.

REFERENCES

[1]. Batty, M. (2004). A new theory of space syntax: working paper 75, UCL, London.
[2]. Bentley, I. (1985). Responsive environments : a manual for designers. London: Architectural Press.
[3]. Carpman, J., & Grant, M. A. (1995). Comparing architectural and verbal wayfinding clues. Progressive Architecture, 76 .
[4]. Downs, R. M., & Stea, D. (1973). Cognitive maps and spatial behavior: process and products. Chicago: Aldine Publishing Company.
[5]. Gärling, T., Lindberg, E., & Mäntylä, T. (1983). Orientation in Buildings: Effects of Familiarity, Visual Access, and Orientation Aids. Journal of Applied Psychology, 68(1), 177-186 .
[6]. Haq, S.-U. (1999). Can Space Syntax Predict Environmental Cognition. Paper presented at the Proceedings of the Space Syntax Second International Symposium,Brasilia, Brazil .

[7]. Herzog, T., & Leverich, O. (2003). Searching for Legibility. Environmental and Behavior .
[8]. Hillier, B. (1996). Space is the machine : a configurational theory of architecture. Cambridge ; New York, NY, USA: Cambridge University Press.
[9]. Hillier, B. (2003). The architecture of seeing and going: Or, are cities shaped by bodies or minds? And is there a syntax of spatial cognition? . 4th International Space Syntax Symposium London .
[10]. Hillier, B., & Hanson, J. (1984). The social logic of space. Cambridge Cambridgeshire ; New York: Cambridge University Press.
[11]. Hillier, B., & Hanson, J. (1986). Ideas are in things. environment and Planning B: Planning and Design .
[12]. Hunt, M. (1984). Environmental Learnin Without being there. Environmental and Behavior .
[13]. Jiang, B., & Claramunt, C. (2002). Integration of Space Syntax into GIS: New Perspectives for Urban Morphology. Transactions in GIS, 6(3), 295-309. doi: 10.1111/1467-9671.00112
[14]. Kolb, j. (2008). Improving conditions, Building Better Health, Architects Journal. Architects Journal, vol.227, no.3 .
[15]. Koseoglu, E., & Erinsel Onder, D. (2001). Subjective and objective dimension of spatial Legibility Social and Behavioral Science .
[16]. Kupritz. (2001). Aging Worker Perceptions About Design and Privacy Needs for Work. Journal of Architectural and Planning Research, 18:1.
[17]. Loomis, J., Klatzky, R., Golledge, R., & Philbeck, J. (1998). Way finding Behavior: Cognitive Mapping and Other Spatial Processes. In R. G. Golledge (Ed.), (pp. 125-151): Johns Hopkins University Press.
[18]. Lynch, K. (1960). The image of the city. Cambridge Mass.: The Technology Press & Harvard University Press.
[19]. Mazumdar, & Geis. (2003). Architects, the Law, and Accessibility: Architects' Approaches to the ADA in Arenas. Journal of Architectural and Planning Research, 20:3.
[20]. Montello, D. (2007 .(The Contribution Of Space Syntax To a Comprehensive Theory Of Environmental Psychology. 6th International Space Syntax Symposium Istanbul .
[21]. O'Neill, M. (1991). Evaluation of a conceptual model of architectural Legibility. Environmental and Behavior .
[22]. Offices, C. B. C. f. (2005). The Impact of Office Design on Business Performance.
[23]. P Ortega, E., Jimenez, S. M., & Estrada, C. (2005). Space syntax as a determination of spatial orientation perception Journal of Applied Psychology .
[24]. Passini, R. (1992). Way finding in architecture. New York, [NY]: Van Nostrand Reinhold.
[25]. Penn, A., & Turner, A. (2003). Space syntax based agent simulatin. Bartlett school of graduate studies, London .
[26]. Peponis, J., & Wineman, J. (2002). The spatial Structure of environment and behavior. Handbook of environmental psychology .
[27]. Peponis, j., Zimring, C., & Choi, Y. (1990). Finding he building in way finding. environment and behavior, 22 .
[28]. Ratti, C. (2004). Space syntax: some inconsistencies. Environmen and Planning .
[29]. Slone, E., Burles ,F., Robinson, K., Levy, R. M., & Iaria, G. (2014). Floor plan connectivity influences way finding performance in virtual environments. Environment and Behavior .
[30]. Soltani, S., NaserAlavi, S., & Ghasr, A. K. (2015). Dwelling in the Workplace: A Contributionto the Phenomenological Attributes of the Workplace. Current World Environment, Secial Issue May 15 .
[31]. Steadman, P. (1983). Architectural morphology : an introduction to the geometry of building plans. London: Pion.
[32]. Weisman, J. (1981). Evaluating architectural legibility. Way-finding in the built environment. environment and behavior, 13 .