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ICONARP

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ICONARP INTERNATIONAL JOURNAL OF ARCHITECTURE & PLANNING

ICONARP as an e-journal considers original articles, research briefs, book reviews and viewpoints in peer-reviewed. ICONARP is an exciting new venture occurred with experiences, theoretical approaches, critical and empirical studies in the field of architecture and urban planning.

SCOPE and AIM

The journal aims to be a platform for the studies of design, education and application and has a goal to be a bridge in between traditional/modern, east/west, local/global in the disciplines of Architecture / Planning.
Architecture and Planning, as two interconnected fields, are strongly affected by other disciplines such as fine art, urban design, philosophy, engineering, geography, economics, politics, sociology, history, psychology, geology, information technology, ecology, law, security and management. However, there are no academic journals which specifically focus on the connections of architecture and planning with other social fields. ICONARP aims to fill that gap. Our scope is to provide a suitable space for theoretical, methodological and empirical papers, which use global and local perspectives together, in architectural and urban studies.

ABSTRACTING AND INDEXING

ICONARP is an Open Access Journal which presents its content freely for online researches with the aim of contributing to the global exchange of knowledge. ICONARP believes that providing free online access ensures a wider spectrum of research base and reading rate to develop the related literature.

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EDITORIAL

ICONARP began its broadcast life as peer-reviewed faculty journal in the field of international architecture and planning and now it is the fifteenth issue.

ICONARP is continuing its growing process with this new issue.

The sixteenth issue will be published in June 2020 and we wait for your contributions with your scientific studies until March 2020.

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Research Article

Characteristics of Irregular Column Capitals in Ottoman Mosques with Courtyards

Nil Orbeyi*

Abstract

The aim of this article is to examine the construction techniques of the irregular column capitals which are located at the junction of portico and courtyard arcades (*revak*) of six Ottoman mosques. The porticos height of the closed-courtyard mosques built during the Ottoman period regarding is mostly equal. However, in six cases, the porticos of the mosques are higher than their side porticos, which led alternative solutions to keep the continuity of the arcade surrounding the courtyard. The first phase of this study focuses on the construction techniques and materials of the column capitals in Ottoman architecture and the second phase deals with irregular capitals including their characteristics (sizes, materials, and relations with other building elements). For this purpose, detailed drawings were prepared through the site examinations and the literature review. As a result, despite that their size and shape vary depending on construction period, the relationship between last prayer hall and courtyard, structural aspects, and visual concern, their construction techniques, materials, and components show similar properties.

Keywords: *Column, capital, constructive details, design principles, portico, Ottoman architecture*

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INTRODUCTION

In Ottoman mosques, portico supported by columns is attached to the primary structure (*prayer hall*) on the north side to provide additional space for the community in case the prayer hall was full or closed. Although the scale and plan layout of mosques varies throughout history, the portico has always been one of the most emphasized parts of the mosques (Kuran, 1964; Özüdoğru, 2005; Mülayim, 2008; Çuhadar, 2011). While it was a single place in the early period of Ottoman architecture (1299–1501), it was transformed into a closed courtyard with the addition of arcades in three directions, especially in the large-scale mosques in the Classical period (1501–1703) (Mülayim, 2008; Orbeyi, 2016). Although the porticos of these mosques are mostly of equal height (Figures 1a, 2a), the porticos of some mosques were designed to be higher than their side porticos (Figures 1b, 2b).

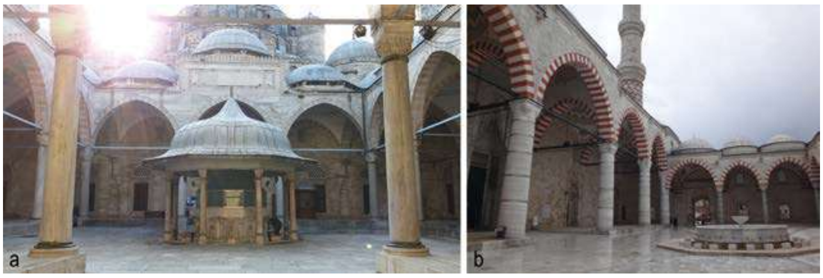

Figure 1. a) The closed-courtyard of the İstanbul Şehzade (Şehzadebaşı) Mosque, b) The closed-courtyard of the Edirne Üç Şerefeli Mosque (Source: Author, 2018)

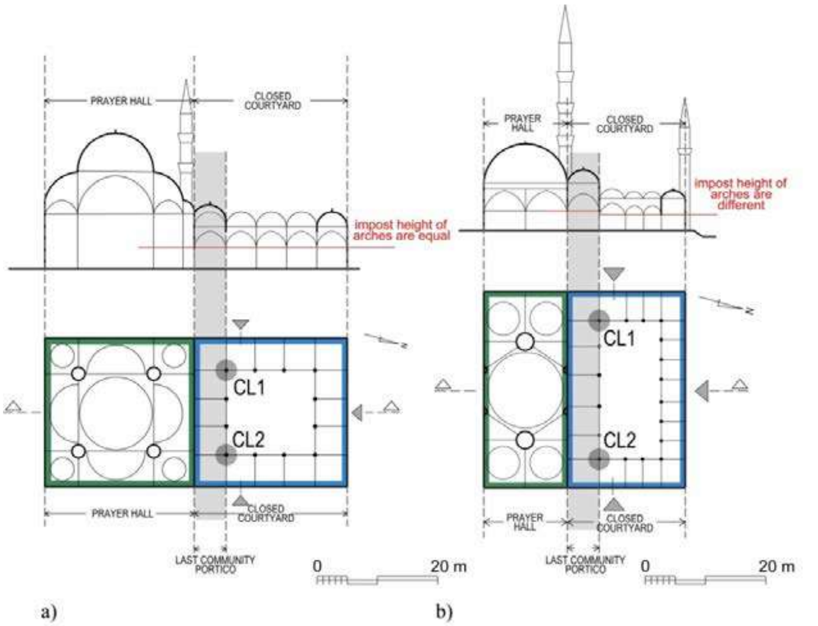

Figure 2. a) Section and plan of the İstanbul Şehzade Mosque (Redrawn from Ülgen, 1989), b) Section and plan of the Edirne Üç Şerefeli Mosque (Redrawn from Ayverdi, 1976)

This formation is seen in six mosques that were built at different times over a period about 40

0 years (from the 15th to 18th centuries): Üç Şerefeli Mosque, Selimiye Mosque, Fatih Mosque, Süleymaniye Mosque, Kara Ahmed Pasha Mosque, and Yeni Valide Mosque. Except for the Üç

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Şerefeli Mosque and Selimiye Mosque, all the structures which are investigated in this research were built in Istanbul (Figure 3).

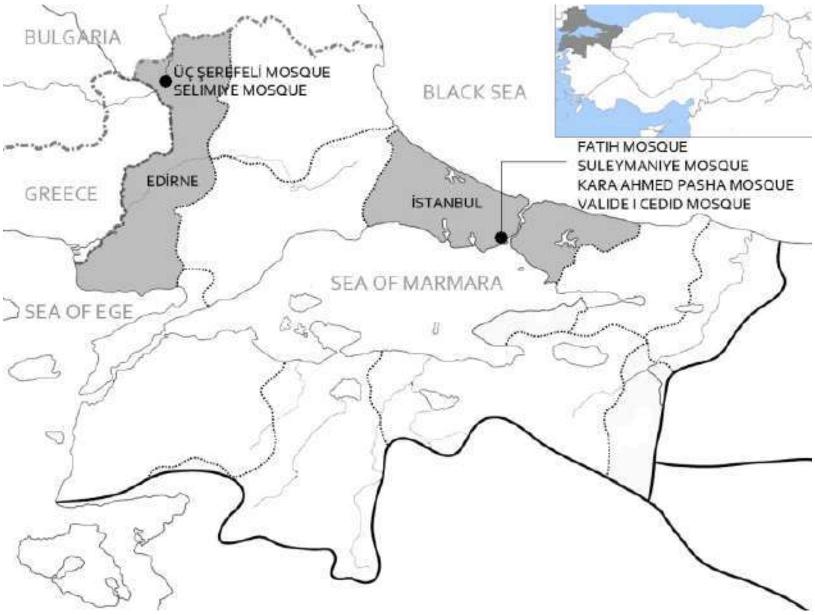

Figure 3. İstanbul and Edirne in the map of Marmara Region (Redrawn form Google map)

The height difference between the portico and arcades of the courtyard of these mosques caused the builders to use two capitals at different heights for the CL1 and CL2 columns, which are in structurally critical locations unlike the other columns (Figures 1b, 2b). This altitude difference was probably preferred for several reasons:

- **Emphasis on the entrance facade:** Supporting monumentality by emphasizing the last community portico and strengthening the pyramidal effect (Kuran, 1964);

- **Visual concern:** Trying to give the impression that the portico was part of the prayer hall. For example according to Ayverdi (1976), in the Edirne's Üç Şerefeli Mosque, the portico was built upward from the side porticos to show the narrow prayer hall larger (Fig. 2b);

- **Adherence to tradition:** The desire to maintain the traditional layout of the Ottoman Early Period (for construction built during this period, see Ayverdi and Yüksel, 1976), especially in the earliest example of the case studies (Üç Şerefeli Mosque) of the closed courtyard type (Mülayim, 2008; Orbeyi, 2016);

- **The influence of patronage:** According to Necipoğlu (2005), the similarities in some mosques show that the patrons' requests about the details they like in different structures constituted an important factor affecting the design process[1]. The height

[1] For example, the using of double porticos in the mosques of Rustem Pasha, his wife Mihrimah Sultan, and his brother Sinan Pasha (Necipoğlu, 2005).

differences in porticos may have been made depending on similar reasons.

Tanyeli (1999) state that the first comprehensive example of Ottoman architecture's attempt to make its technical knowledge in writing is the text in which Ahmed Efendi described the construction of the Nuruosmaniye Mosque in the mid-18th century (For the studies made after this date, see: Tanyeli, 2009). Although no written sources are describing directly the construction techniques of structures built before that date, we can obtain information about the names, sizes, and materials of building elements from archived documents (The Prime Ministry Ottoman Archives (BOA), account and construction books of the buildings (Barkan, 1979), etc.). In addition to historical documents, the examination of buildings that have preserved their original structure to the present day also provides information about the construction techniques and materials. Based on these documents, a limited number of studies have been conducted on the columns of the Ottoman architecture. These studies generally concern the columns under the category of building elements (Yorulmaz, 1986; Ahunbay, 1988; Alioğlu, 1991; Tayla, 2007; Uluengin, 2014) or are about the sizes, shapes, and material characteristics (Alper, 1998; Sönmezer, 2002; Mülayim, 2008; Orbeyi, 2012). In Orbeyi's study (2012), which deals with three of the six differently-shaped column's capitals (Süleymaniye, Selimiye, and Kara Ahmed Pasha Mosques), the capitals were examined only according from the decorative point of view.

METHODOLOGY

This study focuses on the closed-courtyard mosques that were built between the 16th and 18th centuries. In the first phase, the columns in Ottoman architecture were examined depending on their components, construction techniques, and materials. In the second phase, irregular capitals' parts were examined depending on their sizes, materials, and relationships with the other construction elements by using plan and section drawings. In this stage also the repairs of the structures were investigated. Interventions were related to columns and capitals in these repairs are presented in the text together with their accessible visuals. The construction technology and components of an ordinary column are known from archival documents (Barkan, 1979; Tanyeli & Tanyeli, 1993, Ahunbay, 1988; Alioğlu, 1991; Tayla, 2007; Macaulay, 2010, Uluengin, 2014) and restoration reports of the structures (Aksu and Alaca, 2013, Ceylan, 2013). However, since there are no documents for irregular columns,

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documents concerning the possible construction technology and components of these columns were prepared depending, on the results obtained from ordinary column components and on-site examinations. In this context, structural surveys of the capitals were initially prepared. The survey drawings consist of two plans and two elevations. Plan 1, in which the lower and upper part of capitals can be seen together, allows comparison of the capitals. In Plan 2, only the upper part of capital and relationships with the lower arches of the cylindrical shaft can be seen. The last section of the paper describes the irregular columns' similarities, differences, and construction details, depending on the data obtained from this study. The mosques examined in this study, except Kara Ahmet Pasha Mosque, have recently been restored. Restoration of Kara Ahmet Pasha Mosque will also start soon. In the study, the current statuses of the buildings were examined.

CONSTRUCTION TECHNIQUES AND MATERIALS OF THE COLUMN'S CAPITALS IN OTTOMAN ARCHITECTURE

The column, which has been the most common vertical element in many civilizations, usually appears as a rounded shaft with a capital and a base. Although the forms of capitals vary according to civilization and period in use, its dimensions were related to the structural characteristic of the building such as the sizes of the arches connected to the capitals, the connecting directions of the arches to the columns, and the columns' locations in the structure.

In Ottoman architecture, there are two recognized types of capitals: (1) the stalactite or muqarnas and (2) the lozenge (*baklavalı*). In many constructions, they were concomitantly used. The columns consisted of three parts: (1) the capital; (2) the shaft; and (3) the base (Figure 4). The shaft was generally made of Egyptian and Kestanbolic granite, red porphyry, Marmara marble, and various colors of serpentine breccia monolithic stone blocks (Ahunbay, 1988; Goodwin, 2003; Kolay and Çelik, 2007, 2009; Mülayim, 2010; Ahunbay, 2012; Uluengin, 2014). The base, mostly made of marble or granite, was placed between the shaft and the ground and provided even transmission of the concentrated load by the column. The capitals were made mostly of marble. Capitals with muqarnas, which were made with intensive craftsmanship, can be seen in the main places (such as portico, prayer hall, etc.) of the mosques. For example, while two types of capitals had been used in the side porticos, the muqarnas schema was generally preferred for the portico (Kadırga Sokullu Mehmed Pasha Mosque, Rüstem Pasha Mosque, Kılıç Ali Pasha Mosque, Üsküdar Mihrimah Sultan Mosque, etc.) In the monumental mosques, the ground of the porticos is raised on a platform (*sofa*), and the column's bases are integrated with it. Thus, a more enduring connection has been established, which is useful especially in cases of earthquakes (Ahunbay, 1988) (Figure 4).

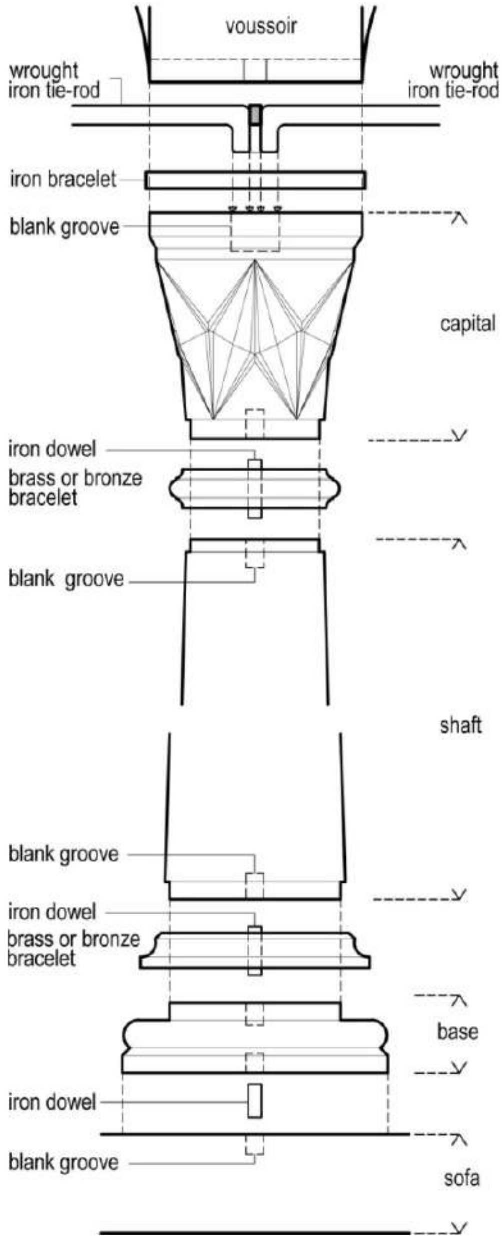

Figure 4. Schematic drawing of an ordinary column in Ottoman Classical Period (drawn by Author)

Figure 4 shows the structural details of a column in the Ottoman Classical Period. The capitals are made of approximately a cubic marble block. At the top of the capital, there is a blank groove[2] in which wrought iron tie-rods are connected from two or four directions at the same level (Ahunbay, 1988; Tanyeli, 1990; Tanyeli & Tanyeli, 1993; Uluengin, 2006; Aksu & Alaca, 2013). The wrought iron tie-rods were used to confront the thrust of arches and keep the structure as a whole. The blank groove in which the wrought iron tie-rods had been placed was filled with lead to prevent corrosion and fix the joint (Aksu & Alaca, 2013). The capital on which an impost has been placed is connected to a

[2] The pits that is at top and bottom of the capital, shaft and base.

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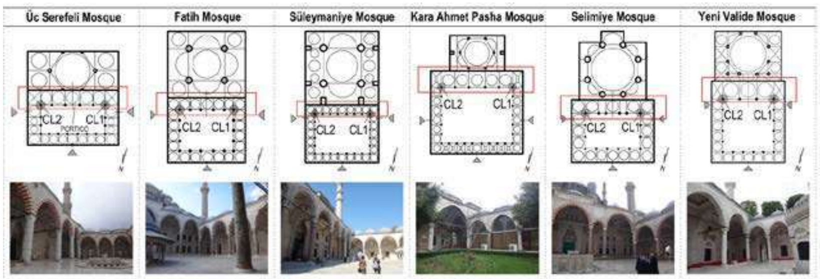
cylindrical shaft. The columns were fixed to the sofa, and the capital with the iron pins and the molten lead filled the pin nests. This application has been known since antiquity (Ahunbay, 1988; Tanyeli & Tanyeli, 1993; Uluengin, 2014; Alioğlu, 1991). The connection bracelet that is an unknown element in antiquity was used extensively in Ottoman architecture to close the connections between the capital, shaft, and base in addition to providing an aesthetic finish (Tanyeli & Tanyeli, 1993; Sönmez, 1997). The material of the bracelets is brass or bronze. Moreover, a rectangular wrought iron tie-rod surrounding the upper limit of the capital increased the durability of the column against vertical loads (Figure 4).

Structural Forms of Irregular Columns

In this study, irregular columns were called CL1 and CL2 for each mosque (Table 1). Since all of the examined mosques are symmetrical relative to the north-south axis, each mosque presents two similar columns at this point. For this reason, in the following chapters, CL1 capital formations in different mosques are discussed, depending on their structures.

Table 1. Plan schemas of the mosques (plans: redrawn from Ayverdi, 1976, Ülgen, 1989; photographs source: Author, 2018)



Üç Şerefeli Mosque

Üç Şerefeli Mosque was built in Edirne during the reign of Sultan Murad II between 1438 and 1447. The mosque consists of a prayer hall and a closed courtyard adjacent to this hall. The dimension of the prayer hall is 60.40 m × 23.90 m, and the closed courtyard 60.70 m × 35.50 m. A seven-bay space; the last prayer hall units at the corners are covered by cross vaults and remain units by domes (Table 1). The columns in the last prayer hall are 7.20 m in height with a diameter of 1.35 m. Regarding the side porticos, height is 5.20 m and the diameter about 0.60 m.

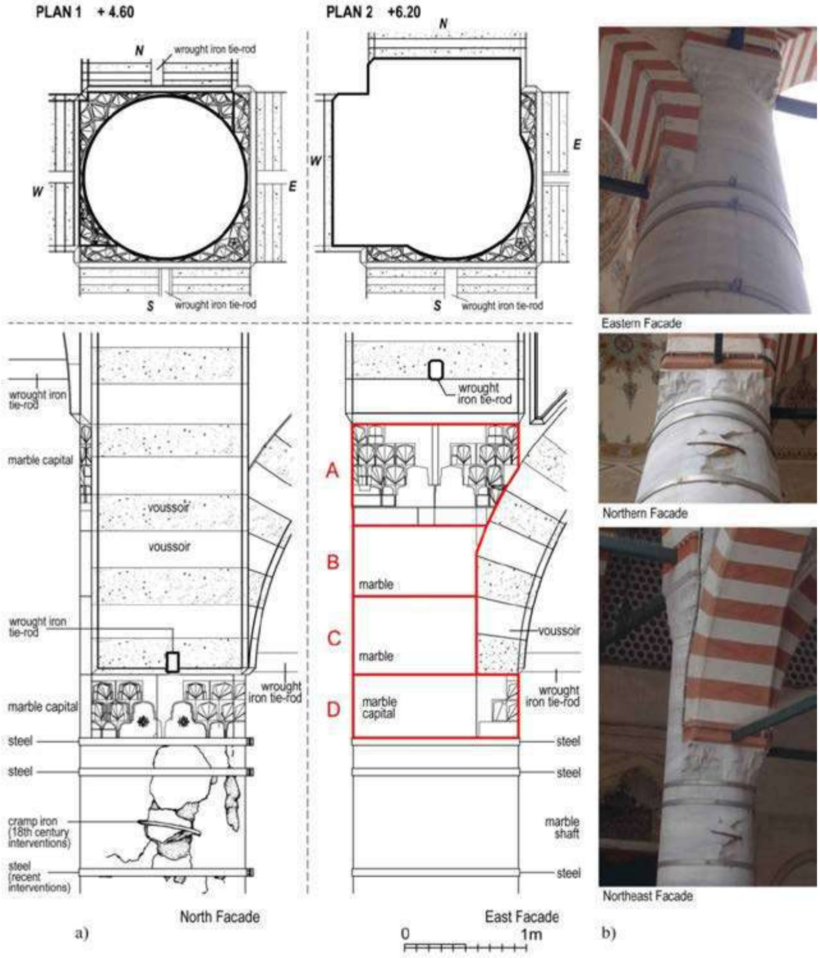


Figure 5. The CL1 column, Üç Şerefeli Mosque: a) scaled drawings of current state (drawn by Author) b) photographs, 2018 (Source: Author)

There are two capitals in CL1 and CL2; upper capital and lower capital. Between those, there is the transition part. This part can be defined as a part of vertical load bearing masonry section (a kind of pier). The capital is formed by placing four layers of blocks on top of each other. The upper and lower capitals consist of one block each (Blocks A and D in Figure 5a), and the transition part two blocks (Blocks B and C in Figure 5a). The blocks are not monolithic (Figure 5a, b). The arches are alternated with one row of red andesite and one row of beige limestone (Figure 5a, b). Because of the last prayer hall arches and the column diameter are equal; the muqarnas schema was applied only for the transition at the corners shown in Figure 5, Plan 1 (Table 3). The upper and lower capital forms a square on the plan layout, but their muqarnas schemas are different. In the connections between the capitals and the shaft, the bracelets have not been used (Figure 5a, b). The ratio of capital (the upper capital, the lower capital, and the transition part) to column height (from the sofa to top of the upper capital) is ~ 1/2,8.

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Figure 6. The CL1 column, Üç Şerefeli Mosque (Source: Altınsoy, 1999)

Regarding this monument that has undergone many repairs throughout history, the 18th-century repair is important. In this repair, the last prayer hall columns that were destroyed during the earthquake of 1752 were rebuilt using original pieces. The three iron bracelets and the cramp iron shown in Figure 6 were added to reinforce the CL1 in this process (Altınsoy, 1999). During the recent repair (between 1990 and 2006), iron bracelets were removed, and the shaft of the column was reinforced with six steel rings. The cramp iron added in the 18th-century repairs is still present (Figure 5a, b).

Fatih Mosque

Fatih Mosque was built in İstanbul by Atik Sinan between 1463 and 1470. The closed-courtyard has found its exact proportions and has become a classic example with this mosque (Cezar 1963; Aslanapa, 1986; Öz, 1987; Eyice, 1995). During the 1766 earthquake, the mosque was damaged severely and rebuilt with a different plan scheme. The closed-courtyard, the last prayer hall, and the prayer hall's northern wall remained from the original structure. The dimension of the prayer hall is approx. 45.00 m x 48.00 m (exterior) in plan. The closed-courtyard is square in plan, 42.00 m x 42.00 m. The width of the portico surrounding the courtyard has an equal dimension in four directions and is covered by domes (Table 1). The columns at the last prayer hall are 8.75 m in height and approx. 0.90 m in diameter. While the columns at the side porticos are 5.45 m in height with a diameter of about 0.65 m.

The capital was formed by placing four layers of monolithic blocks on top of each other. The upper and lower capitals consist of one block each (Blocks A and D in Figure 7a), and the transition part two blocks (Blocks B and C in Figure 7). The voussoirs are alternated in color; marble and red somaki (Figure 7b). The upper and lower capitals are similar in size and shape (Figure 7a, Plan1). The bracelets have not been used between the marble capitals and the granite main shaft as they were in the Üç Şerefeli Mosque (Figure 7a, b). The ratio of capital to the column height is ~ 1 / 2,5.

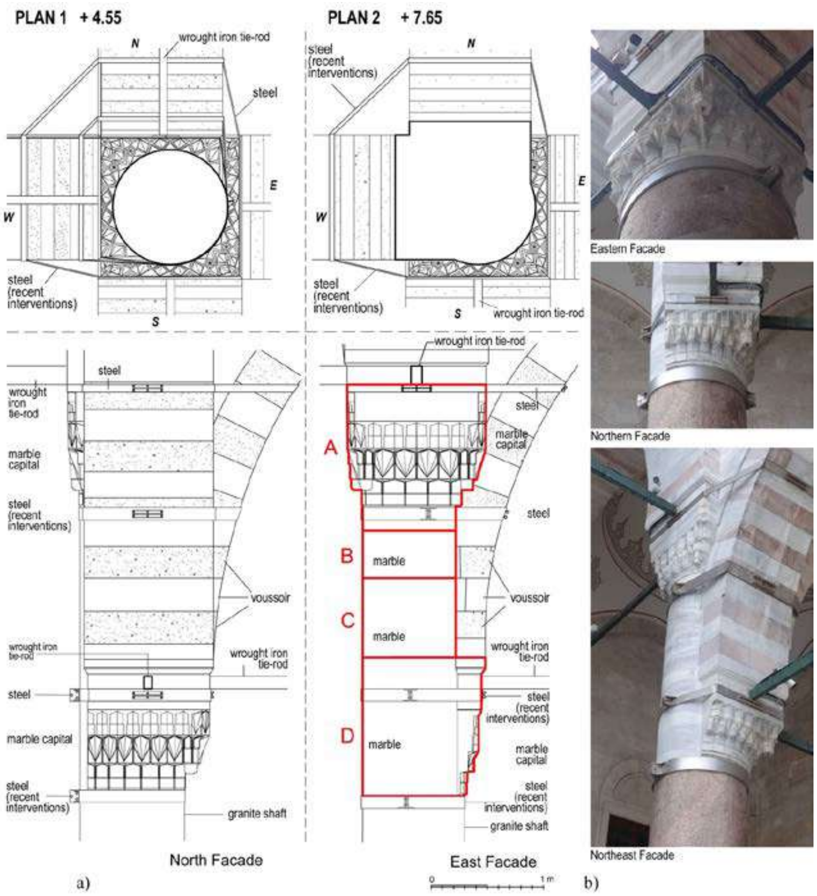

Figure 7. The CL1 column, Fatih Mosque: a) scaled drawings of current state (drawn by Author) b) photographs, 2018 (Source: Author)

The building was recently repaired between 2007 and 2012. During this restoration, the column surface was cleaned, iron strains were cleaned and painted, and cracks were repaired by injection. The wrought iron tie-rods that lost their function were removed and a new stainless steel system was installed to strengthen the structure (Ceylan and Ocakcan, 2013; Çılı and Yıldız, 2013) (Figure 7a, b and 8).

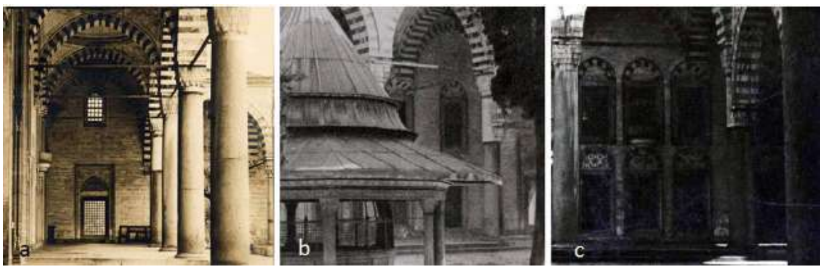

Figure 8. The CL1 column before restoration, Fatih Mosque, a) undated (Source: URL-1), b and c) a date between 1913 and 1963 (Source: Ali Saim Ülgen Archive, URL-1)

Süleymaniye Mosque

The Süleymaniye Mosque was built in Istanbul by Architect Sinan between 1551 and 1558. The dimension of the prayer hall is 64.00 m x 68.00 m, and the closed courtyard 47.00 m x 61.00 m. The widths of porticos are equal in four directions and covered by domes (Table 1). The columns bearing the nine-bay portico is 8.00 m in height with a diameter of 1.10 m. Regarding the side porticos, height is 5.70 m and the diameter between 0.65 m and 0.70 m.

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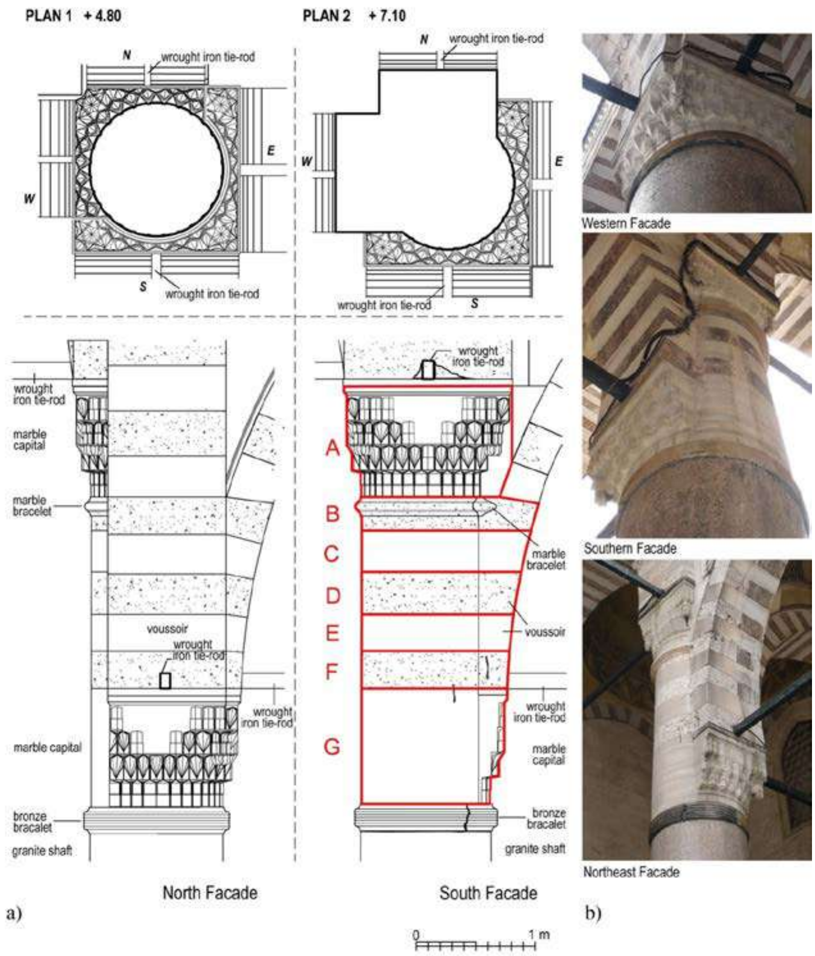

Figure 9. The CL1 column, Suleymaniye Mosque: a) scaled drawings of current state (drawn by Author) b) photographs, 2018 (Source: Author)

The capital was formed by placing seven layers of monolithic blocks on top of each other. The upper and lower capitals consist of one block each (Blocks A and G in Figure 9a), and the transition part five blocks (Blocks B-F in Figure 9a). The capitals form a square on the plan layout, and their muqarnas schemas are similar. There is only a slight difference appears in the Northwest corner of the lower capital (Figure 9a, Plan 1). The lower capital is connected to the granite main shaft with the bronze bracelet. However, the upper capital bracelet is carved out of puddingstone as a part of Block B (Figure 9a). The transition part blocks, which are alternated with one row of marble and one row of pudding, are carved together with the voussoirs (Figure 9). The ratio of capital to column height is ~ 1/2,5. The current appearance of the CL1 column is similar to the mid-20th century (Figure 10).

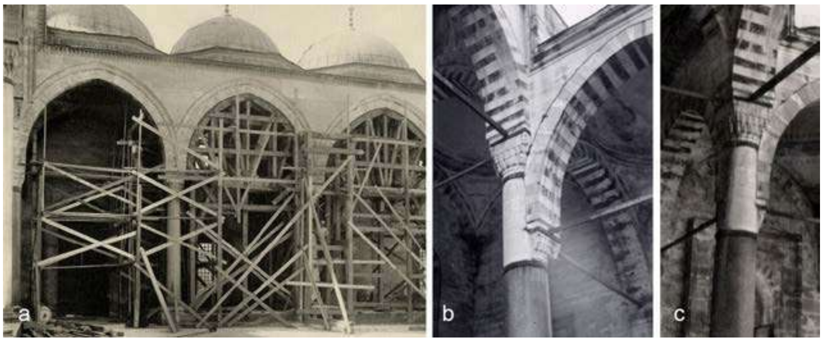

Figure 10. The CL1 column, Süleymaniye Mosque; a) undated (source: URL-1), b and c) a date between 1913 and 1963 (Source: Ali Saim Ülgen Archive, URL-1)

Kara (Gazi) Ahmed Pasha Mosque

The Kara Ahmed Pasha Mosque was built in Topkapı, İstanbul by Architect Sinan between 1565 and 1567. The dimension of the prayer hall is 18.50 m x 26.60 m, and the closed courtyard 46.93 m x 37.43 m. The width of the seven-bay last prayer hall is about twice of the side porticoes. As a result of this, the corner units in the last prayer hall are rectangular and are covered by cross vaults, remaining units by domes (Table 1). The columns in the last prayer hall are 4.00 m in height with a diameter of 0.53 m. Regarding the side porticos, height is 2.78 m and the diameter about 0.54 m.

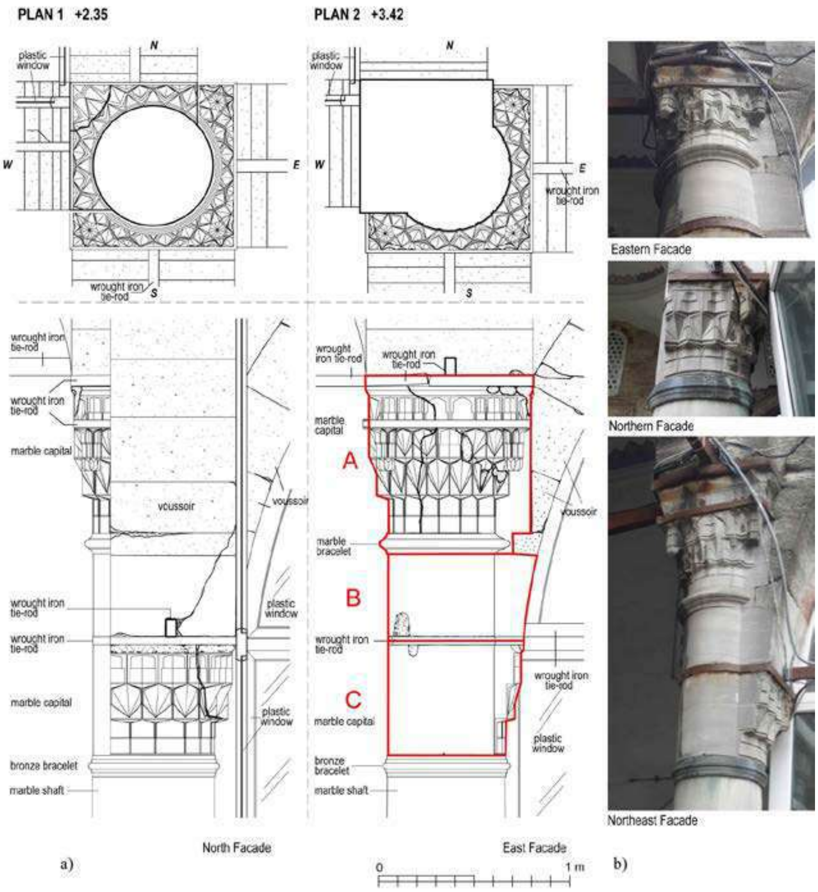

Figure 11. The CL1 column, Kara Ahmet Pasha Mosque: a) scaled drawings of current state (drawn by Author) b) photographs, 2018 (Source: Author)

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The capital was formed by placing three layers of monolithic marble blocks on top of each other. The upper and lower capitals, with the transition part, are made of one block each (Blocks A, B, C in Figure 11a). The upper and lower capital forms a square on the plan layout, but their muqarnas schemas are different (Figure 11a, Plan 1). The lower capital is connected to the marble main shaft with the bronze bracelet. However, the upper capital bracelet is carved out of marble as a part of Block A (Figure 11a). The transition part is carved together with the impost (Figure 11). The ratio of capital to column height is ~ 1 / 3.

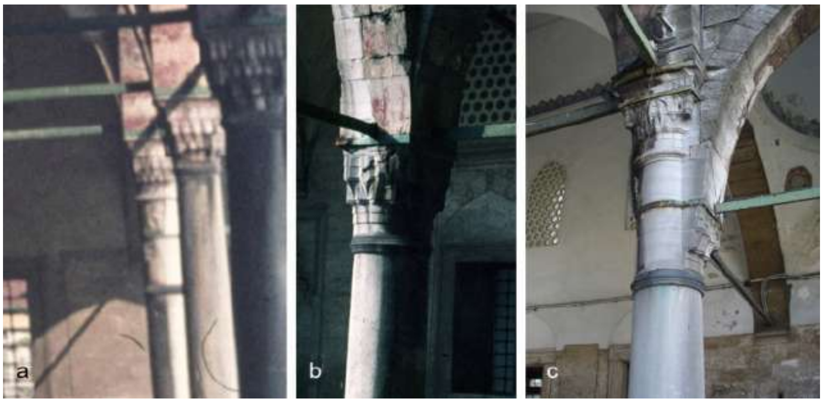

Figure 12. The CL1 column, Kara Ahmed Pasha Mosque: a, b) 1986 (Source: Kemali Söylemezoğlu Archive, URL-1), c) 2011 (Source: Author)

The columns are ruined today. The upper two muqarnas rows of the lower capital are detached (Northern view in Figure 11b). For this reason, an iron bracelet, which is available today, was added between the 3rd and 4th rows of the capital in previous repairs (Figure 11 and 12).

Selimiye Mosque

The Selimiye Mosque was built in Edirne by Architect Sinan between 1568 and 1574. The prayer hall and the closed courtyard are about the same size, 44.00 m x 60.00 m. The porticos' widths are equal in all four sides. A seven-bay space; last prayer hall units are covered by cavetto vaults and domes (Table 1). The columns in the last prayer hall are 8.30 m in height with a diameter of 0.84 m. Regarding the side porticos, height is 5.20 m and the diameter about 0.75 m.

The capital was formed by placing four layers of the monolithic marble blocks on top of each other (Figure 13b). The upper and lower capitals consist of one block each (Blocks A and D in Figure 13a), and the transition part two blocks (Blocks B and C in Figure 13a). The arches are alternated with one row of red andesite and one row of beige limestone, similar to Üç Şerefeli Mosque. The size and shape of the capitals are affected by the arches which have different widths in three directions (Figure 13a, Plan1). The schema of the rectangular upper capital has symmetrical on the courtyard-face, while not symmetrical on the portico-face (Figure 13a, plan 2 and 9b, Southern facade). The capitals connect to the main shaft and the transition part with the bronze bracelets (Figure 13b). The ratio of capital to column height is ~ 1 / 2. The current appearance of the CL1 column is similar to the mid-20th century (Figure 14).

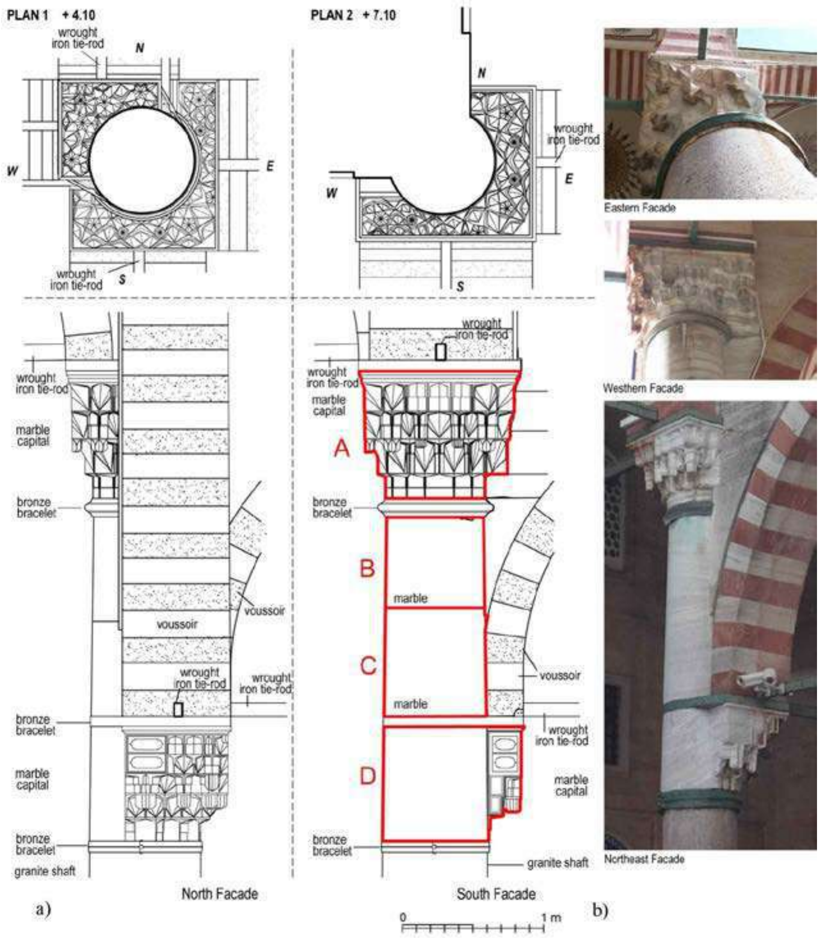

Figure 13. The CL1 column, Selimiye Mosque: a) scaled drawings of current state (drawn by Author) b) photographs, 2018 (Source: Author)

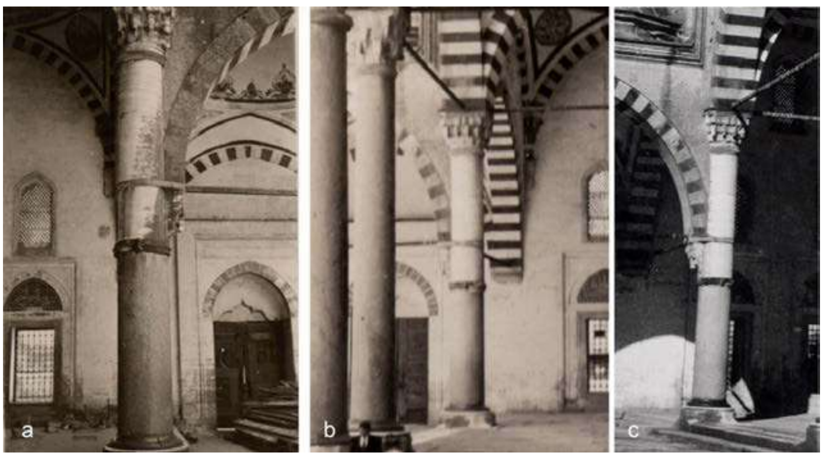

Figure 14. The CL1 column, Selimiye Mosque: a-c) a date between 1913 and 1963 (Source: Ali Saim Ülgen Archive, URL-1)

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Valide-i Cedid Mosque

The Yeni Valide Mosque was built in İstanbul between 1708 and 1710 about 300 years after the first practice. The dimension of the prayer hall is 21.00 m x 27.00 m, and the closed courtyard 31.00 m x 30.00 m. The width of the five-bay last prayer hall is about twice the side porticoes (Table 1). Accordingly, rectangular units in the corners are covered by vaults, remaining units by domes. The columns in the last prayer hall are 5.25 m in height with a diameter of 0.70 m. Regarding the side porticos, height is 4.50 m with a diameter of 0.60 m.

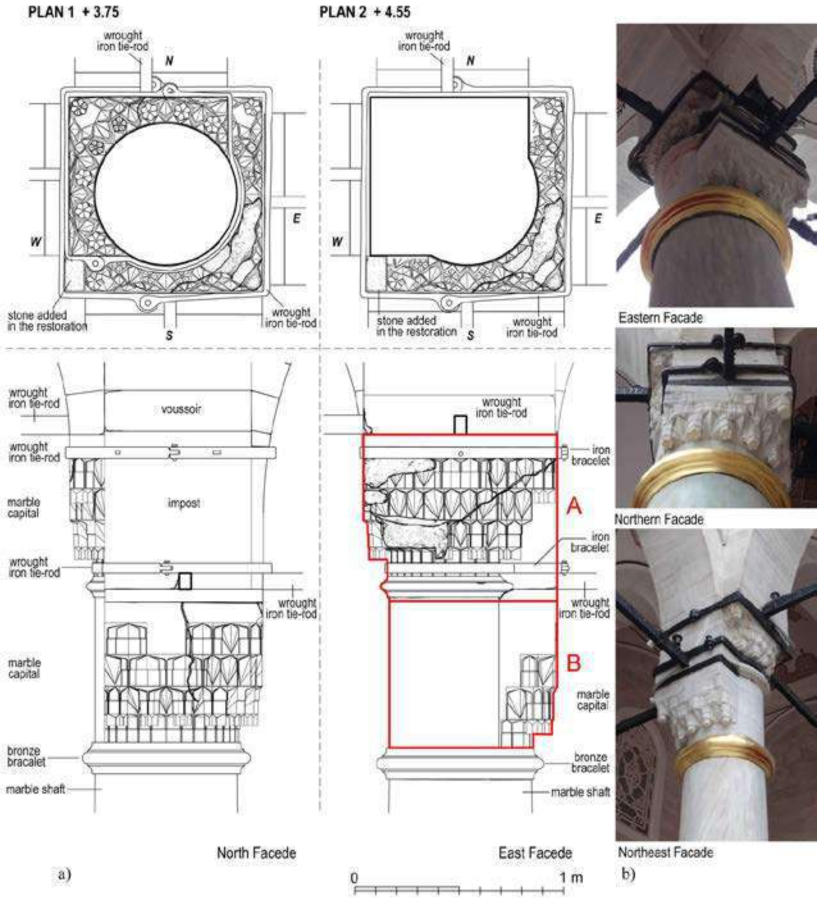

Figure 15. CL1 column, Valide-i Cedid Mosque: a) scaled drawings of current state (drawn by Author) b) photographs, 2018 (Source: Author)

The capital was formed by placing two layers of monolithic blocks on top of each other. The upper and lower capitals consist of one block each (Blocks A and B in Figure 15a). There is no transition part between them. The capitals and the voussoirs are marble (Figure 15b). The schemes of the upper and lower capitals are similar except for minor differences (Plan 1 in Figure 15a). The lower capital is connected to the marble main shaft with the bronze bracelet, while the upper capital bracelet is formed with block A and made of marble (Figure 15). The ratio of capital to column height is ~ 1 / 4.

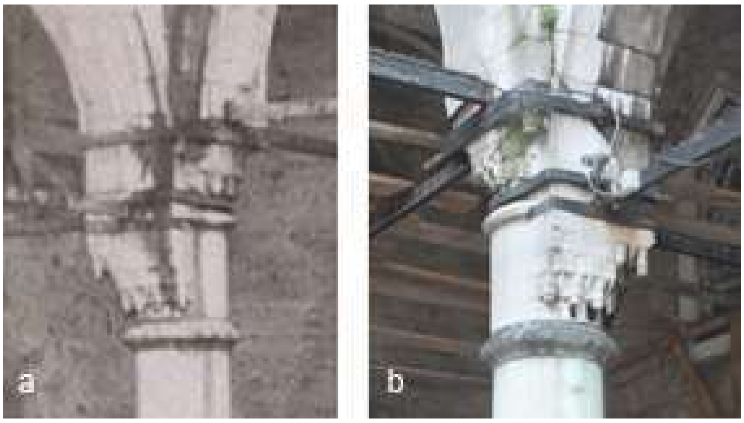

Figure 16. The CL1 column, Yeni Valide Mosque: a) late 19th century - early 20th century (Source: URL-2), b) before recent restoration, 2013 (Source: Author)

There are two iron bracelets on the upper capital. Figure 16 shows that these bracelets in the CL1 existed in the late 19th century - early 20th century. They have been added in a repair before this date. The last repair of the mosque was made between 2013 and 2015. During this restoration, the surface was cleaned, iron tie rods were cleaned and painted, and cracks were repaired by injection (Figure 15).

EVALUATION AND CONCLUSION

According to the data obtained from this study, the features of the capitals vary depending on several factors:

- **Construction period:** The capitals were made in a period for about 300 years. There are dimensional and formal differences between the capitals of early and late period mosques. For example, the shafts of the last prayer hall are thicker than the side porticos in all samples. This dimensional difference is about twice as much in the early period mosques and gradually decreased toward the late period (Table 2, 3). Also in the early period examples (Üç Şerefeli Mosque and Fatih Mosque) there are no bracelets in the connections of the shaft, capital and transition part however there are in the late period mosques (Table 3). The blocks forming the capitals are monolithic except Üç Şerefeli Mosque.

- **The relationship between the last prayer hall and courtyard:** The porticos' dimensions are the primary factor in the capitals' differences. Different portico widths and heights affect the capitals' heights, and thus, affect the shape of the lower and upper capitals (Table 3). It is not possible to select a ratio that would cover all the columns. The ratio of the column capital to column height is in the range of 1/2–1/3 in five of the columns. Only in Valide-i Cedid Mosque, this ratio is 1/4 because there is no shaft between the lower and upper capitals (Table 2, 3).

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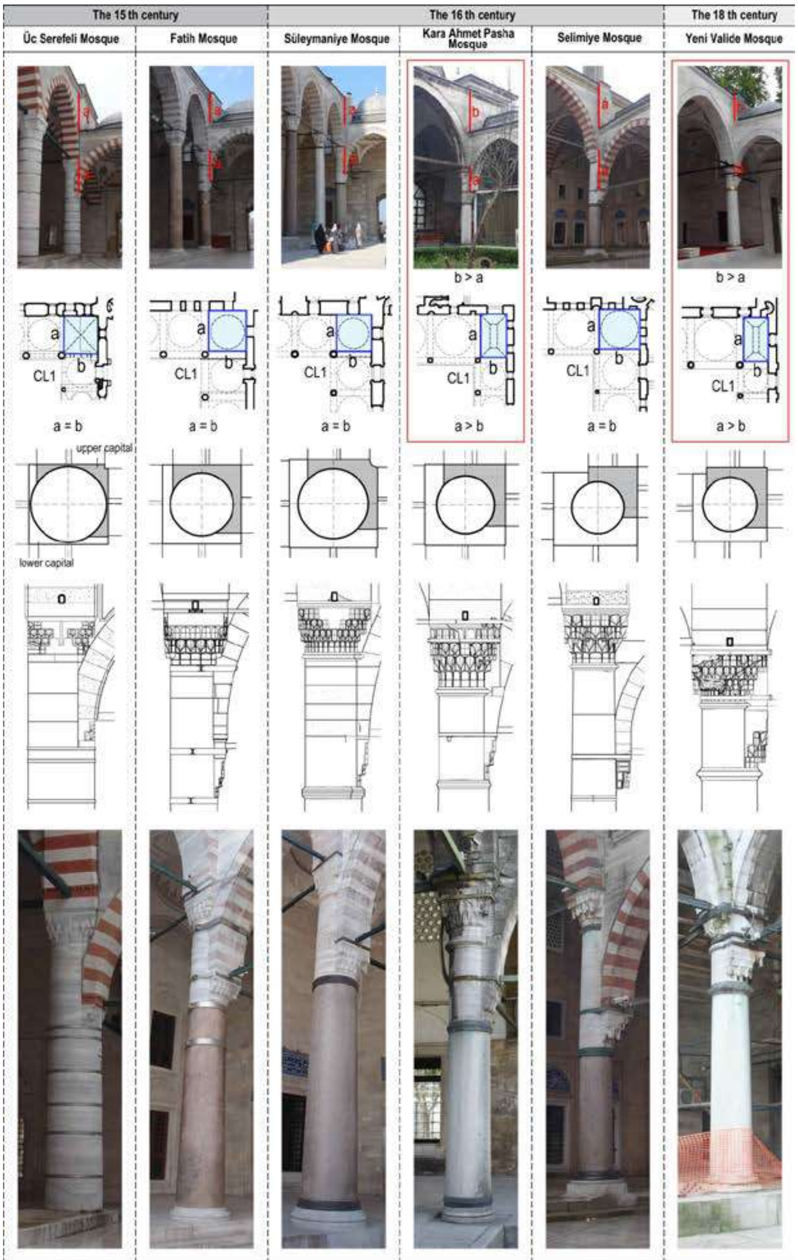
Table 2. The CL1 column dimensions (Source: Author)

MOSQUES	column height (m)		column diametre (m)		arch width (m)		ratio capital/column height
	CL1	side porticos	CL1	side porticos	CL1	side porticos	
Üç Şerefeli Mosque	7.20	5.20	1.35	0.60	1.35	1.00	1/2.8
Fatih Mosque	8.75	5.45	0.90	0.65	1.13	0.98	1/2.5
Süleymaniye Mosque	8.00	5.70	1.10	0.65	1.35	0.97	1/2.5
Kara Ahmed Pasha Mosque	4.00	2.78	0.53	0.45	0.72	0.54	1/3
Selimiye Mosque	8.30	5.20	0.84	0.75	1.35	0.80	1/2
Yeni Valide Mosque	5.25	4.50	0.70	0.60	0.84	0.72	1/4

Table 3. The CL1 column capitals of the mosques (Source: Author)



- **Structural aspects:** The structural necessities have been taken precedence over to the visual concern. For example, in the Selimiye Mosque, the shape of the capital and accordingly its muqarnas schema of upper capital differ due to the different arch widths (Western facade in Figure 13b, Table 3).

- **Visual concern:** The height of the capitals is linked to the height of the last prayer hall but is not always directly proportional. For example, in the Kara Ahmet Pasha and the Yeni Valide Mosques, the height difference between their porticos is more than their capitals' height; however, it is equal in the other mosques (Table 3). Another reason for the differences in the capitals is the diversity of the schema that increases the visual richness. Having the capitals in one of the most intense regions of visual perception has created an appropriate environment in which the master-builder could have demonstrated all of his skills (Table 3).

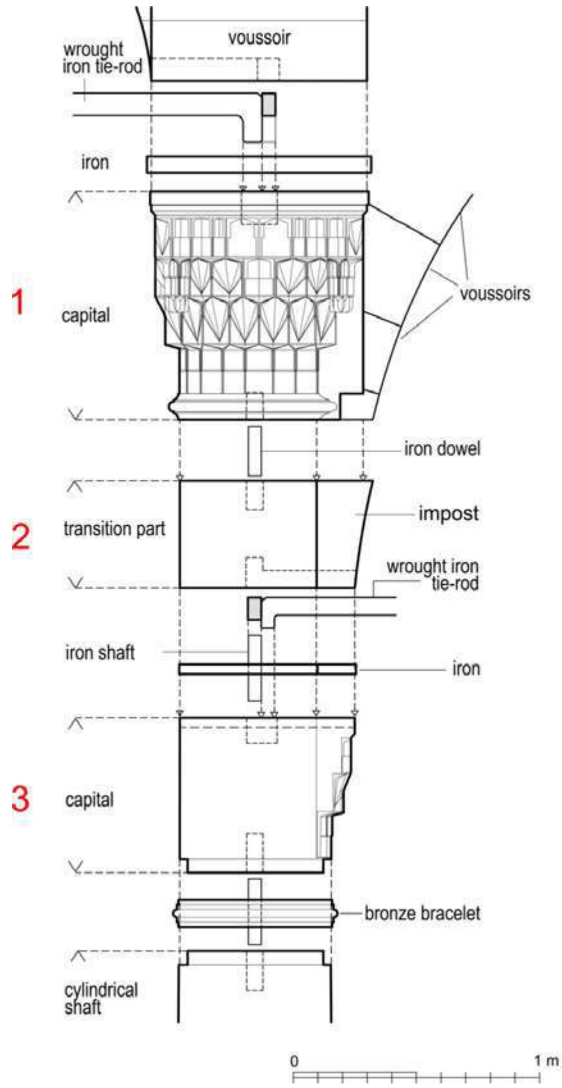


Figure 17. Construction details of the CL1 column capital, Kara Ahmet Pasha Mosque (Drawn by Author)

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Although the size and shape of these six column capitals differ, their construction techniques are similar. The capital consists of three parts: upper capital, lower capital, and transition part as shown in Figure 17 and 18. The vertical iron shaft should have been used in the connection of the blocks as in an ordinary column. The portico arches are connected to the upper capital. For this reason, the capital's shape, size, and material are similar to the portico capitals. The arches of the side porticos were connected to the lower capital, so its characteristics appear to be similar to the capitals at the side porticos. The stone bracelet carved out together with the upper capital (Figure 18, Block 1). At the top of the capitals, a groove that was used for connecting wrought iron tie-rods similar to a typical capital can be seen. However, since only the portico's two arches were attached to the upper capital, two wrought iron tie-rods were connected at this level. On top of this, the imposts of the last prayer hall's arches were placed. In Block 2, the imposts of the side portico's arches were carved together with the transition part. The lower capital (Figure 18, Block 3) connected to the cylindrical shaft with a bronze bracelet (Figures 17, 18).

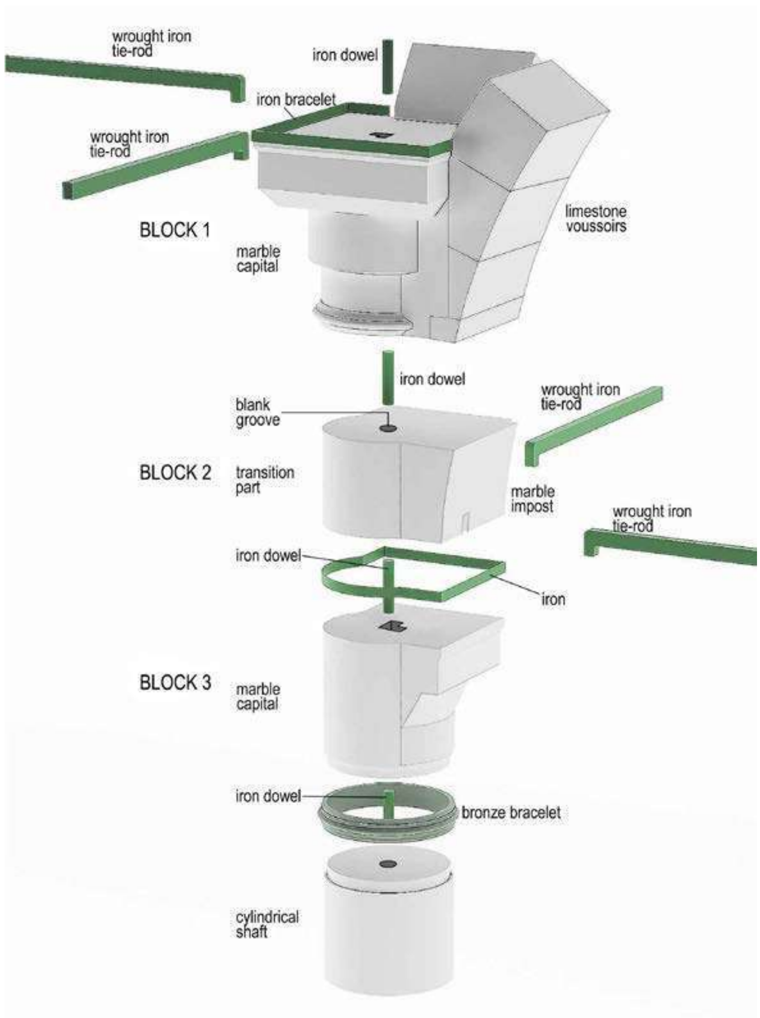

Figure 18. 3D representation (model) of CL1 column capital (Drawn by Author)

Two separate structures that were connected at different heights caused formal differentiation of the columns, and this formation becomes one of the unique examples in Ottoman architecture. We can define these examples as a different interpretation of a traditional practice that emerged as a result of structural necessities. In this point, documenting the present conditions of the capitals, which survived to the present day by preserving their original appearance on a large scale despite minor reinforcement additions, will also provide an important resource for conveying this tradition to future generations.

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URL-2 http://www.eskiistanbul.net/2033/yeni-valide-camii-sadirvani-nikolai-andreomenos-fotografi

Resume

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Urban Conservation Proposal: The Case of Şile Balibey District

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Kemal Kutgün Eyüpgiller**

Abstract

The Balıbey district, analyzed in the scope of this paper, is one of the important surviving districts of the area. This district of importance with its plan schemes, building materials, construction techniques and beautiful large vegetable gardens, was approved as the Şile Central Urban Site and a 1st and 2nd degree natural conservation site area by the Second Board for the Conservation of Cultural and Natural Heritage of Istanbul with its resolution dated 01.28.1992 and numbered 2796.

Urban space analyses were made through field surveys in order to document the present situation, identify the problems, assess the potentials and recommendations were also developed to reveal these potentials. All the buildings in Balibey district of the urban conservation site were examined, the analysis maps prepared in 1/1000 scale were synthesized and proposal maps were prepared. The present situation has been documented, and recommendations have been presented by silhouette studies plans in 1/200 scale conducted on 'Cami Street' the most well-preserved axis of the district. The plans, façade and building materials of the buildings that preserved their originality were considered on a single building scale and classified according to their typology.

Keywords: *Şile, urban conservation, urban texture, vernacular architecture, timber construction system.*

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By mentioning the legal process, suggestions were developed in order to resolve the problems which arise from interaction between the whole district and the work area in Şile, where conservation plan and reconstruction plan do not coalesce. In this work, the aim was to identify the path to be followed for the gentrification of the Balibey District Urban Site Area integrated with the city as a whole, keeping its characteristics and original inhabitants to be handed to future generations.

INTRODUCTION

This study is conducted in Balibey district of Şile, which is the third largest borough of Istanbul and had a settlement since the prehistoric times so far, according to the data obtained from the "Şile Balibey Urban Conservation Proposal" postgraduate thesis prepared in Graduate School of Science Engineering and Technology of Istanbul Technical University in 2017. First stage of the land analysis started in the beginning of September in 2016 and lasted for 10 days. Monuments in and close to the borough and preserved areas such as Hamamdere district, Üsküdar, Camcı ve Cami streets were included in the thesis and the inventory of the buildings in Balibey district was prepared. Second stage of the land analysis started in the beginning of April in 2017 and lasted for 10 days. Types of the houses and facade characteristics were assessed, facade surveys of all buildings in the north south axis of preserved Cami Street were obtained and street silhouettes were prepared.

We opted for Balibey district as the working field due to the increasing construction improper to its original texture and aimed to document the cultural property. Thus, 137 buildings and their plots in Fener Street and the parallel Cami Street were inventoried. Increasing tourism demand, abandonment of the uncared for civil architecture and the reconstruction income endanger Şile, as do they in several urban areas. This study aims to develop conservation proposals to prevent the urban texture from destruction considering the settlement up to this time, economical dynamics and life characteristics.

METHODS

Before working in Şile Balibey district, the potentials and the threats were observed and the juridical status was determined. Borders of the working field was defined according to the maps of the registered monuments, obtained from Şile Municipality Reconstruction and Urbanization Unit on 10.4.2016 and Şile inventory list, obtained from Sixth Board for the Conservation of Cultural and Natural Heritage of Istanbul on 02.21.2017.

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In the scope of the study, first the existing situation was determined. On the current map of Şile; destroyed, abandoned and damaged buildings, urban furniture, pavements and roads, and the recent buildings were updated. After analysis maps in 1/1000 scale, for silhouette studies in 1/200 scale in Cami Street, survey measurements were done in the conventional manner and the required intervention decisions were ascertained.

All published documents related to Şile until this time were assessed in detail. The data, acquired from theses focused on reconstruction and urbanization, were analyzed in comparison with the existing situation considering the chronology and recent information. The resources were gained from libraries, digital databases and academic platforms.

LOCATION AND HISTORY

Şile is located on the north-west of Turkey, north-east of the Marmara region and on the Black sea shore of the Kocaeli peninsula. The area of the district which is 55 km west of Ümraniye, one of the central districts of Istanbul, is 755 sq. km[1] (Ertek, Kozak & Evren, 1998, p. 3). The district center is located at the tip of a peninsula reaching out to the Black sea (Fig.1).

[1]https://tr.wikipedia.org/wiki/%C%9Eilc, access date 14.04.2016.

Figure 1. Map of Istanbul and its districts *(http://www.turkiye-haritasi.net/istanbul-haritasi.html, access date 29.04.2017)*

The evidence that Şile was inhabited since pre-historic times can be seen in its historical development. Tools made of flintstone that were found at stream beds during archeological excavations show that this place was inhabited during pre-historical periods of Paleolithic Period, Middle Paleolithic Period and Mesolithic Period (Özdoğan, 1982a, p. 48; Özdoğan, 1982b, p. 137; Özdoğan, 2016, p. 19). Although the finds indicate the presence of habitants in the region, remains of a settlement from the period could not be discovered (Özdoğan, 2016, p. 20; Özdoğan, 2014, p. 37).

Throughout history the Şile Region was occupied by the Hittites, Phrygians, Lydians, Persians, Bithynians, Romans and Byzantines respectively (Temir, 2010, p. 16). The district that was ruled by the Genoese and Seljuks for a short period (Ertek, Kozak, & Evren, 1998, p. 172), has a rough period under the rule of first Byzantine, then Turkish rule.

Şile that was under the Ottoman rule for almost 500 years, was considered as the Straits Region and was transferred to British rule due to the armistice signed during the First World War (Uykucu, 1973, p. 364-365), and was retaken from the British rule on 7 October 1922 (Ertek, Kozak & Evren, 1998, p. 176). Following the proclamation of the Republic, new municipalities were formed around the country. It is alleged that Şile Municipality, established in 1923, is one of the first ones (Aksel, 1995, p. 180).

The district and its surroundings known today as Şile was named diversely by different civilizations and these names form the source of the present name. It was called *Artana*[2] (Umar, 2004, p. 113) in the early ages, *Philee*[3] during ancient times, *Khela*[4] (Umar, 1993, p. 24) during the middle ages and *Şili* Âşık Paşazade and Neşri and *Şilihisar* in Behişti during the Ottoman period (Muslu, 1999, p. 16-17).

[2] The meaning of Artana in the Luvi language is Land of Rivers (Umar, 2004, p. 24).

[3]Means "Wild Flower" in ancient Greek.

[4]Is described as "curved breakwater reaching the sea", "wave breaker" (Umar, 2004, p. 430).

MONUMENTAL BUILDINGS

FORTRESSES

Şile Fortress: It is located on Block 135 Lot 1 on the Ocaklı Island (Fig.2: a, c, d) (Ertek, Kozak & Evren, 1998, p. 262). The fortress is also named after the Ocaklı Island (Temir, 2010, p. 100). The Şile Fortress was registered on 10.07.1981[5]. The fortress located on the crest of the hill is surrounded with fortification walls (Fig.2: b) (Fıratlı, 1952, p. 18). There are different opinions about the construction of the fortress. Although it is believed that the fortress is a Byzantine building from the 13th century (Ertek, Kozak & Evren, 1998, p. 262; Uykucu, 1973, p. 365; Temir, 2010, p. 102) yet some sources state that it was built by the Genoese (Temir, 2010; Güner, 2013, p. 22).

[5]http://www.envanter.gov.tr/anit/kentsel/detay/40959, access date 20.03.2017.

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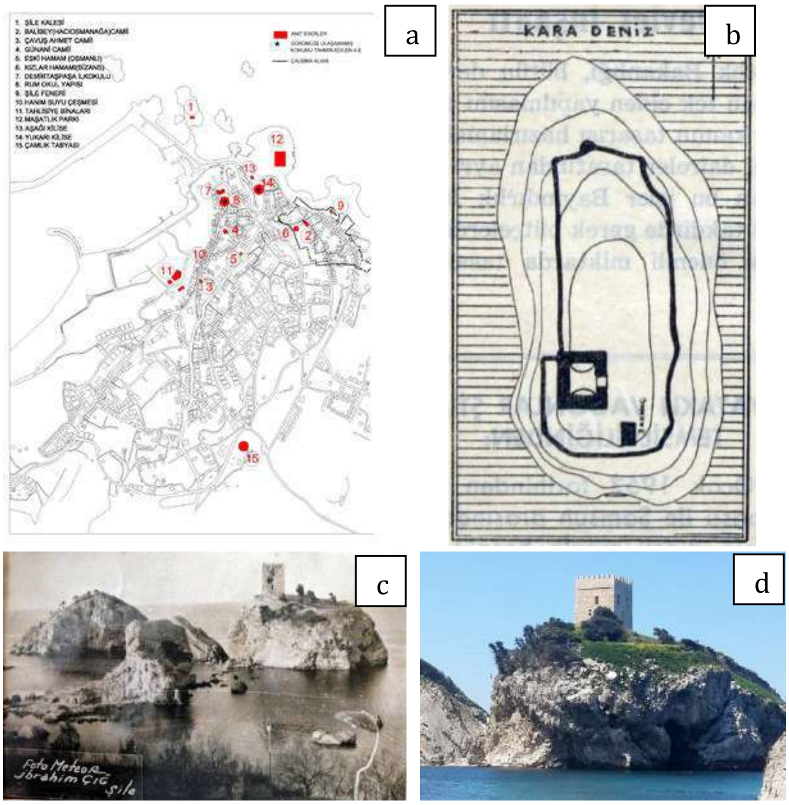

Figure 2. a) The location of the monuments in the center of Şile *(Drawing: Aydın, 2017).* b) Şile Fortress, fortification wall and cistern *(Fıratlı, 1952, p. 18).* c) Şile Fortress *(Photo: İbrahim Çığ).* d) Şile Fortress after restoration *(Photo: Aydın, 2017).*

Heciz Fortress: It is located on a hill at the steep slopes of Yeşilvadi situated at the Kalealtı district of Şile (Fig.3: a) (Ertek, Kozak & Evren, 1998, p. 262; Temir, 2010, p. 102). It is about 15 km on the Şile-Üsküdar highway (Ertek, Kozak & Evren, 1998, p. 262). There are different arguments on who built the fortress. Even though some sources state that it was built by Byzantines against enemy attacks from Anatolia century (Ertek, Kozak & Evren, 1998, p. 262; Uykucu, 1973, p. 365; Temir, 2010, p.102). Fıratlı claims that the fortress was built by the Ottomans at the end of the 14th century (Fıratlı, 1952, p. 20).

Sarı Kavak Fortress: It is located near Hasanlı village 32 km away from the center of Şile (Fig.3: b) (Ertek, Kozak & Evren, 1998, p. 262; Temir, 2010, p.102). It is believed that it was built by the Byzantines against enemy attacks coming from Anatolia (Uykucu, 1973, p. 366; Temir, 2010, p.102; Şile Tanıtım Kitabı, 1995).

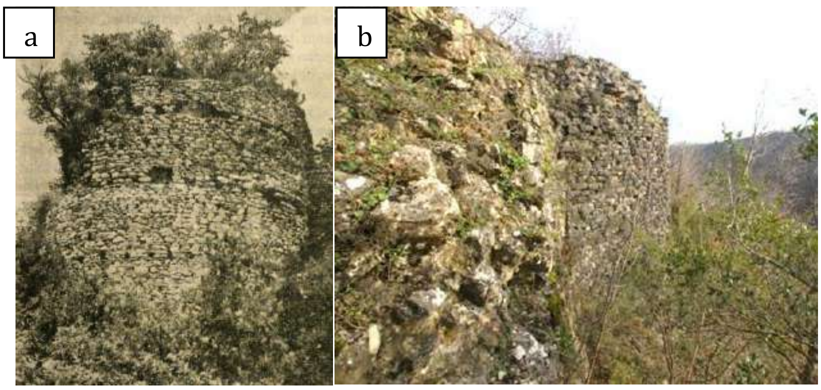

Figure 3. a) Heciz *Fortress (Fıratlı, 1952, p. 19).* b) Sarıkavak Fortress ruins *(Photo: Bünyad Dinç; http://www.aktuelarkeoloji.com.tr/sarikavak-kalesi).*

Teksen Fortress/Citadel: It is located quite close to Akçova settlement which is near Ağva Teksen Village on the southeast of Ağva (Uykucu, 1973, p. 366; Dinç, 2013, p. 37). It is believed to be a Byzantine monument (Uykucu, 1973, p. 366; Dinç, 2013, p. 39).

MOSQUES

Balibey (Hacıosmanağa) Mosque: It is located on the corner of Cami Yokuşu and Cami Streets in the Balibey District (Fig.2:a ; Fig. 4). The building on Block 48 Lot 1 was registered on 28.01.1992[6]. The construction date is unknown.

[6]http://www.envanter.gov.tr/anit/kentsel/detay/49137, access date 20.03.2017.

Figure 4. a) Hacıosmanağa Mosque and wooden building *(Photo: Aydın, 2017)* b) Hacıosmanağa Mosque, mihrab and edge of the window *(Photo: Aydın, 2017).*

Çavuş Ahmet Mosque: It is located on Block 93 Lot 30 on the corner of Üsküdar Road and Çavuş Ahmet Street (Fig.2:a). Although the building date of the mosque is unknown it is believed to be a 20th century monument (Fig.5). The mosque was registered on 28.01.1992[7].

[7]http://www.envanter.gov.tr/anit/kentsel/detay/49172, access date 20.03.2017.

Figure 5. Çavuş Ahmet Mosque, before and after intervention *(Güner, 2013, p. 32; Picture 2.13).*

Günani Mosque: It is located on Block 16 Lot 1 opposite the present Şile Municipality building and on the corner of Üsküdar Road and Mektep Street (Fig.2:a; Fig.6). The mosque is a Republic Period monument and was inaugurated on 23 May 1952. It was registered on 28.01.1992[8].

[8] Şile (İstanbul) Explanatory Report of Conservation Master Plan -1992.

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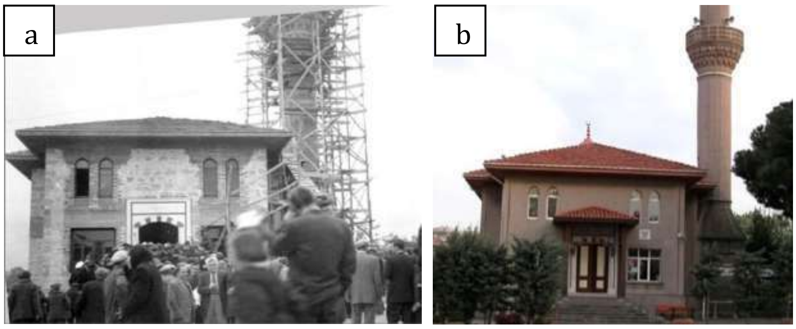

Figure 6. a) Günani Mosque 1970's *(Güner, 2013, p. 32; Picture 2.14, Atılay Erge Archive).* b) Günani Mosque entrance facade, 2017

HAMMAMS

Eski Hamam (Ottoman) (Old Hammam): It is located on Block 10 Lot 2 on the Cumhuriyet Road at the Hamamdere District of Şile (Fig.2:a; Fig.7). It was registered on 28.01.1992[9]. Although its building date is unknown, some sources state that it is an Ottoman monument (Ertek, Kozak & Evren, 1998, p. 264; Şile Tanıtım Kitabı; Temir, 2010, p.110).

[9]http://www.envanter.gov.tr/anit/kentsel/detay/40812, access date 20.03.2017.

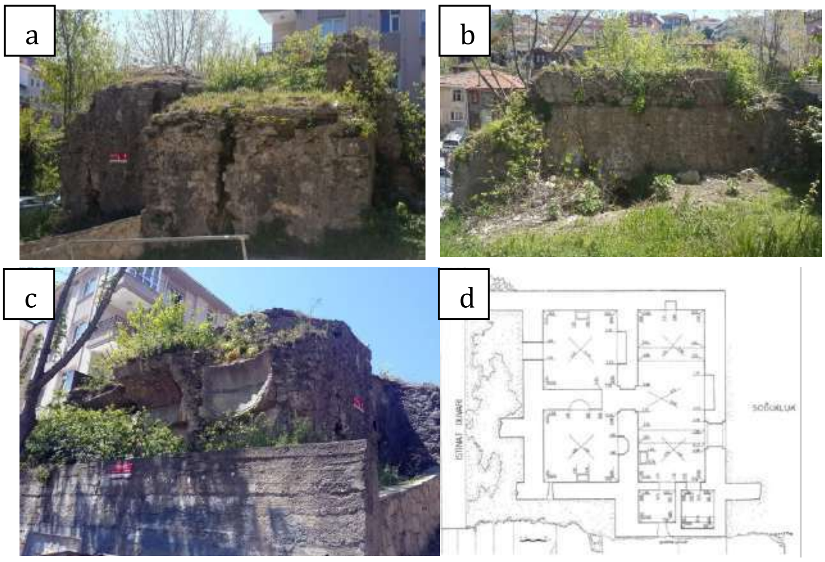

Figure 7. a) Eski Hamam (Old Hammam), 2017. b) Eski Hamam (Old Hammam), 2017. c) Eski Hamam (Old Hammam),2017. d) Eski Hamam plan (Old Hammam) *(Teker, 1992)*.

Kızlar Hamamı (Byzantine) (Girls' Hammam): These ruins believed to be from the Byzantine period are mentioned as Girls' Hammam (Uykucu,1973, p. 366; Kasar, 1987, p. 58; Teker, 1992, p. 24; Şile Tanıtım Kitabı, 1995; Temir, 2010, p.110). Its ruins are on Block 46 Lot 8 on the Cami Yokuşu Street near the Fener site (Fig.2:a; Fig.8).

Figure 8. Ruins of the Girls' Hammam, 2017

EDUCATION BUILDINGS

Demirtaşpaşa Primary School (Ottoman school building): It is located on Block 136 Lot 1 (Fig. 9: a,b) where the Üsküdar Road meets the harbor in Hacıkasım District (Teker, 1992, p. 27; Güner, 2013, p. 36). It was built in 1927 and education at the school started in 1930[10]. It was registered on 28.01.1992[11].

[10]http://silekizteknik.meb.k12.tr, access date 20.03.2017.
[11]Şile (İstanbul) Explanatory Report of Conservation Master Plan -1992.

Greek School Building: This school building that could not reach today is described in the book "Şile'nin Ağıtı" (Lament for Şile) written in Athens in 1988 by the Greek writer Yeorgios Bakalakis, expatriate of Şile (Şarlak, 2010, p. 70). Bakalakis describes the location and the plan of the school in his text (Fig.2:a; Fig. 9: c).

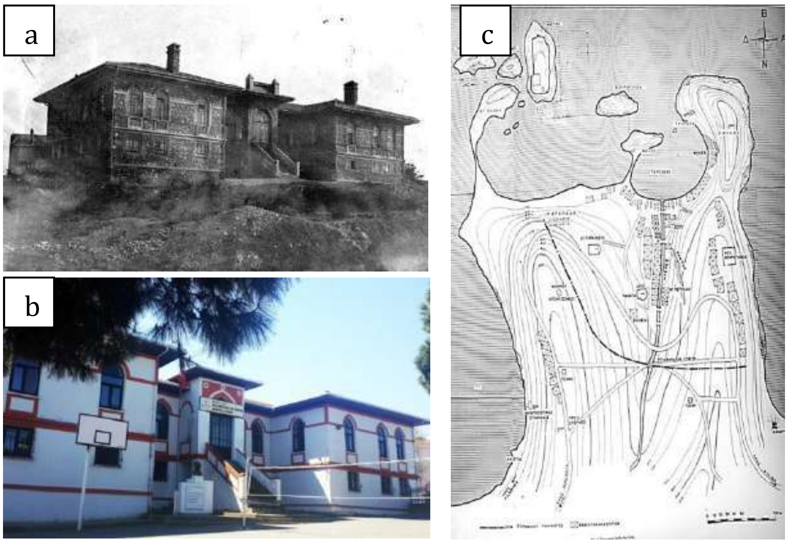

Figure 9. a) Demirtaşpaşa Primary School (*Photo:http://silekizteknik.meb.k12.tr).* b) Demirtaşpaşa Primary School, 2017. c) Map of Şile in 1920 *(German Archeology Institute).*

OTHER BUILDINGS AT ŞİLE'S CENTER

Şile Feneri (Lighthouse): It is located on Block 26 Lot 23 in the Balibey District (Fig.2:a; Fig.10) and was registered on 28.01.1992[12]. The lighthouse was built by the French and was put into service in August 1859 (Kolçak, 2010, p. 94; Seri, 1994, p. 23). The Şile Feneri, which is a routing lighthouse (Demirel, 2011, p. 24; Toroslu, 2009, p. 76), is serving as a museum exhibiting components of its original system since 2004 (Temir, 2010, p. 97).

[12]http://www.envanter.gov.tr/anit/kentsel/detay/49128, access date 20.03.2017.

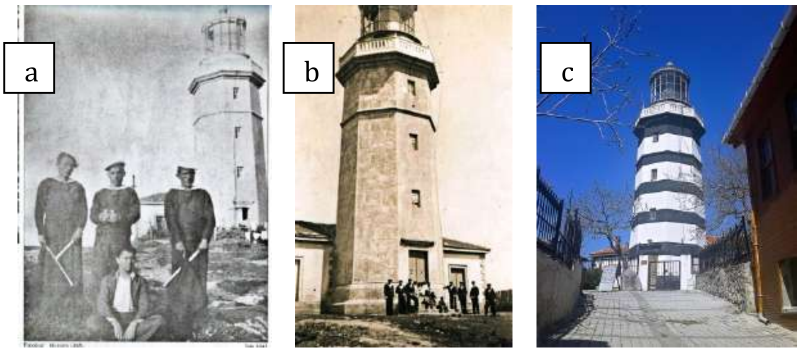

Figure 10. a) Şile Lighthouse *(Photo: Mustafa Ünal 1941).* b) Şile Lighthouse *(Photo: Anonymous).* c) Şile Lighthouse, 2017.

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Hanım Suyu Fountain: It is located in the center of Şile on Lot 27 on the corner of Üsküdar Road and Çavuş Ahmet Paşa street (Fig.2:a; Fig.11) and was registered on 28.01.1992[13]. It is believed to be built in 1871 (H.1287) as a charity under patronage of Mısırlı Hatice Hanım during the Ottoman period (Uykucu, 1973, p. 366; Ertek, Kozak, & Evren, 1998, p. 263; Temir, 2010, p. 106).

[13]Şile (İstanbul) Explanatory Report of Conservation Master Plan -1992.

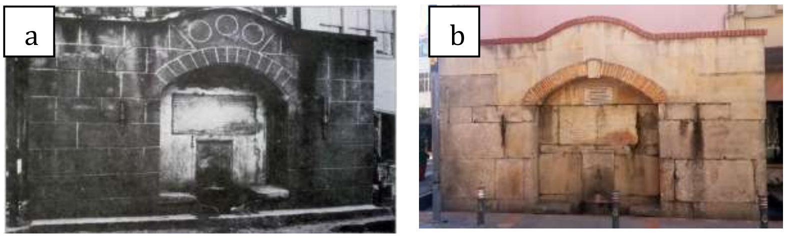

Figure 11. a) Hanım Suyu Fountain *(Photo: Anonymous, 1974).* b) Hanım Suyu Fountain *(Photo: Aydın, 2017).*

Salvage Buildings: They are built on the foothills of the slopes facing the Şile Harbor (Ertek, Kozak, & Evren, 1998, p. 266). It is registered that these buildings were built in 1883 following the establishment of the Ottoman Salvage Administration in 1869 (Aygün, 2010, p. 82). The salvage buildings comprising stations, barracks, boathouses and rocket-houses are located at different parts of the town. The Şile Salvage Buildings lost its lifesaving functions with the landfills made in front of them during the construction of the harbor (Fig.2:a; Fig. 12).

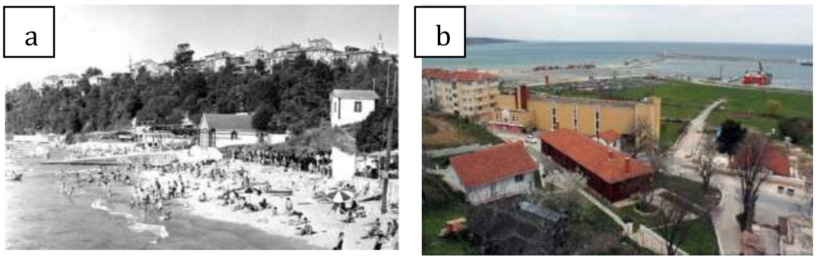

Figure 12. a) Salvage Building before losing fuction *(Photo: Anonymous, 1965).* b) Salvage Building *(Photo: Güner, 2013, p. 30; Picture 2.11).*

Maşatlık Park (Greek Cemetery): Today there are ruins of walls not higher than 1,5-2 meters on the non-Muslim cemetery area located on Lot 22 at the tip of Fener Road in the Balibey District (Fig. 13) (Ertek, Kozak, & Evren, 1998, p. 264; Muslu, 1999, p. 74-77). Lots 12 and 2 of the Maşatlık Park located on Block 22 were registered on 21.08.1997[14].

[14]http://www.istanbulkulturenvanteri.gov.tr/anit/kentsel/detay/49126, access date 20.03.2017.

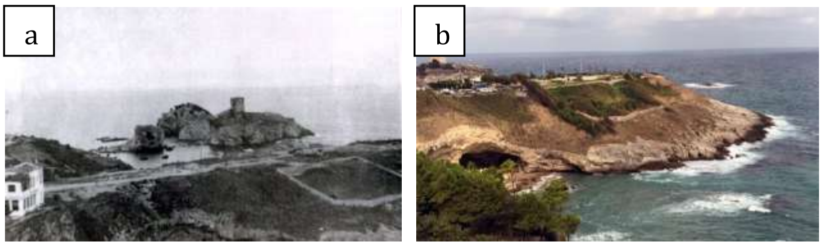

Figure 13. a) Maşatlık Peninsula *(Photo: Güçlüel, 1952).* b) Maşatlık Peninsula *(Photo: Aydın, 2017).*

Church Ruins: Ruins found on Block 103 at the Çavuş District indicate the presence of a church. The church whose construction date is unknown is believed to have been built at the end of the

19th century. These ruins were registered on 03.02.2006[15] (Fig.2: a; Fig.14: a).

[15]http://www.envanter.gov.tr/anit/kentsel/detay/41097, access date 20.03.2017. (There is a mistake in the inventory: although Yeniköy is written as the village, the Church ruins in the Çavuş neighborhood are described.)

Çamlık Redoubt and Arsenal: There are ruins of an arsenal where the ammunition of the redoubt was kept and a position area and a cistern next to an old reservoir in the park (Fig.2:a) located on Block 70 Lot 3 at the Üst Çamlık Area of the Çavuş District (Fig.14:b). The building ruins are believed to be 100-150 years old. The park belongs to the Treasury and was registered on 22.12.1992[16].

[16]http://www.envanter.gov.tr/anit/kentsel/detay/40797, access date 20.03.2017.

In addition to the immovable cultural assets in Şile, there are quite a lot of movable cultural assets. Yüksel Özden Antik Park and Kumbaba[17] Touristic Facilities located on Block 23 Lot 29 are places where archeological finds from the vicinity of the town are exhibited.

[17] It is a historical motel known as Kumbaba and was built by the late Turan Aziz BELER in accordance with the natural structure of sand. It was one of the main European tourist attractions in the 1960's. Today it is being restored. Its new function will be Şile Cloth Modelling Center with hands-on training for the production of Şile cloth. It will also function as an open-air museum.

Figure 14. a) The ruins of the church *(Güner, 2013, p. 34; Picture 2.17).* b) Ammunition depot *(Photo: Aydın, 2017).*

PROTECTED AREAS

The initial site decision for Şile was taken to prevent irregular settlements around the Şile-Istanbul highway and to protect Şile from becoming a dense housing area outside the tourism season because of the easier and shorter access to Istanbul. Prof. Dr. Mete Tapan, who at the time was a member of the conservation board, in an interview he gave to Cumhuriyet newspaper in 1990 stated that the new Şile-Istanbul highway under construction would in the future cause a rapid housing development in Şile and emphasized that the Natural Site Decision and the Conservation Master Plan would save the future of Şile[18].

[18]Cumhuriyet newspaper dated 23 December 1990 p: 15 (Tapan, M. 1990).

Şile town center was declared urban site and Grade I and II natural site by the Second Board with a decision dated 28.01.1992 and numbered 2796. The border of the urban site comprises the area between the east of Üsküdar Road and the west of Fener Road. On the north of the settlement, the site area is framed with the new housing around Fener and the Maşatlık Mevkii (Fig.15).

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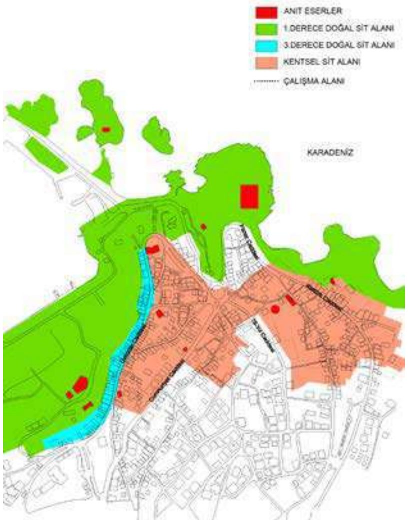

Figure 15. Protected Areas of Şile Central.

On the south, it ends where the old town texture disappears, and new development starts[19]. The 1/5000 and 1/1000 urban and natural conservation plans for the town center, published in 6 parts in 1992, were approved by the board's decision dated 22.09.1992[20] and numbered 2934. As the conservation board agreed to transform the Grade II natural sites into Grade III by a decision dated 17.09.1998 and numbered 4915, plan revisions were approved by the board decision dated 12.04.2001 and numbered 6001 (Dinçer, Enlil, Evren & Som, 2011, p. 33).

[19]Şile (İstanbul) Explanatory Report of Conservation Master Plan -1992.
[20]The date in question is stated as 02.09.1992 in the Istanbul Environment Report 2008-09 (p.136) and the Istanbul Environment Report 2014 (p.161).

Whereas for Şile Doğancalı and Alacalı Region the Grade I and II archeological site with an area of 96,24 hectares published in 3 parts in 1997 was approved with the decision dated 11.12.1997 and numbered 4667 (Dinçer, Enlil, Evren, & Som, 2011, p. 40). The Domalı (Sahilköy) Göztepe Region of Şile was declared an archeological site with the decision dated 07.02.2001 and numbered 5950. The 1/5000 and 1/1000 conservation plans of the site were approved by the board with the decision dated 17.03.2004 and numbered 6888. The Second Board has declared a part of Ağva settlement with an area of 20,71 hectares Grade I natural site and Grade I archeological site with a decision dated 13.04.2001 and numbered 5572. 1/5000 and 1/1000 conservation plans and 1/500 urban design projects are approved by board decisions dated 08.01.2003 and numbered 6544 and dated 16.11.2005 and numbered 586 (Dinçer, Enlil, Evren, & Som, 2011, p. 42-43).

Today Şile falls into the area of responsibility of Istanbul 6th Cultural Heritage Preservation Board.

LIMITS OF AREA OF STUDY AND THE CHARACTERISTICS OF THE SETTLEMENT TEXTURE

LIMITS OF THE AREA OF STUDY

The area of study analyzed in the scope of this paper is at the Balibey district situated at the north of Şile town. It forms part of the urban site area determined by the Cultural and Natural Heritage Regional Committee and comprises the immediate surroundings of Fener road and Cami Street (Fig. 16). At its north, it is limited by the cliffs that are natural borders and at its east comprises all the buildings facing Atatürk road. There are the Kızlar Hamamı believed to be from the Byzantine period, the Şile Lighthouse built in 1857, Balibey (Hacıosmanağa) Mosque believed to date from 19th century and examples of civil architecture with traditional characteristic.

Figure 16. Satellite Image of Şile Balibey District Work Area.

CHARACTERISTICS OF THE SETTLEMENT TEXTURE

In Şile, where the natural environment is nested with the built environment, the examples of traditional civil architecture integrated with nature and the topography forms a harmonious silhouette with its hillside and sea facades (Fig. 17). The topography, view-direction and street texture are effective in the positioning of the buildings on the terrain (Fig. 18). The buildings positioned perpendiculars to the slope are in harmony with the natural state of the terrain. The buildings face the street with cantilevers on their facades and benefit from the sea and land views with their back gardens. The street texture is effective in the positioning of buildings and footpaths and dead-ends formed according to the conditions of the terrain have influenced the rules for the positioning of buildings. Vegetable gardens and orchards have important environmental significance for the region. It is observed that most of the buildings have street facades, with rear fronts opening to quite large and sloping vegetable gardens and orchards. There are also examples of traditional houses with gardens in the area. Today, settlements

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parallel to the grade lines have caused a gradually rising texture and the housing texture along the Fener road is different from the traditional texture of the area and is formed by high-rise buildings (Fig. 19).

Figure 17. Silhouette of Balibey District from the front slope *(Photo; Anonymous).*

Figure 18. Silhouette of Balibey District from the front slope *(Photo; Anonymous).*

Figure 19. Balibey District Coastal Silhouette from the park, *(Photo;Aydın, 2017).*

EVALUATION OF THE TRADITIONAL HOUSING ARCHITECTURE

The traditional houses of Şile are positioned on sloping and narrow streets and are generally one or two-storeys high. These buildings believed to be 100-150 years old are mostly built as timber framed houses .These buildings with extremely simple designs do not have any exterior or interior ornaments (Temir, 2010, p. 113-117).

When the traditional housing in the Balibey district chosen as the area of study is analyzed, it is observed that there are a few single-storey buildings. The area has mostly two-storey houses. If there is a half-floor or a low basement due to the slope, this space is used as either a woodshed or winter storage. These buildings generally designed according to the traditional Turkish house plan types vary mostly according to the layouts of their facades, their rooms with cabinets and stoves, their sofas (halls) and cantilevers (Göktaş. 1992, p. 22). These houses were destroyed in time, some were abandoned, and some lost their plan schemas and original facades through insensate interventions due to the wish to adapt to present conditions.

The pilot area chosen for conservation within the scope of the study is Cami Street. The facades of the buildings on this street were measured for measured drawings but as entering the buildings was not possible in a large part of the area, the plans could not be determined. The thesis studies made all across Şile in the past years and the Explanatory Report of the Şile Conservation Master Plan prepared in 1992 were analyzed and a new proposal for the classification of the plan and façade typologies was made according to these data.

Plan characteristics

When the traditional housing space setup is observed, it is seen that the ground floor comprises daily living space and the upper floor has bedroom units (Eraslan, 2010, p. 29; Göktaş, 1992, p. 23). The ground floor comprises a room with a stove used as the kitchen, common spaces such as the daily living room and the toilet (Göktaş, 1992, p. 23). There is a link between the sofa on the ground floor and the units of the house (Göktaş, 1992, p. 23; Teker, p. 31). The windows of the living rooms that are placed on the façade that can best see the street are at the same time designed to see the street and the entrance door. The above-mentioned room with a stove and the living room are sometimes a single unit in some examples (Göktaş, 1992, p. 23). The upper floor rooms are cantilevered to benefit from the view. There are large closets (yüklük) for mattresses, bedding, quilts and clothing. One unit of these closets that consist of three parts is designed as a bath closet (Göktaş, 1992, p. 24). As a result of the documentation study made in the area, it was determined that most of the single and twin buildings have symmetrical plans and facades with regard to their middle axis. When all data is studied it is possible to make a new classification for the plan types with respect to their sofas (Fig.20).

Single houses
- With exterior sofa (hall)
- With interior sofa

Twin houses
- With exterior sofa
- With interior sofa

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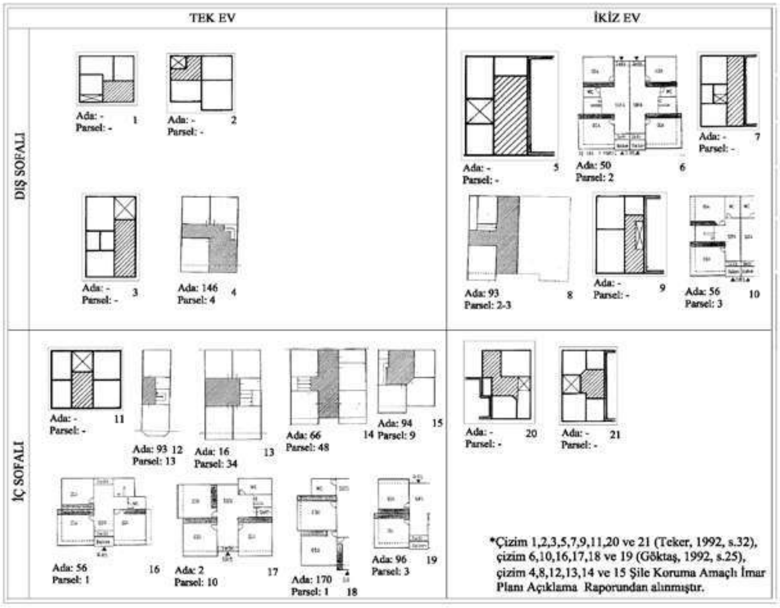

Figure 20. Sile houses plan typology *(compiled from Teker, Göktaş and Şile KAİP).*

Façade Characteristics

The facades of Şile houses are generally plain and modest. In general cantilevers are designed on the first floors to add mobility to the façade and this design is realized as the reflection of the plan on the facade. There are also buildings without cantilevers in the area. Some buildings have balconies on the central axis. Instead of a door, there is only a window opening to this building component that is used for drying winter supplies. The most important reason for this is the strong winds (Göktaş, 1992, p. 26).

Weather boarding made of chestnut tree wood with dimensions of 15-20-30 cm, flat or ribbed grooved profiles are used (Fig. 21:a,b) for the facades. The boarding is used in natural form without any synthetic paint or varnish. Some buildings are whitewashed on their ground floors (Göktaş, 1992, p. 68; Teker, p. 43). Masonry garden walls made of rubble stone are usually low. The building is not hidden behind high walls (Göktaş, 1992, p. 72; Teker, p. 44). As a result of the data from different sources and documentation studies, it is possible to make a new classification for the types of façade under twin house and single house groups according to the position of the cantilevers on the façade and according to whether there is window or balcony on the central axis (Fig.22).

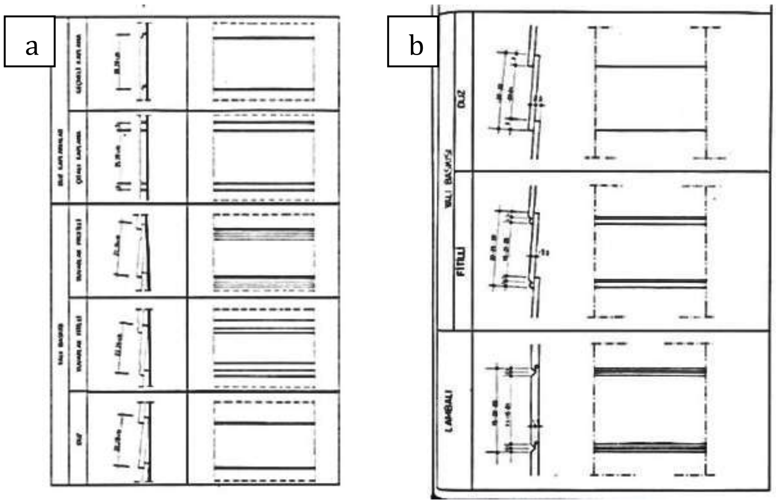

Figure 21. a) Facade cladding types in wooden structures *(Göktaş, 1992, p. 71; Table 9).* b) Facade cladding types in wooden structures *(Teker, 1992, p. 42; Table 8).*

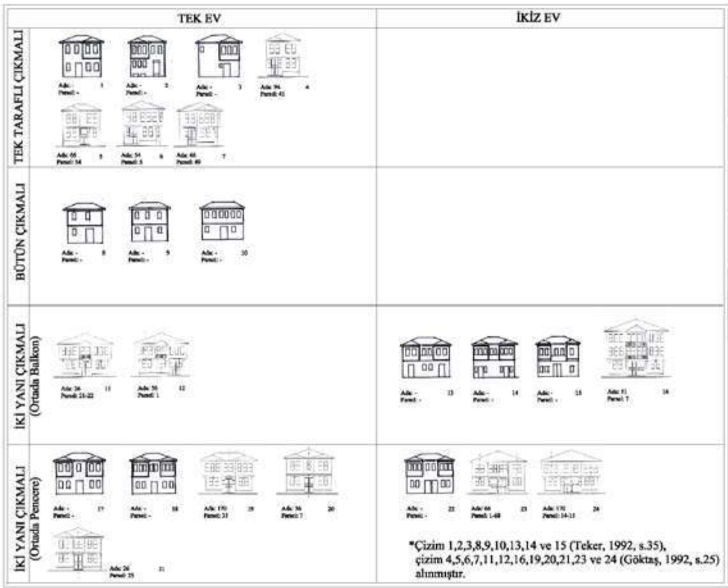

Figure 22. Sile houses facade typology *(compiled from Teker, Göktaş and Şile KAİP).*

Construction elements

Cantilevers

As the buildings in the area of study are located in gardens and are detached, the wish to obtain a certain order for the geometric disorder of the plot on the first floor is not a reason for the cantilevers. The cantilevers generally protrude 40-50 cm from the vertical bearing elements with 45 degrees and are joined to the lower floor with buttresses with different profiles.

When the plan characteristics of the traditional housing architecture in the town is studied, it is observed that the cantilevers of single and twin houses use the axis of the central sofa as the axis of symmetry. In facades where the entrance is on one side of the façade, asymmetrically ordered cantilevers are the continuation of the ground floor movements on the upper floors. Another type of cantilever in the area is where the whole surface makes a cantilever on the first floor (Fig.23:a).

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Buttresses

The height of the buttresses supporting the cantilevers limited to 40-50 cm in the Şile houses vary between 50 and 90 cm (Teker, 1992, p. 38). All buttresses used in the traditional housing architecture are made of wood. They are different variations of certain geometric forms (Fig.23: b,c) (Göktaş, 1992, p. 50).

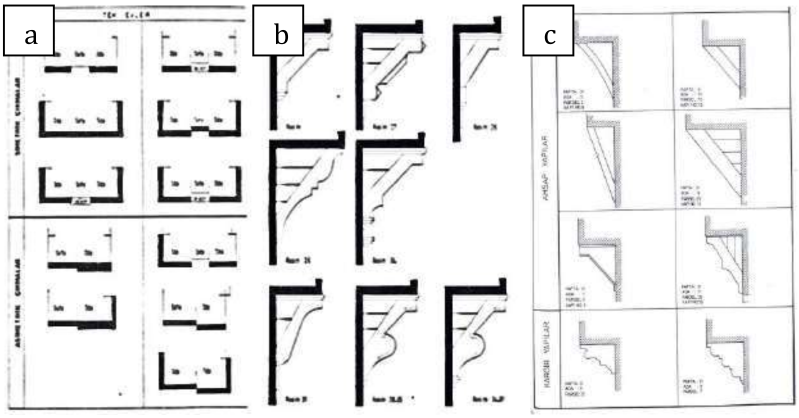

Figure 23. a) Cantilevers typologies in wood structures *(Göktaş, 1992, p. 49; Tab. 5).* b) Buttresses typologies in wood structures *(Göktaş, 1992, p. 51; Table).* c) Buttresses typologies in wood structures *(Teker, 1992, p. 37; Table 5).*

Windows

Although sash windows that are the period's traditional system are used in the traditional housing architecture of Şile, they are replaced by casement windows in some examples. The windows are placed on the façade as modules with a ratio of 1/2. They are detached from each other with rhythmic gaps within the façade arrangement. In some very rare examples, the windows are emphasized in an integrated form. The sides of sash windows with lintel are usually enclosed with an 8-10 cm wide molding. In some examples the lower molding is decorated with various profiles (Fig.24) (Göktaş, 1992).

Figure 24. Examples of windows from the area on the left, building inventory 97, building inventory no. 96 in the middle and building inventory no. 128 on the right *(Photo; Aydın, 2017).*

Entrance doors

The entrance doors of the traditional houses of Şile are usually double-winged (Fig.25: a).In most examples there are sky-lights letting the light into the space. The doors are mostly paneled and are surrounded with approximately 9 cm wide wooden sills (Göktaş, 1992, p. 62-63). Wooden thresholds are placed below the doors (Fig. 26) (Teker, 1992, p. 41).

There are small windows on both sides of the door to supervise the entrance door and to illuminate the space. In some examples the entrance door may be in a niche. When the niche is not wide enough, these small windows are moved to the side walls of the room and are used for the supervision of the entrance (Göktaş, 1992, p. 62).

It is possible to classify entrance doors in Şile under two groups according to their location on the façade;

-Entrance doors located on the middle axis of the building
 -Recessed entrances
 -Entrances without niches

- Entrance doors located on one side of the façade
 -Below the cantilever
 -Next to the cantilever (Fig.25: b).

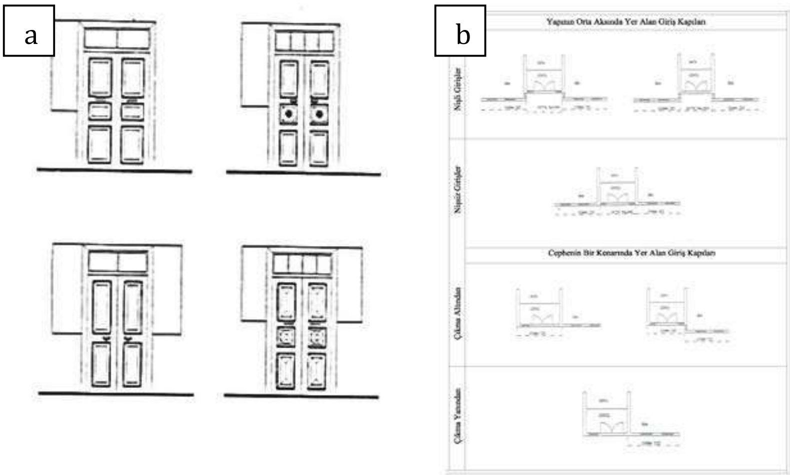

Figure 25. a) Types of entrance doors in wooden buildings *(Göktaş, 1992, p. 64; Table 8).*
b) Types of door entrances in wooden structures *(compiled from Göktaş).*

Figure 26. Examples of doors from the area; on the left, building inventory 97, building inventory no. 133 in the middle and building inventory no. 45 on the right *(Photo; Aydın, 2017).*

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Building Techniques and Materials

The basic material used for civil architecture in Şile is wood (Temir, 2010, p. 116; Göktaş, 1992, p. 76; Teker, 1992, p. 47). The buildings are mostly constructed on a stone wall acting as a foundation and reaching the plinth level. Loadbearing wooden frames are filled with mudbrick made of straw and mud (Fig. 27) (Göktaş, 1992, p. 76-77).

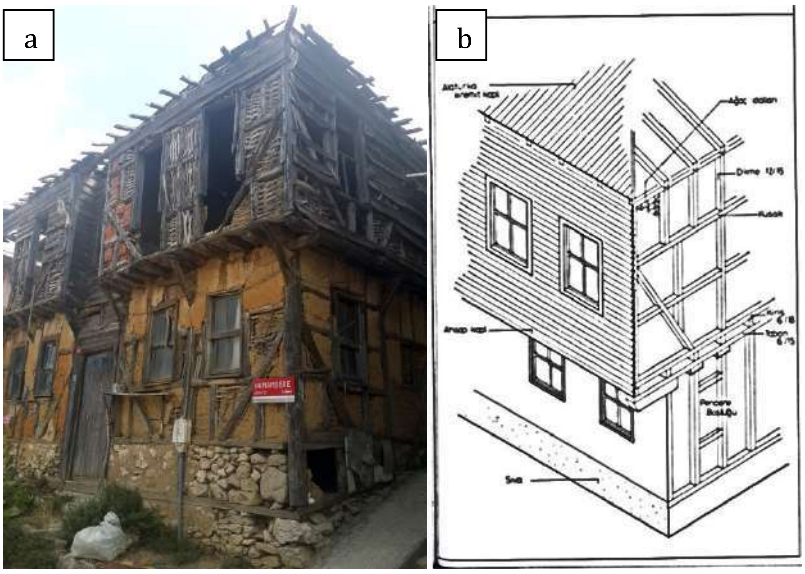

Figure 27. a) The building located at Hamamdere Street no: 44 *(Photo; Aydın, 2017).* b) Construction techniques and materials in wooden structures *(Teker, 1992, p. 45; Table 9).*

The gaps between the wooden frameworks is woven with chestnut branches and then plastered with a mortar made of a mixture of mud and straw.

The common roof style in the region is hipped and gabled roof. The roof coverings have wooden structures and are covered with pantiles.

DETERMINATION WORK CARRIED OUT IN THE BALIBEY DISTRICT

In the study carried out in the Fener neighborhood of Şile Balibey district, urban space analyses were carried out to document the present state, to determine and synthesize problems and potentials. 137 buildings and lots were evaluated within the scope of this work. During the analyses, all buildings were evaluated regardless of their characteristics, originality or state of registration. Urban space analyses were interpreted over 1/1000 scale drawings with the help of incoming data, graphics and tables. The analysis work includes the following:

<u>Environmental values analysis:</u> In this analysis urban elements such as streets determining building blocks, traffic flow direction, paving materials, vista points, traffic signs, electricity, water and telephone poles, manhole covers, garbage containers and trees were identified and marked on the drawings (Fig.28).

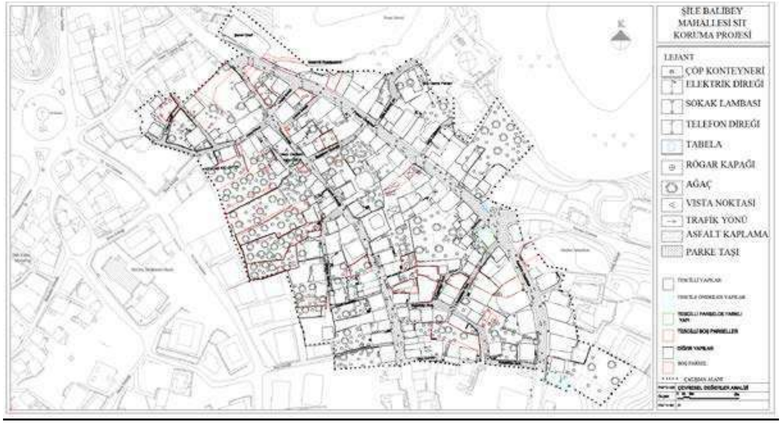

Figure 28. Environmental Analysis. *(Drawing: Aydın, 2017).*

<u>Plot analysis:</u> The map of the area prepared by the municipality was superposed with the cadastral map and its relation to the present state was determined. The plots were classified as empty plots, registered plots and registered empty plots. Blocks, plots, door numbers and building entrances were determined and marked.

<u>Entrances analysis:</u> This was the analysis that determines the roof types, entrances and door numbers in the area. When the roof types were evaluated, it was seen that the roofs of new buildings, especially the ones on Fener Road did not comply with the provisions of the Conservation Master Plan. There were penthouses and terraces. Access to the plots that were not connected to the street was provided by connections through the plots that have street access.

<u>Traffic analysis:</u> Fener Road is the densest axis that connects the work area to the town center. There are four dead-ends in the area: Güz Çıkmazı (dead-end), Sarp Çıkmazı and two others without a name. As a natural result of the topography and the land subdivision, curvy and narrow pedestrian ways (pathways) are formed (Fig.29).

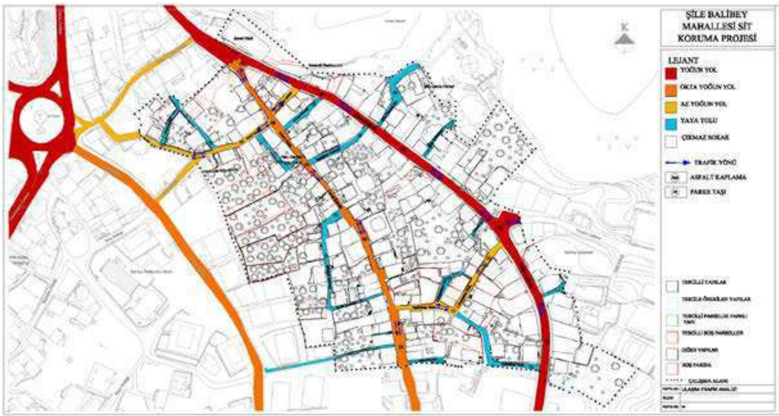

Figure 29. Traffic Analysis *(Drawing: Aydın, 2017).*

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Spatial analysis: Within the scope of this analysis, it was determined that plots with large gardens create dense emptiness whereas contiguous building groups on the Fener Road create denseness in the area (Fig.30).

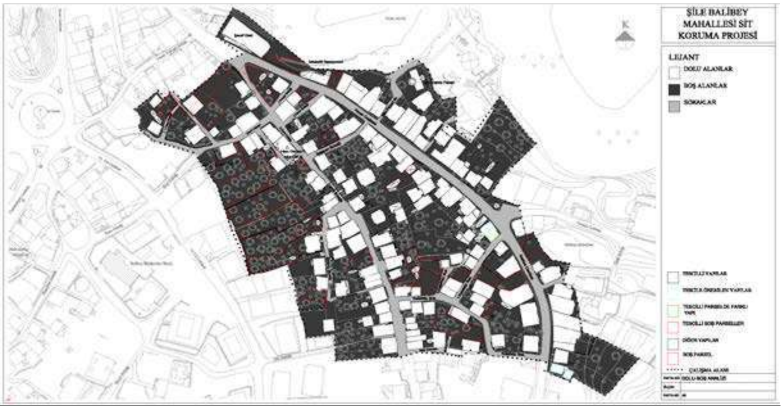

Figure 30. Spatial Analysis *(Drawing: Aydın, 2017).*

Ownership analysis: As a result of the assessment made in the area studied 133 buildings were determined to belong to individuals and 4 buildings were public property.

Legal status analysis: Analysis of the registration status of buildings in the said area determined that out of 137 buildings, 50 buildings were registered. 3 of the registered buildings were abandoned. There was 1 registered empty plot, 1 registered plot with a different building and 2 buildings proposed for registration in the area (Fig.31).

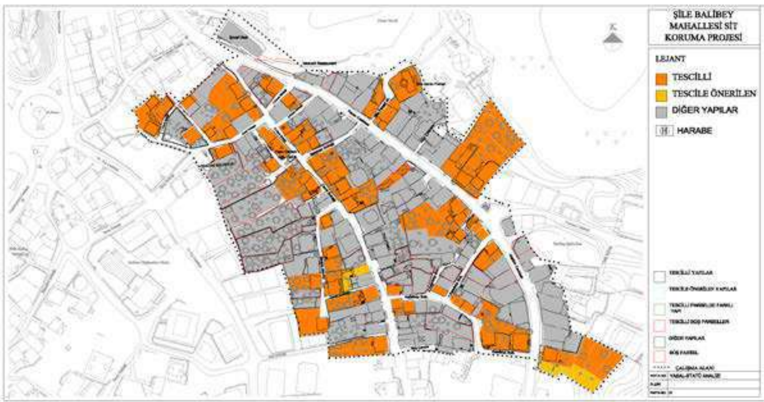

Figure 31. Legal Status Analysis *(Drawing: Aydın, 2017).*

Land use analysis: When the functions of the buildings were considered the following building types were found in the area: housing, housing + trade, accommodation, accommodation + trade, religious, lighthouse/museum, fountain, housing/parking, housing + parking + trade, ruin (housing), worksite.

Number of floors analysis: The analysis of the number of floors determined that high-rise buildings were on the Fener Road and spread into the side streets. The Cami Street which is in the interior of the area is the axis where low-rise buildings form the majority. The breakdown of the buildings according to number of floors: Ground (%9), Ground +1 (%57), Ground +2 (%22), Ground +3 (%10), Ground +4 (%1), Ground +6 (%1) (Fig.32).

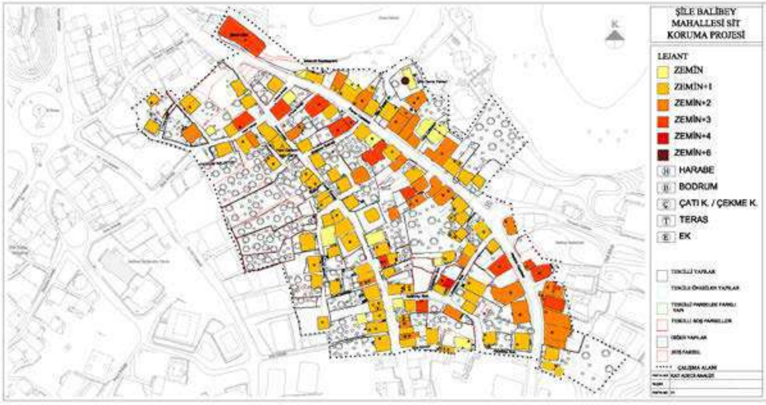

Figure 32. Number of Floors Analysis *(Drawing: Aydın, 2017).*

Construction system and material analysis: The following was observes in the evaluation of the buildings within the area with respect to construction techniques: 62% reinforced concrete, 23% wooden framed, 12% reinforced concrete + wood, 2% stone and 1% stone + wood (Fig. 33).

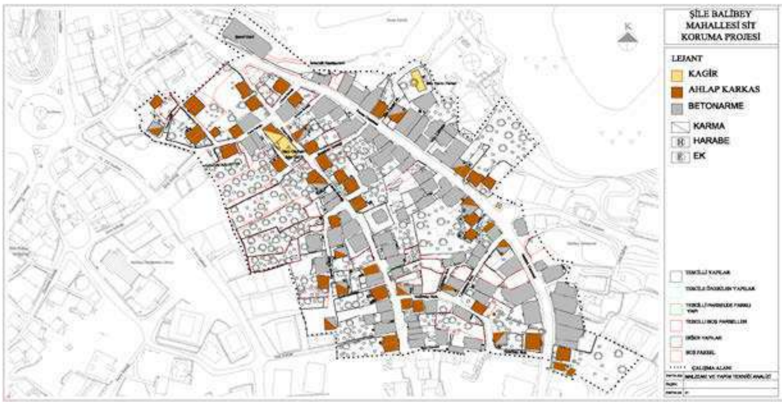

Figure 33. Construction System and Material Analysis *(Drawing: Aydın, 2017).*

Structural condition analysis: Evaluation with respect to structural status determined that 12% pose danger in terms of load-bearing systems and were unusable. Most of these buildings were abandoned and there was no one living inside them. The walls, roofs and floors of the ruined buildings that form 2% of the area, have collapsed and there is very little left of (Fig. 34).

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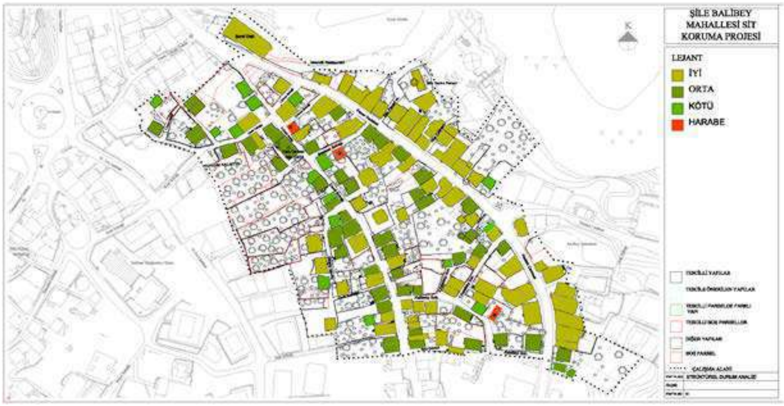

Figure 34. Structural Condition Analysis *(Drawing: Aydın, 2017).*

Evaluation of cultural property analysis: The registered buildings were evaluated with regard to originality and wholeness values and almost half of the 50 registered buildings and 2 buildings proposed for registration were determined not to be in a good state of conservation. 48 buildings out of 137 are well adapted to the original urban texture in terms of position on the plot, number of floors, ratios of façade and similar characteristics. 37 buildings on the Fener Road are noncompliant with the area and the topography with their number of floors, usage of plot and façade ratios (Fig.35).

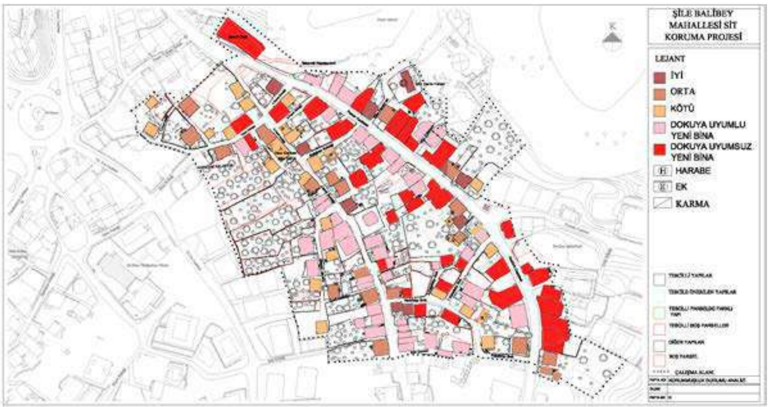

Figure 35. Evaluation of Cultural Property Analysis *(Drawing: Aydın, 2017).*

Use of building stock analysis: It was determined that 101 buildings in the said area at the Balibey district use 74% of the area. 7 buildings were used partially, and 4 buildings were used seasonally. Besides these, 2 buildings were worksites and 3 buildings were in ruins.

Chronological analysis: There are 2 monumental works valuable in terms of history in the area: The Şile Lighthouse built in 1859 and the Hacıosmanağa Mosque that is an Ottoman monument. The buildings, examples of civil architecture in the area, are believed to be 100-150 years old (Fig.36).

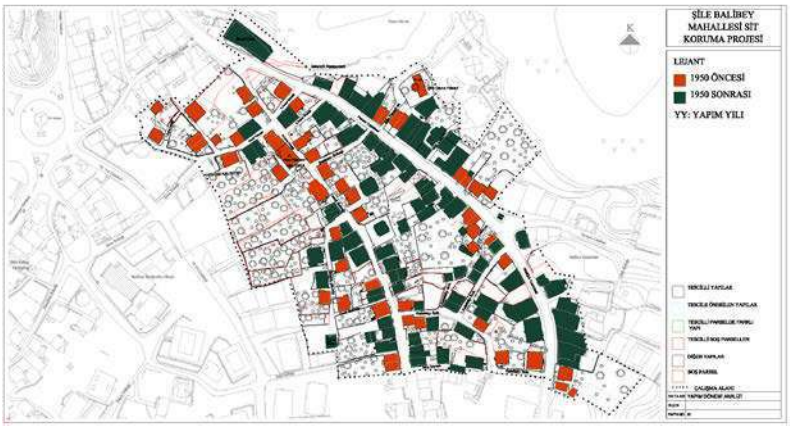

Figure 36. Chronological Analysis *(Drawing: Aydın, 2017).*

EVALUATION OF THE CHANGE

The main reasons behind the changes in the historical urban texture of Şile are the uncontrolled growth and the pressure of tourism for which the town is not ready. There are threats on preserving and carrying into future the abstract and tangible cultural heritage that reached the present. The study tried to determine these threats.

CHANGES IN THE URBAN TEXTURE

- With the immigration of the Greek population living in the center and villages of Şile as a result of the Turkish-Greek Population Exchange that was signed in the first quarter of the 19th century, Şile underwent a radical change culturally and economically and the texture of the town started to change (Goularas, 2010, p. 78).
- The fate of the settlement that transformed the transportation problems into an advantage and preserved the settlement's original structure and texture changed with the construction of the Istanbul-Şile highway in the 1990's and went under the threat of the secondary residence and opened to tourism.
- Another reason for the town to open to tourism uncontrollably is the Master and Implementary Development Plans that were prepared to help the development of tourism and approved in 1991. As a result of these plans the urban site was imperiled.
- With the increase in the demand of tourism, in the 1980's the economic, social and cultural structure developed rapidly. Consequently, in the Hacıkasım and Balibey districts, especially on the shore line, unearned income increased, and the houses started to rapidly change hands.
- Another radical change that took place in the urban texture of Şile was the harbor area that was filled and left to its fate in 1990. With this filling, the salvage buildings that are among the monuments of Şile lost their rescue function realized for many years.

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CHANGES IN THE BUILDINGS

- Despite new conditions for housing in the notes of the 1992 plan, when the allowed height for buildings was determined, the registered buildings were not used as reference. Instead elevation differences were used. These neighboring buildings that were constructed without the reference of the registered buildings were the most important factors in the increase of the destruction of the texture.
- Despite the clause in the notes of the 1992 plan stating, "attic floors cannot be acquired", the roof and half storeys that were realized affect the shoreline and the wholeness of the texture.
- With the new buildings, there were critical changes in the usage of blocks and plots. With the current new buildings, attempts were made to use the plots fully and consequently the texture system that had developed organically was left aside and original applications were used in which buildings that can be reached through each other or their gardens were created. Plots that were once used as vegetable gardens or orchards were left empty in time.
- In the usage of plots on the Fener axis, buildings with characteristics such as uncontrolled floor heights, façade ratios, etc. that did not comply with the urban texture and topography emerged.
- When the interventions on the registered buildings of the area were analyzed and evaluated in terms of structure, it was determined that 12% of them were dangerous in terms of load bearing systems and were uninhabitable.
- Another problem in the area was the damage to the structural and aesthetic wholeness of the twin buildings due to the separation of ownership. While one part of these buildings was preserved, the other part of the building was left to its fate. This causes a conservation problem.
- The traditional houses that are still inhabited went under spatial changes to reach modern comfort requirements and their plan compositions were damaged by additional spaces.
- When the conservation status of the registered buildings in the area was evaluated, the traditional and original architectural characteristics of the area such as original construction system of the buildings, façade systems, original building material, roof type and coating material were analyzed. Consequently, it was determined that out of the 50 registered buildings, originality and wholeness was not conserved in 40% and 34% were partially original.

INTERVENTION PROPOSALS

Proposals Regarding the Urban Texture Scale

- Today, 15% of the buildings in the said area are either empty or abandoned and 2% are in ruins. In the work area, housing or boutique hotel functions are proposed for these buildings to prevent the pressure of secondary housing, to stop the increase in the number of summer houses and to provide a controlled economic support for the owner.
- Urban texture should be used with all its components in the most effective and productive way. The unused vegetable gardens and orchards and passive green areas must be rehabilitated for active usage. Otherwise, these areas are under the risk of zoning for construction. The gardens must regain their original functions and organic production must be encouraged and supported.
- The vehicle traffic in the area must also be revised. It is important to pedestrianize the Fener-Atatürk road in terms of the planned urban layout. The alternative axis for the Fener-Atatürk road is the 75th Year road. This redirection aims at the Şile Cultural Center located outside the area at the end of the Atatürk Road, not a very busy place, to host cultural and art activities. The Çamlık Tea garden and picnic areas are located at the continuation of this axis that was created. These can also present a recreative function to the area (Fig.42).
- To provide for the need of parking space, it was proposed to arrange the parking in front of the Maşatlık Park as a pocket parking for short-term parking for visitors coming from Fener Road. For visitors coming from the Atatürk Road direction, the presently empty lot on block 63 plot 29 was arranged as a short-term parking[21].
- Redirection to two main axes in the work area where the historical texture is continuous is proposed. The Şeref Hotel located at the beginning of Fener Road, one of these axes, must be pulled down and replaced by a view terrace so that the monuments of the town will be viewed panoramically from this terrace. Şile Fortress, Maşatlık Park-Greek Cemetery and Şile Lighthouse can be viewed from a single spot.
- Re-functioning of the buildings on Fener axis and creating refreshment spaces required by the area will revive trade. This axis must serve the housing + trade functions. On another axis, the Cami Street many buildings with large gardens are either abandoned or neglected. With restorations along the street a qualified axis will be created. House-guesthouse type buildings where main user and guests will meet are proposed (Fig.39).

[21] For the parking problem existing throughout the town, the "Town Square and Multi-Storey Car Park Project" carried out jointly by the Şile and Istanbul Municipalities is believed to provide a solution. The expectations about this project include not only a car park but also a space, which is the town square that will be designed, where the town people will gather and sustain the town culture. http://www.sile.bel.tr/Page/Detail/8663, access date 03.08.2017.

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- The ruins of a hammam, believed to be from the Byzantine period, located on the Cami Yokuşu Street, block 51 plot 8, is proposed to be unearthed and used as both an exhibition and recreation area (Fig.41).
- Besides exhibiting the natural and historical environment of Şile, the town, which is rich in archeological finds also, needs a museum building to exhibit these. It is proposed to include a museum building in the project called "Şile Harbor Renovation and Recreation Project" run by the Şile municipality to transform the harbor into an active tourism area covering an area of 120 thousand square meters.

Proposals Regarding Single Building Scale

- The intervention proposals for the registered and suggested for registry civil architecture buildings are: maintenance, simple repair, restoration and reconstruction.
- New buildings are evaluated in terms of being compatible or incompatible with the urban texture. While pulling down or decreasing the number of storeys were proposed for the incompatible buildings, for the buildings compatible with the texture intervention proposals on their facades and roofs were made (Fig.37; Fig. 38).
- Cami Street was chosen as a pilot axis in the area for this study. In the silhouette work on the Cami Street, proposed intervention decisions were reflected on the project. Besides simple repair decision such as color changes, material changes and completion on the facades, intervention decisions such as removing or adding storeys, removing late period additions or changes in the façade system were dealt with on the single building scale. Additionally, decisions such as reconstruction of the buildings that have not survived, infill design or removing some buildings were indicated on the silhouette work (Fig.43, 44, 45, 46).
- As a result of studies carried out in the Balibey district, it was determined that the present built-up areas are saturated. Therefore, further housing in the area must not be allowed and the present building stock must be used effectively. If housing continues, new buildings will cause the vegetable gardens and orchards to disappear. When the buildings complete their useful economic lives, housing compatible with the historic texture with modern design criteria are proposed on these plots. The proposals are presented as plan marks. Gentrification proposals for the pavements and width of Fener Road were also made (Fig.41).

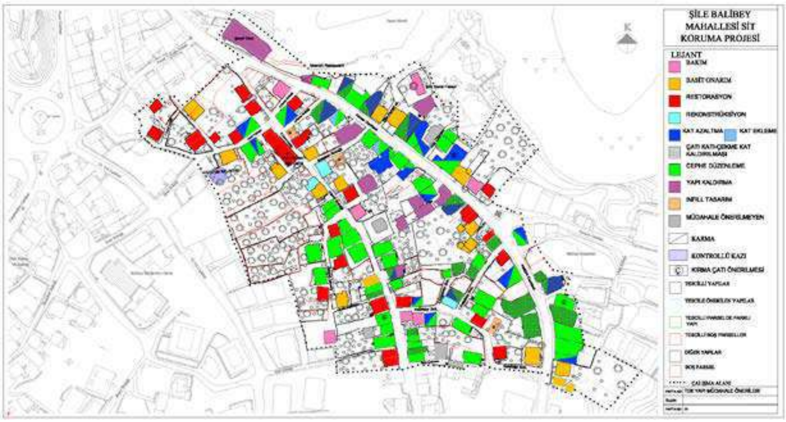

Figure 37. Single Structure Intervention proposal Analysis *(Drawing: Aydın, 2017).*

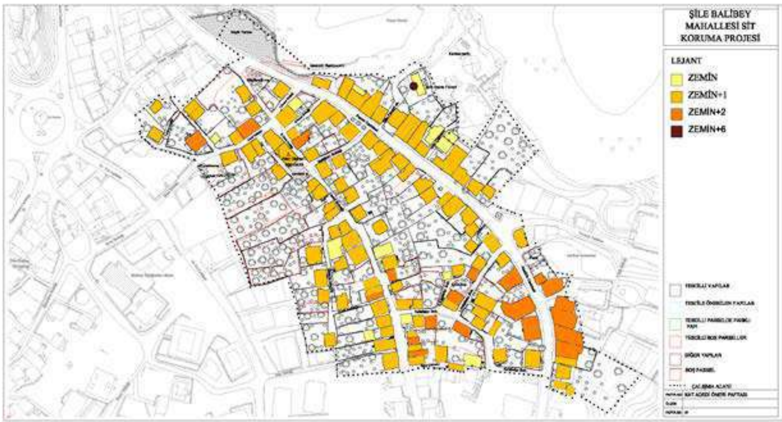

Figure 38. Number of Floors Proposal Analysis *(Drawing: Aydın, 2017).*

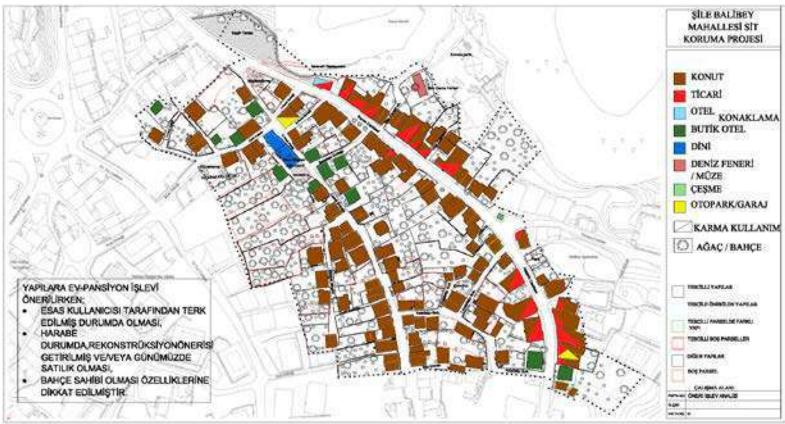

Figure 39. Use of Building Stock Proposal Analysis *(Drawing: Aydın, 2017).*

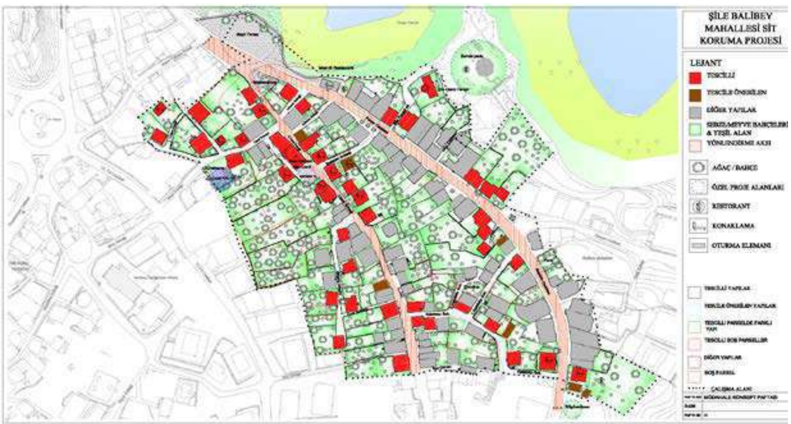

Figure 40. Intervention Porposal Analysis-I *(Drawing: Aydın, 2017).*

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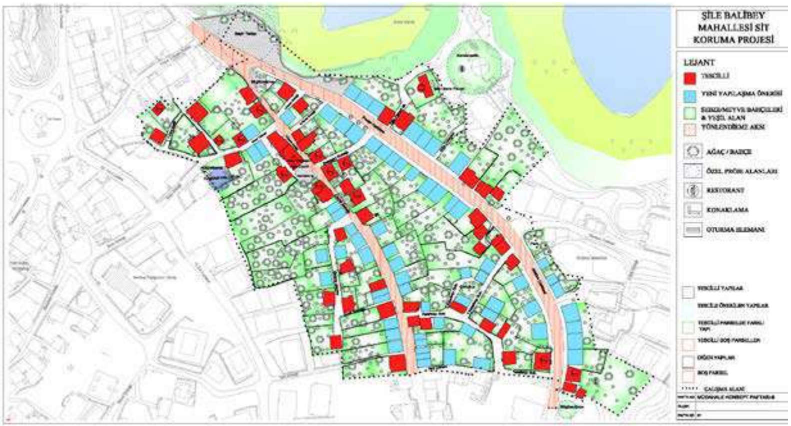

Figure 41. Intervention Porposal Analysis-II *(Drawing: Aydın, 2017).*

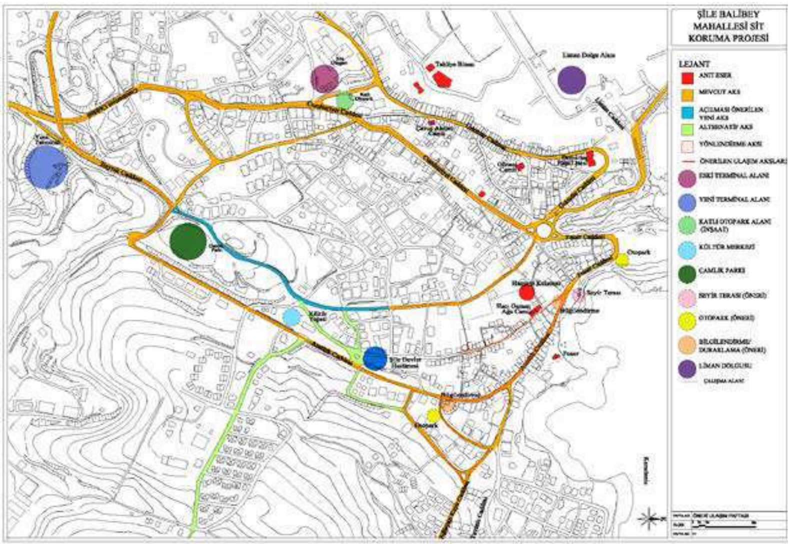

Figure 42. Traffic Proposal Analysis *(Drawing: Aydın, 2017).*

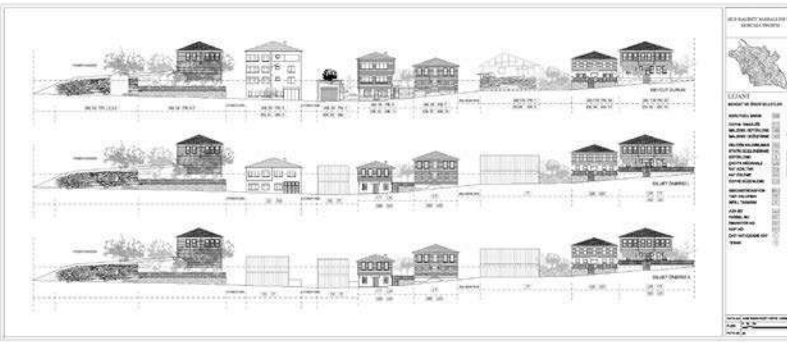

Figure 43. Silhouette 1 Cami Street North Facade Proposal *(Drawing: Aydın, 2017).*

Figure 44. Silhouette 2 Cami Street North Facade Proposal *(Drawing: Aydın, 2017).*

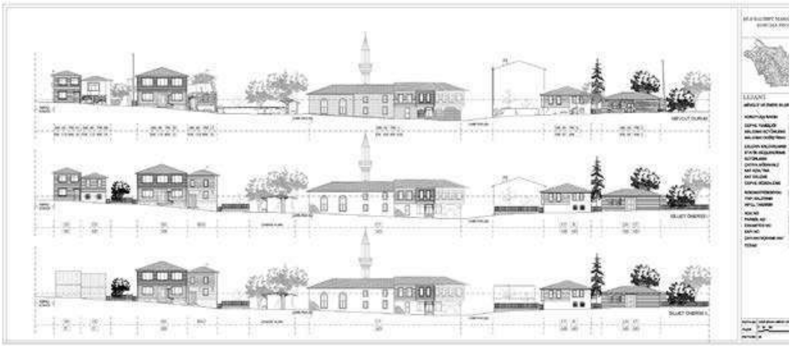

Figure 45. Silhouette 1 Cami Street South Facade Proposal *(Drawing: Aydın, 2017).*

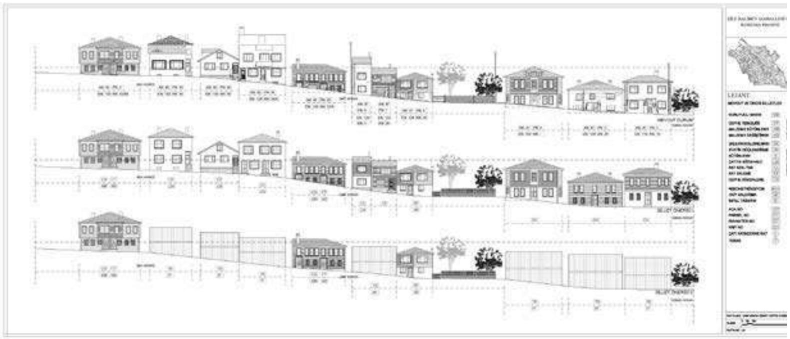

Figure 46. Silhouette 2 Cami Street South Facade Proposal *(Drawing: Aydın, 2017).*

CONCLUSION

An original urban texture reflecting the architectural characteristics of the 19th and 20th centuries was created in Şile that was inhabited by different civilizations and societies due to its location. However, in the 1980's rapidly developing transportation facilities and value increase, reinforced concrete structures started to emerge in the historical urban texture. Although the notion of conservation first came up in the 1990's, the desired level of conservation was not reached. The goal for the future must be to create an environment meeting modern comfort requirements and integrating with the city while preventing further destruction of the original structure of the site area and to sustain the city with its natural, archeological and urban sites.

Şile has not been touched upon in a comprehensive academical or scientific paper so far despite its rich architectural and urban heritage. Importance of this paper is that urban protected area of Şile has been presented to the attention of the architects, art and architect historians, and other specialists working on this field in a scientific paper firstly. In addition, this study includes determination of approximately 50-year-long unfavorable changes in the architectural and urban heritage of Şile, and protection proposals from now to the future.

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A Restoration Criticism of Historical Buildings According to Thermal Comfort Conditions through Ali Gav Madrasah

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Abstract

Thermal comfort studies have been a subject of research since the 1930s. Thermal comfort conditions which are of great importance for human health, are also important for energy. Todays due to climate changing and a decrease in energy resources, there is a change in indoor thermal comfort conditions in historic and contemporary buildings. Thermal comfort conditions are the most important factors affecting the use of buildings. So places and spaces where thermal comfort conditions aren't good are tried to improve to optimal.

The historical buildings constitute the majority of the city's building stock in addition to their original and aesthetic architectural qualities, the value for the city. From the planning to the construction process in historical buildings it is observed architectural plan schemes are shaped by considering various environmental and climatic factors such as sun and climate thus it can be said energy uses is taken into account. It is important to use historical structures and to re-function when they are

Keywords: *Ashrae standard 55, conservation of historic buildings, integrated restoration, thermal comfort*

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not available with their original function. With re-use, the new details and additional applications that are applied can affect the thermal comfort properties of the building positively or negatively.
This study focuses on the thermal comfort properties that come with the restoration of a historic building. In this context, Ali Gav Madrasah which is located in castle borders in the historical city center of Konya in Turkey and restored with a contemporary additional feature that is considered worthy of being examined in terms of thermal comfort. Thermal analysis of the reconstructed Ali Gav Madrasah, which has undergone restoration through integration based on historical documents and excavations and has a top cover made of modern materials, was carried out in August 2018 and January 2019. According to these analyzes, today's thermal conditions are inadequate for all places in Ali Gav Madrasah of thermal comfort conditions. Comments are made on the connection of this insufficient thermal comfort with the restoration/reconstruction. From this point of view, Before the restoration procedures for historical buildings, required feasibility studies and necessary solutions about buildings thermal conditions are investigated. And then architectural details should be produced for this.

INTRODUCTION

Thermal comfort, which has been the subject of scientific studies since the 1930s, is a very important term for architecture. In general, thermal comfort is a concept related to user satisfaction in buildings, use of the building, building health and energy consumption (Zomorodian, Tahsildoost, & Hafezi, 2016). Moreover because of global warming, increased carbon emissions and consumption of non-renewable energy sources, and many other factors, thermal comfort features are of great importance (Çalış, Kuru, & Alt, 2017).

When within the architectural discipline, it does not only cover modern buildings, the production of these structures causes huge energy losses, made with modern methods. Also, it covers surely historical buildings. At the same time, energy inputs have to be taken into account for structures with historical meaning and significance built by traditional methods, which have been re-functionalized or have not lost their original function.

When the historical buildings are examined without regard to the civil or monument structure, it is seen that if there is no other specific reason, the orientation of the building in plan schema is designed to take advantage of the sun. Looking at the wall surfaces of the buildings, it is observed that the walls store heat inside themselves as long as the sun is shining. And when the day is over, it is seen that the heat is released to the interior, thus increasing the ambient temperature. As a result, the wall surfaces that the sun directly reaches are getting warmer and the orientation

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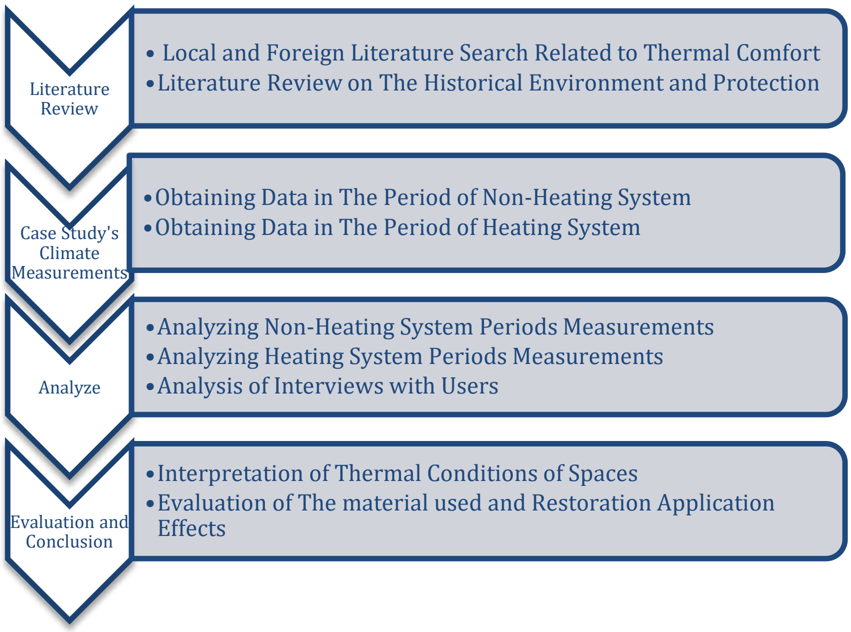
towards the sun can be considered a more accurate approach in terms of thermal comfort. But the restorations work carried out for the historic buildings to function and maintain their existence, in some way, affects these thermal states. From this point, In the scope of this study, Ali Gav Madrasah which is restored with reconstruction and a Seljuk's historic building located in Konya/Turkey is worth to be examined for evaluation of thermal climatic conditions and satisfaction levels of users in terms of the last restoration application.

As a result, in this study, the thermal comfort conditions of a historical structure which is in a cold semi-dry climate are determined. And it has been observed how these comfort conditions change when the heating system operates and does not work. It has been determined that the additions and arrangements made in order to re-align with the changing world and living standards, have the effect of thermal comfort, which is felt by the structure in terms of the conditions of the new function brought which have survived despite the centuries of construction. Depending on all of this, it is determined how the users felt in this historical building and tried to understand the effect of the restoration.

MATERIAL AND METHOD

In the context of the study, literature review about thermal comfort, historical environmental conservation, refunctioning and contemporary addition have been detailly examined. Within the scope of this literature review, studies on modern and historical buildings in various climate zones have been investigated. Moreover, the historic environment and conservation are mentioned briefly. Information about the existing structural features and socio-cultural status of Ali Gav Madrasah is provided. Maintenance and restorations of the madrasah structure from past to present are examined.

Table 1. Method of Research



Until the last restoration in 2013, Ali Gav Madrasah continues to exist with a different function than its original architectural structure and function. During the restoration of 2013, it includes cleaning, consolidation, renovation and integration, which is one of the interventions to the monuments. In general, it is observed that the original architectural structure is preserved and the functions that could cause problems are not given into the structure. After all these interventions thermal comfort determination of this structure is decided to be worth after it has been observed that the increasing temperature and humidity emerged very soon after, being in a disturbing level for the users, the presence of moisture-absorbing lens devices that are positioned in the courtyard and in the spaces around the courtyard to eliminate the humidity and the distortions that have started to occur on the surfaces. In addition, the modern building material used in restoration and the effect of modern construction techniques on this structure are also among the reasons to be selected.

In this research, thermal comfort properties are evaluated from obtained data which are measured by the climate devices from all cell rooms, iwans, main axle symmetry over the dome covered space and the indoor courtyard in the middle of the pool of Madrasah. In order to determine the measurement and evaluation method for the study, similar methods have been made use of (Çalış et al., 2017; Elwefati, 2007; Mıhlayanlar, Kartal, & Erten, 2017).

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Ali Gav Madrasah climate measurements which are located between the buildings in Karatay District of Konya in the cold semi-arid climate zone has been carried out in two periods as winter and summer season, in which the heating system works and does not work. In both measurement periods, temperature, humidity and air velocity values are measured by means of measuring devices in each space, for 3 times a day in a week. Since the madrasah is used as a public education center, it is open every day of the week and between 07.00-18.00. Therefore, these measurements will be made at 7.00-8.00 in the morning, 12.45-13.45 in the afternoon, 17.00-18.00 in the evening, with the doors and windows closed in the center of each space. These measurements are considered as a standing person and are made from the centers of the ground, waist and head alignments. Besides, the courtyard, which has been closed for the contemporary addition, measured the temperature and humidity values by means of a data logger in both periods. The measurement dates of periods are between 06.08.2018-12.08.2018, 15.01.2019-21.01.2019 in the seven-day period.

The clo value used in the evaluation part of this study is determined according to ISO 7730 standard clo values. For the summer period when the heating period is not working, this value is calculated as 0,76 clo and for the winter period when the heating period is working, this value is calculated 1,42 clo.

The data collected for the evaluation is transferred to the computer and a graph is created in Excel program. In this way, differences in temperature, humidity and air speed factors are being formed within the madrasah structure, which has been restored and integrated with a contemporary addition. The data of these three factors are evaluated separately, as well as a combination of them. These data indicators are created separately for each room. Thermal comfort conditions are evaluated according to the standards and a restoration criticism is made by interpreting how these conditions affected the material durability and structural factors of the building.

Evaluating Method

The ANSI-ASHARE-55 standard, which was first published in 1966, will be used in the evaluation process. The standard was published in 1966 and re-published in 1974, 1981 and 1992. Since 2004, the standard is regularly updated every year and is published on the ANSI ASHARE website. The assessment can be carried out according to the standard values of ASHRAE 55 and ISO 7730 in the heating period and non-heating periods (Table 2.).

Table 2. Values in the standards for relative humidity and temperature (Çalış et al., 2017)

	During Non-heating Period		During Heating Period	
Standard	ASHRAE Standard 55	ISO 7730	ASHRAE Standard 55	ISO 7730
Indoor Temperature (°C)	22-24	20-24	22-24	20-24
Air Velocity (m/s)	-	0,19	-	0,16
Relative Humidity (%)	40-60	30-70	40-60	30-70
Operative Temperature (°C)	-	24,5±1,5	-	22±2,0

When evaluating, for the average radiation temperature (Tr, ° C) developed depending on indoor air temperature (Ta, ° C) = 0.99 × Ta −0.01 Nagano and Mochida (2004)'s equation is used. In addition operative temperature for required to calculate PMV and PPD indices is figured with depending on indoor air temperature (Ta, °C) and mean radiant temperature (Tr, °C) $To = A \times Ta + (1 - A) \times Tr$ equation according to Ashrae Standard 55. In the equation A is a constant connection to the airflow rate (Vr) and the values in ASHRAE Standard 55 are used. According to this, A value can be thought based on Vr<0,2; 0,2<Vr<0,6 ve 0,6<Vr<1,0 respectively 0,5; 0,6 ve 0,7. The "CBE thermal comfort tool – CBE (Center for the Built Environment) thermal comfort calculation tool" is used with ASHRAE standard 55 when calculating PMV and PPD indices (URL-1). In the assessment, environments in which PMV is between (-0.5) and (+0.5) ranges in standard Ashrae 55-2013 and ISO 7730 accepted considered thermally comfortable (Çalış et al., 2017).

It has been shown that the data, which is concreted by measurements, is perceived by different user typologies, whether by teachers, students, administrators and other employees who use this structure continuously or for a short time. Measurements and verbal/written interviews are conducted simultaneously with this method. Then, the thermal comfort measurement part of the study was completed by comparing the thermal comfort conditions of summer and winter period. Finally, the effect of the restoration applications and the re-functionalization on thermal comfort are evaluated by comparing the original parts with the evaluation of the thermal comfort analyzes in summer and winter periods via Ali Gav Madrasah.

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Climatic Properties of The Place Where The Madrasah is Located

There have been ongoing classification studies on the categorized of world climates since the past. In 1900, the German scientist Wladimir Köppen made the first classification quantitatively. The map (figure 1.), which has been made this classification, has been continuously updated and developed by many scientists due to changing climatic characteristics. However, the most commonly used map is the original map of Köppen. This map is based on various temperature, humidity and rainfall activities (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006).

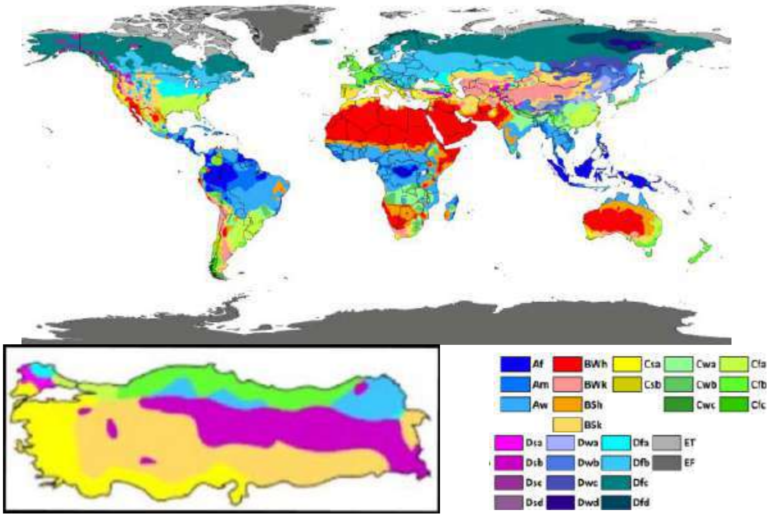

Figure 1. Köppen Geiger's World Map (URL-2)

According to this map, Konya is located in the cold semi-dry climate regions (type "BSK"). These regions are usually limited to a humid continental climate or Mediterranean climate, in temperate regions or in temperate regions with high altitude. They have usually located some distance from large water bodies. In cold semi-arid climatic regions, summers are usually hot and dry, and winters are cold. In these areas, snowfall is mostly seen in winters and snowfall is lower than in more humid areas. Cold semi-arid climatic zones have great temperature fluctuations between day and night in all seasons (URL-3).

The Reasons for Ali Gav Madrasah Being An Example in The Context of Thermal Comfort Studies in Historical Buildings in This Study

The building continues its existence with a different function from the original architectural structure and function from the declaration of the Republic to its latest restoration in 2013. It includes cleaning, consolidation, renovation and integration, which is one of the interventions to the monuments during the restoration of 2013. When we look at the structure, It is observed that the original architectural structure is preserved and functions that may cause problems, later on, are not given. As a result of the investigations and interviews, it is seen that the amount of moisture in the structure causes problems in the disturbing level and the problem is tried to be solved with moisture devices. It is known that a humidity device is located in each room and four devices in the courtyard, can collect a maximum of 50 liters of moisture and it is used to eliminate moisture at night even though it is not used for daytime because of their loud. These devices are usually operated when fewer users exist and employees say at least once a day the moisture collection's tank is filled. After all these interventions are made, it is worth to determine the thermal comfort of the building due to the obtrusive temperature and humidity by the users, the presence of dehumidifying devices which bring the additional energy cost and the deterioration of the surfaces. In addition, the modern building material used in the last restoration and the effect of modern construction techniques on this structure are also among the reasons to be selected.

THERMAL COMFORT

The definition of the comfort zone was first introduced by Prof. John Sheppard in 1913-1923. In 1923, Houghten and Yaglou used the concept of effective temperature (et) by combining dry thermometer temperature and relative humidity in a single index. The comfort chart was first mentioned in 1924, and the climate-conditioned comfort was mentioned in 1938 in the Ashare report (Altıntaş, 2008). The comfort zone is defined in terms of the average radiation temperature and the thermal conditions accepted by the users or combinations of the range of average thermal temperatures suitable.

In Turkey, it is seen that work related to thermal comfort starts at the end of 1960. In 1969, Berköz focused on a method for determining the appropriate ceiling height in terms of bioclimatic comfort. In 1980, Sungur conducted a study with the Turks found the optimum temperature values for Turks. These values are 16.7 - 24.7 °C, but found that these values are subjective. Koçman, in his study in 1991, defined the effective temperature values for our country as 17.0 - 24.9 ° C. Topay and Yılmaz (2004) prepared bioclimatic comfort maps for the first time in 2004 with a study on the opportunities to utilize GIS in the determination and mapping of areas with bioclimatic comfort (Çetin, Topay, Kaya, & Yılmaz, 2010). Relative humidity should be between 30% and 70%, wind speed should be less than 6 m/s. These three factors are dependent on each other and it should be handled together (Güçlü, 2008).

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Thermal comfort is defined at different times by various standards and people working on this subject. The definition of thermal comfort according to ashare 55 standard is defined as a subjective moment when a man feels comfortable with the thermal environment (American Society of Heating, 2010). Fanger refers to the person's 'condition of being thermally neutral' as an environment in which the person 'does not want to be cooler or warmer'. Givoni's thermal comfort is not anger or discomfort due to temperature or coldness and as a matter of contentment (Yaşa, 2010). Thermal comfort can be viewed as the most dynamic feeling and harmony with the environment. The comfort values created by these ambient conditions vary from person to person. This can be explained by the fact that psychological and physical comfort conditions change from one person to another and each person cannot feel happy at the same time, frame and space so that the environmental conditions required for comfort cannot be the same for everyone. From this point of view, it is natural that people spend most of their time indoors and demand to the comfort level of climatic characteristics of these areas. People feel comfortable, fit and healthy if they are in good weather conditions and so they produce more efficient work (Daneshkadeh, 2013).

Nicol and Humphreys (2002) explain why thermal comfort is important as simply three main factors. These include providing satisfactory ambient conditions for users, controlling energy consumption, setting and recommending standards (Salur, 2016). When the thermal comfort conditions are not at the appropriate values, dissatisfaction and discomfort begin and "patient building syndrome" or "building-related illness" occurs (Balkaş, 2005; Salur, 2016). In addition, the decrease in the level of thermal comfort causes not only physical and biological but also mental activities to be limited.

Thermal Comfort Factors

Some factors are used to evaluate the thermal comfort conditions in buildings. The Ashrae Standard is said to be basically six factors affecting thermal comfort. These factors are metabolic rate, clothing insulation, air temperature, radiant temperature, air velocity and humidity. It is also stated that other secondary factors may affect comfort conditions in some cases (American Society of Heating, 2010). According to Carpenter ve ark. (1975), four climatic factors influence human comfort. These are air temperature, air movement, or wind, humidity and solar radiation constitute factors. According to Marsh (1991), 5 climatic factors affect climate comfort. These are air temperature, humidity, solar radiation, wind and air pollutants (Güngör & Polat, 2012).

In short, thermal comfort evaluations also have two main indicators, depending on the climate and depending on the user. Indicators linked to the user are the clothing factors, the metabolic temperatures of the users, subcutaneous fat ratios, age and gender factors. Indicators related to climatic factors are temperature, humidity, mean radiant heat (MRT) and air velocity. While the climate-related ones can be controlled by design methods, only the clothing factor can be controlled by human factors.

Standards are published in various time frames for different needs or in order to update another version. In the literature, there is a wide range of studies and classifications related to these standards. According to Markov (2002), standards are direct thermal comfort and standards for the thermal environment in which it is located (ASHRAE 55, ISO 7730, ISO 7993), standards related to the design of the interior (ASHRAE 62, CR 1752), standards covering the measurement of indoor thermal environment parameters (ASHRAE 55, ASHRAE 113, ISO 7726) classifies into four groups as standard (ISO 8996, ISO 9920) for determining personal factors.

Looking at the Ashrae 55 standards considered in this study accepted environment is comfortable if 80% of the users are undisturbed. According to Ashrae 55, combinations of personal and environmental factors are affected by thermal comfort. This standard takes into account environmental factors such as thermal radiation, humidity and air velocity, as well as personal factors such as clothing and activity, and is not interested in physical chemical and biological factors that may affect air quality, lighting, comfort, acoustic or health. The measurement period is more than 15 minutes according to the standard (Altıntaş, 2008; American Society of Heating, 2010).

The other considered standard in this study ISO 7730 standard aims to estimate the thermal sensitivity value and to determine the degree of disorientation of a person in a moderate thermal environment by determining acceptable thermal conditions. PMV and PPD calculation formulas are used when determining these grades (ISOEN7730, 2006).

Thermal Comfort in Historic Buildings

Climate refers to the entire of all kinds of weather events observed over many years of a region. Despite the long years of accumulation of data, the climate has a constantly changing and transforming structure (Çalışkan, 2012). Climate change, one of the most important issues of our day is investigated climate scientists, as well as ecologists, biochemists, botanists, biologists,

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environmental engineers, Foresters, hydrologists and geologists, are examined by scientists in other areas of expertise. Climate change is caused by the change of climate factors such as temperature, humidity, precipitation and wind. From this point of view, the interventions to adapt the spaces used to the changing climatic factors should be made and comfort conditions should be improved (Nikolakis, 2007).

Users ask to be at the comfort level of the indoor air quality without noticing any issues such as using a building with traditional or contemporary construction techniques and different construction functions. As a result of interviews with users living in buildings built with traditional building material and literature studies on thermal performance, it seems that user satisfaction comes to the fore in the context of thermal comfort (Asadi, Fakhari, & Sendi, 2016; Elwefati, 2007; Georgescu, Ochinciuc, Georgescu, & Colda, 2017; Samuel, Dharmasastha, Nagendra, & Maiya, 2017; Timur, Başaran, & İpekoğlu, 2017).

To protect historic buildings with a different function or their original function, thermal behavior analysis should be done before the interventions are performed. In addition to shaping the interventions to be carried out with these analysis studies, it provides design data in a wide perspective for the energy infrastructure planning to be developed in historical environments. Moreover, the intervention methods prepared for thermal behavior analysis should be considered in such a way as to require minimal changes and interventions in historical buildings, so that historical buildings should be changed and architectural heritage should not lose value (Timur et al., 2017).

In the regions with similar climatic conditions, it is observed that the aforementioned factors such as typology, material and so on are similar in historical buildings. When we look at the historic buildings today, we can clearly see that they are in a rare group of buildings in which active systems are not used regardless they are civil or monumental architecture. Active systems produce many negative effects such as mold, fungi, dust, noise, stress and thus create factors that disturb human comfort. Therefore, it is necessary to avoid the factors that could impair the preservation of the present situation of historical buildings.

Form of the structure, where it is located; material affects the level of thermal comfort (Asadi et al., 2016). In addition, the location of the building is important for climatic factors such as air temperature, solar radiation affecting energy expenditure, humidity, as well as microclimate conditions that affect the energy efficiency of the building (Yilmaz, 2006). In this respect, while looking at historical buildings, it is observed that the regions were formed according to climatic factors and material selection. Also, many factors such as orientation, location solutions, façade characteristics, material selection are shaped according to the climatic factors of the region.

CONSERVATION OF HISTORICAL BUILDINGS

The rules related to the concept of historical environmental protection are based on The Upanishads (Brahma Laws 800-400 BC), which includes the protection of cultural heritage (Öz, Aydin, & Güner, 2013). Later, the idea of conservation evolved into stylistic reconstruction, romantic vision, historical restoration and contemporary restoration theories, and is in a constant change and development and took its present position (Kuban, 2001).

The concept of protection, even if there are constant values and rules in shaping applications; decision-making and implementation processes are effective in relation to the cultural, political, social and economic structure of each region, rather than scientific definitions, search for methods, international principles, theoretical frameworks, and ideas (Altınöz, 2010). Today, intervention to historical monuments is realized with two different approaches. The first is the model of conservation, namely restoration, renovation, reconstruction, and the second is the participatory planning model, which enables reintegration and utilization into the city (Tanrısever, Saraç, & Aydoğdu, 2016).

To integrate damaged or destroyed structures or elements of buildings today, modern methods and materials are now used and completed with it. Factors causing integration; aesthetic, functional or structural balance can be caused by the anxiety and another element of the structure as a need for integration and completion occurs (Zeren, 2010).

The method of integration is a method that is considered for structures since the birth of conservation theory. Related to this topic Venice charter's 13. article states that " Additions may only be allowed if the structure does not suffer damage to its traditional location, composition, balance and connection to its surroundings.". from this point, according to Ahunbay (2017), The contemporary additions should be as compatible as possible on the surroundings. In addition, applying a different material and construction technique will be good for separating the design from the original.

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The roof is an element of the outer shell in the horizontal direction that formally completes the structure and protects it from the external environment. It is appropriate to gather the required characteristics of the roof systems under four main headings. The first of these; it is that prevent factors that will adversely affect the structure such as heat, wind, water or stopping these existing factors. The second factor is that the structure brings the interior environment to a certain comfort condition and that it controls the sustainability of these conditions. As a third factor, it is to carry its weight, snow load coming to buildings, wind load, and transfer them to the carrier system. The fourth and last factor is aesthetics. In other words, it is expected to be aesthetic because it symbolizes and defines the end of the shell in the vertical direction regardless of being a directly visible element (Coşkun, 2006; Yazıcıoğlu, 2014).

ALİ GAV MADRASAH

The building is located in the district of Selçuklu, one of the central regions of Konya province in Turkey in the archaeological site of III. degree (KonyaKentRehberi, 2013). In 1982, the madrasah was registered officially as the first group building by the Konya Regional Committee for the protection of Cultural Assets. The property is currently located on the Konya Metropolitan Municipality as a public building. The madrasah is located inside the main road and is not visible from the road as it is below the buildings and road level (Figure 2.). The entrance to the madrasa building can be accessed from the northern façade by descending the stairs from the Karatay Street on the west side. The garden wall forms the border between the high school building in the south of the madrasah. There are generally residential apartments, commercial spaces and school buildings around the madrasah. The structure is in a state of being stuck and isolated.

Figure 2. Ali Gav Madrasah's Location in Konya (URL-4)

Ali Gav Madrasah has no foundation showing the construction date, archive document, the construction site and the architect. All the restorations have been altered by the remains of the excavations during the repair and maintenance process and have been made according to the founds (Yaldız, 2003). When the madrasah is compared with the other madrasah structures, it is right to date one of the works of the early Anatolian Turkish Architecture, namely to the last period of the Seljuk State, the end of the 12th century and the first quarter of the 13th century (Kuran, 1969). This shows that the example of the first closed courtyard madrasah in Konya is the Ali Gav madrasah.

Although there is no definite evidence for the madrasah, the building was built as the Bektashi zawiya when it was first built, but it was closed by the governor of Konya Ferid Pasha of 1896-1902 and it was given to Hodja Mehmed Vehbi ibn Hüseyin. In 1901, with the support of the governor, he has made the renovations with the money collected by the philanthropists and opened as a madrasah (Konyalı, 2007; Kuran, 1969; Sözen, 1970). As a result of the arrangements made in education together with the proclamation of the Republic of Turkey, it was closed as in all other madrasahs. The madrasah, which was later transferred to the Ministry of National Education, began to function as a children's library. Then, in 1983, the building was used as a bookbinding office of the provincial public library. In the same year, it was asked by the Konya Folklore Research Association to be a presidential building, but his request was turned down that it was not appropriate to use it for commercial purposes because it is thought by directorate general of foundations madrasah is located in an important district and between the Street (T.R. directorate general of foundations archive).

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Many excavations have been made to find a trace of the building until the present day, and they have undergone repair, maintenance and restoration and have many different functions. As a result of the excavations carried out in 2009, The madrasah is revealed the main plan scheme of the madrasah which is an example of a madrasah with a closed courtyard. So the integration method was applied within the scope of restoration work. The ruined building walls were completed with the rectification proposal suggested in the restoration in accordance with its original form and material such as rubble stone. The upper cover of the spaces on both sides of the entrance is covered with a flat roof, the portico of the courtyard is covered with a brick material as a vault and the central area is covered with a tempered glass geodesic dome. Date of 14.12.2010, the directorate general of foundations leased to the Konya Metropolitan Municipality. After its restoration in 2013 (figure 3. and 4.), KOMEK (Konya Metropolitan Municipality Vocational Courses) started to serve as a public education center with darülhuffaz, music and traditional handicraft courses (T. R. Konya General Directorate of Cultural Heritage Archives).

Figure 3. Top Cover Of The Courtyard

Figure 4. Madrasah Before and After Restoration-(Aynur Yılmaz's Archive)

FINDINGS

As a result of the thermal comfort analysis of the Ali Gav Madrasah, the comfort features of a closed courtyard building with integrated contemporary features are revealed. Thus, this kind of integration is aimed at modern technical, repair and restoration works in cold climate regions, both for energy cost reduction and to ensure user satisfaction. The data taken during the periods when the heating system is operating and not operating is shown in the diagram according to the space names shown in the schematic plan (Figure 5).

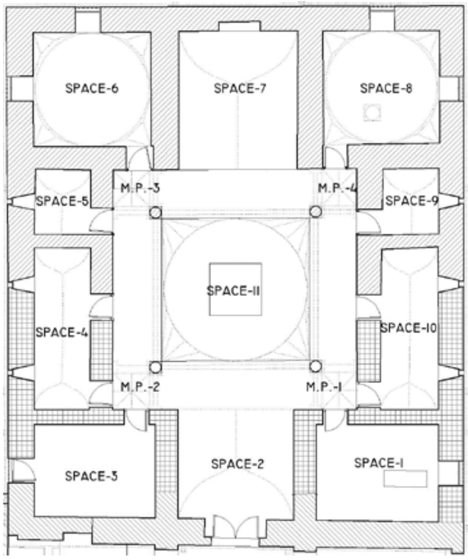

Figure 5. Madrasah's Plan Schema and Place Names (Ceray Architecture Restoration, Konya Metropolitan Municipality)

When a general evaluation is made, it can be said that the parameters affecting the thermal comfort especially in summer are proportional to the external environment data. During the measurements, temperature and humidity changes are observed according to the height of the instrument. This change occurs as the height of the tool increases in the space and there is not much change in the temperature value but there is an increase in the amount of moisture is observed. Air velocity factor (wind), which is one of the factors affecting thermal comfort, is measured in both measurement periods. But no airflow is observed in any of the interiors. Therefore, there is no positive or negative effect of the air velocity factor.

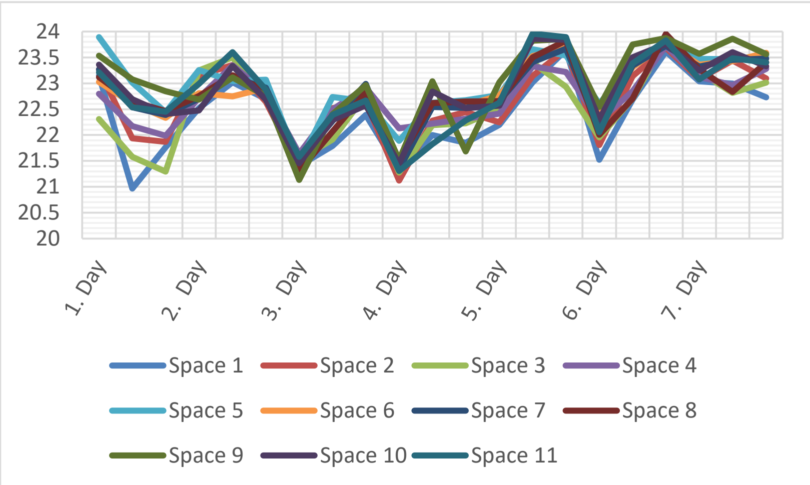

Figure 6. Heating System works Period's Temperature Diagram of Places (Şenalp, 2019)

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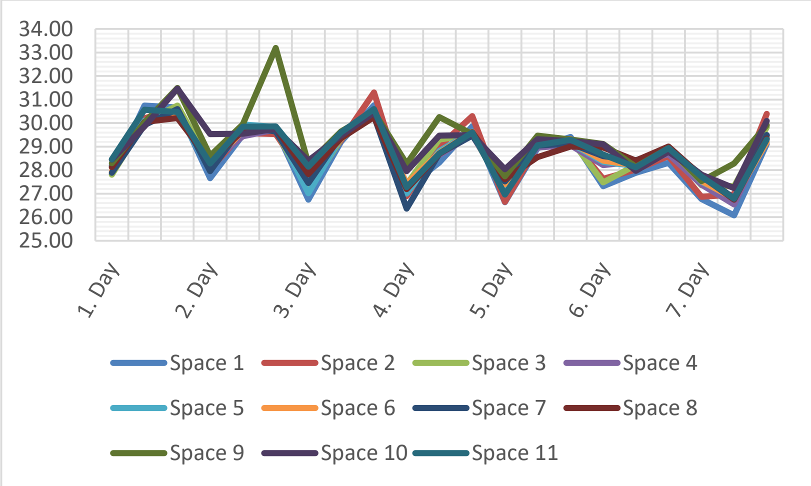

Figure 7. Heating System does not work Period's Temperature Diagram of Places (Şenalp, 2019)

As a result of the measurements made, the temperature value for the period (summer period) without heating system exceeds the ideal level due to the high ambient temperature. Since the temperature can be adjusted manually in the period when the heating system is running (winter period), the temperature value is generally constant and it is also thermally positive.

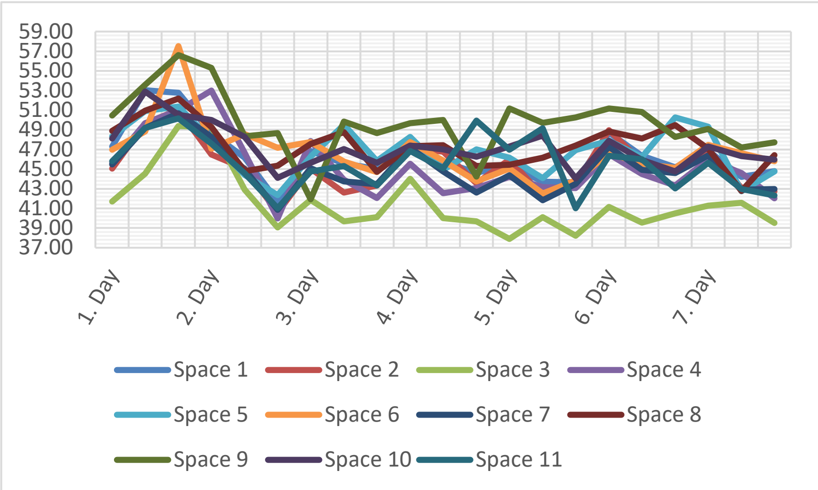

Figure 8. Heating System works Period's Relative Humidity Diagram of Places (Şenalp, 2019)

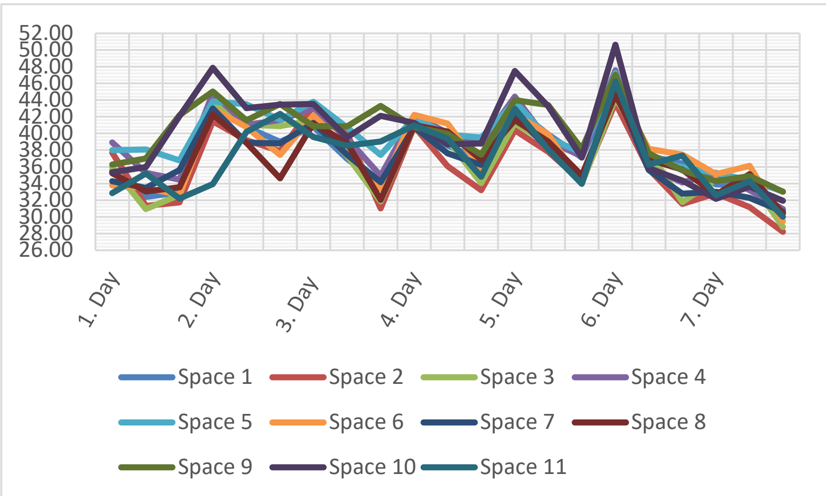

Figure 9. Heating System does not work Period's Relative Humidty Diagram of Places (Şenalp, 2019)

Moisture factor is determined as the main reason for the lack of thermal comfort in the measurements made during the period when the heating system is running and is not. The other two factors based on the measurements are sufficient to provide ideal conditions especially during the operation of the heating system, while the comfort level in the structure falls back due to the high amount of humidity in the indoor environment.

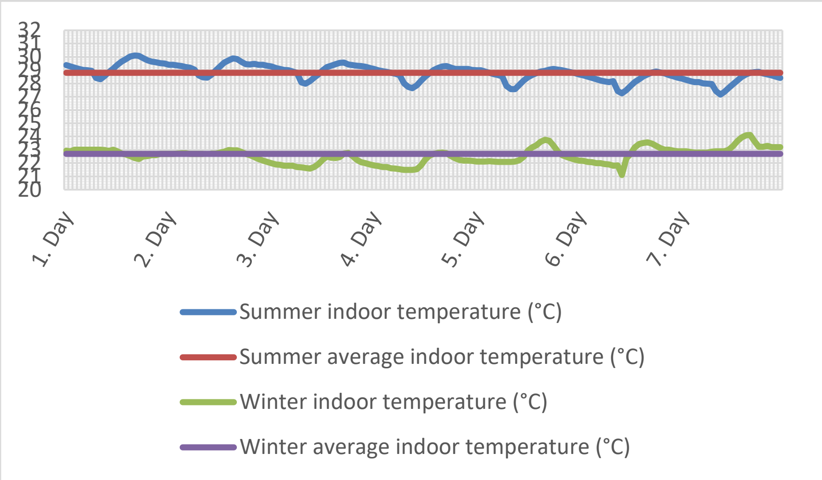

Figure 10. Datalogger's Temperature diagram (Şenalp, 2019)

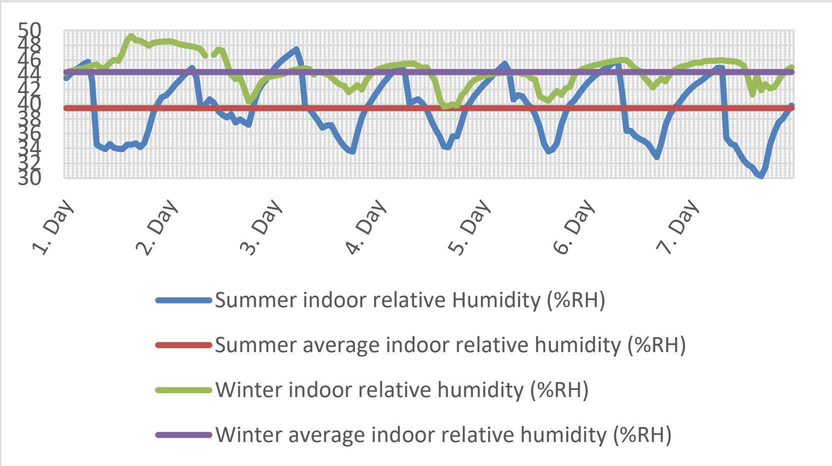

Figure 11. Datalogger's relative humidity diagram (Şenalp, 2019)

The users who use the madrasah continuously during the summer and winter periods and managers express that they feel extremely uncomfortable in the interior. Personnel say that they have been working for a long time and that their health is disrupted by many reasons such as pain in their knees, breathing during breathing and many others. Users who stay at certain time intervals and only some days in the summer period say they don't feel well inside the place and they haven't mentioned a problem in their health. Every user of madrasah state that they feel themselves overwhelming and stifling in the time periods they use.

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CONCLUSION AND RECOMMENDATIONS

As a result of the research, thermal comfort conditions are thought to affect both human health and efficiency as well as structure and energy cost. If the thermal comfort is at the optimum level for the users, their desire to work and the efficiency of the people increase and he/she feels psychologically better. While looking at the factors affecting the comfort conditions structurally, it is observed that the orientation of a building, the material and the openings in the structure differentiate these conditions. In addition, it is possible to improve the comfort of the interior with various devices and machines in places that do not have this comfort condition. For this reason, the structures which are not suitable for this comfort condition increase the cost in terms of energy and raw material expenditures. In this context, it is observed that there are some problems in terms of thermal comfort conditions in the madrasah structure which was completed in 2013 within the scope of restoration.

In the Madrasah, spaces, which are opened to a common indoor courtyard, the doors opening to the courtyard, are permanently opened except for special times. There is continuous air circulation between courtyard and spaces. As a result, there is no difference between the comfort conditions of the rooms. So there is a lack of thermal comfort in the madrasah's entire spaces.

During the measurements it seems that; The climate devices located in various parts of the building contribute normalization of thermal comfort conditions. In addition, due to the warm weather conditions during the summer period, doors and windows opened for ventilation for long periods can easily be ensured by balancing the thermal comfort with the external environment and it seems that temperature and especially humidity increase rapidly after the closing of the madrasah in the evenings.

As a result of the measurements made in summer and winter, it seems that the heat conditions of the spaces are similar to each other regardless of the size, number of openings and the direction they look at. The differences are formed due to the direction, a number of openings, usage conditions and many other structural factors, and these differences are minimal. The reason for this situation is the opening of all the spaces into a common area of the courtyard.

In the oral interviews conducted during the periods, the users mentioned that in the winter period when the heating system is running, the building's atmosphere is generally more humid and disturbing. But the result of the measurements and analyzes, it is observed that the windows and doors are kept open and the humidity is removed by the interaction with the external environment during the summer period. As proof of this situation, the summer period's night data and winter humidity rates are similar with the humidity rates during the summer period after the course center is closed in the summer period, it is shown that the humidity increased in the evenings but there is no such difference between the day and night humidity in winter. However, since there is no such situation during the winter, moisture remains indoors. Thus, the perception that the madrasah in winter is more humid is formed. But this is not a spatial situation which is a result of external factors.

As a result of the study, thermal comfort analysis of the Ali Gav Madrasah, which has a wide variety of user typologies, is carried out also the effects of the restoration and its newly gained functions on these comfort conditions is revealed. It is thought that this study will provide a basis for how to do the preliminary research on how this intervention will affect the thermal comfort in the structure before the modern restoration applications such as the contemporary additions and materials.

When we look at the applications of restoration in Turkey, it can be said that thermal effect, thermal comfort that will occur before and after restoration is completely ignored. Today, examined restoration, reconstruction and recommendation studies show that contemporary additions and top cover applications are increasing. In general, the restoration applications made with modern materials, buildings are negatively affected by the thermal aspect according to observations and interviews. It can be said that this is mostly due to the greenhouse effect caused by the transparent/glass steel top and wall coverings made by ignoring the climatic and structural features. The importance of this issue emerges in this context. From this point of view, it's necessity arises to increase and deepen these research on historic structures.

The restoration, maintenance, repair and restoration activities which will be carried out for the use of historic buildings in order to use the existing building stock, which is a very important phenomenon, are of great importance not only to protect the historic work and the culture it reflects but also to use the existing building stock by means of economic and temporal factors. For this purpose, necessary feasibility studies should be carried out before the procedures and applications to be carried out,

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determination of the thermal effect, investigation and analysis will be required. And so it should be carried out to produce detail to solve the problems that occur in the determination.

It seems that the problem that is the subject of the research constitutes a problem in the interviews and detailed investigations with the users of the structure before restoration/reconstruction. From this point of view, as a result of verbal and written interviews conducted in Madrasah and objective climatic measurements, it is concluded that this problem rises neither due to the geodesic tempered glass dome of the top cover of the courtyard nor Ali Gav Madrasah's restoration-reconstruction application. In fact, it can be said that the problem originates from the external factors such as the location of the building, the soil characteristics, or the internal factors such as the use of bad workmanship and detail due to the first construction.

Restoration Interpretation in terms of Used Material and Application

- The presence of moisture and hence water in the madrasah not only affects the users but also affects the structure and material. The interior and exterior walls of the building and floor of interior surfaces have deteriorated the effects arising from water/moisture like salinity, color change. In addition, cracking, breakage and spills are observed on some wall surfaces.
- Thermal comfort, thermal behavior analysis revealed that the building does not enough in terms of thermal. However, before and after the reconstruction/integration process, the oral interviews with the trainees taking part in this structure show that this amount of moisture felt in the structure is much more overwhelming. It is said that the amount of depressing moisture decreases day by day. Prior to restoration studies, no preliminary studies are made concerning any problems existing except the determination of the planning scheme. Therefore, the thermal problems that existed before the restoration application continued after the integration.
- In order to solve the problem, it is tried to find temporary solutions by using climate devices, air conditioners and ventilation systems. However, none of these solutions can be seen as a method to eliminate the problem radically.
- Based on this, restoration studies should not be started before the necessary feasibility studies such as problem detection and search for ways to reach. However, when we look at the applications, it is seen that there are

deficiencies in the preparation of the preliminary studies. In this case, it is seen that it does not constitute a healthy application for historical structures and users.

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Resume

Mihrimah Şenalp is a research assistant at Konya Technical University (Konya/TURKEY) in architecture department. She graduated from Faculty of Architecture of Selçuk University in 2016. She is Phd student at Konya Technical University. Her research interests are architectural conservation and restoration, reuse of historic buildings, historical environment, protection of cultural heritage thermal comfort of historic buildings.

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Universal Design in Interior Architecture Education: The Case of Store Design

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A. Nilay Evcil**

Abstract

Universal design is a user-focused designing approach that involves cultural, physical, mental and dimensional aspects and takes into account the needs of different personal characteristics. This study will analyze the resolutions for different personal characteristics in the design qualities of an apparel store designed by interior architecture students and then utilize the results to make suggestions for curriculum studies in which universal design embedded continuously. In terms of the different user characteristics, the study participants mainly focused on physical and visual disabilities, as well as older people and families with children. According to the participants, the most important issues to be attentive to when making interior space resolutions included reaching the shelves, disabled access ramps at the entrance, size of the circulation area, accessibility of the cashier counter, and size of the changing rooms. Another important issue related to the store design is aesthetic appeal. Serving as an indication of their concern for the commercial success of the store, the participants offered suggestions about the window display and the aesthetic quality of the store.

Keywords: *Universal design, store design, inclusive design, interior architecture education, diversity*

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INTRODUCTION

Universal design (UD) is a design concept which aims to pay attention to different users' characteristics such as cultural, physical, mental and dimensional. The concept is similar meaning to inclusive design or design for all which involves designing spaces capable of being use by everyone regardless of physical or mental or emotional differences (Evcil, 2014; Helvacıoğlu & Karamanoğlu, 2012). To ensure that building interiors take into consideration the different user characteristics, approval of these concepts by institutions providing interior architecture education is necessary. Indeed, besides user characteristics, store design encompasses aesthetic understanding with the functional and commercial performance (Petermans & Van Cleempoel, 2010). Null (2003) introduced four main categories under which the concept of universal design approaches human differences: older adults experiencing age-related changes; adults; children; and people of all ages with disabilities. These categories stand as the starting point for the universal design approach. Mace (1998) said that everybody was going to get old one day, which means, essentially, that everyone will experience the state of being a person with disabilities.

The aim of this study is to examine both, how interior architecture students interpret different human characteristics during their design process and to improve the methodology applied in interior design curricula with the help of these findings. To reach an inclusive world, design related undergraduate curriculum should concern universal design paradigm which is almost scarce in our universities. The study group consisted of third grade interior architecture students from a foundation university in Istanbul. At the beginning of the study, students were asked to write down their initial ideas about how store design could be more inclusive. Next, they were tried to empathetically understand 'different' people's requirements and problems causing disablement with the help of empathy. Finally, students were asked to draw sketches pertaining the process.

The research aims to answer the following questions regarding a good store design for all people: "What suggestions do the interior design students offer for accommodating user-differences in a space?" "How do they apply the principles of interior architecture for store design when suggesting solutions for the differences?" "What kind of studies should be conducted on curricula to facilitate awareness in interior architecture students about human characteristics other than the normal ones ("...to be

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perfect, capable, competent and independent") described by Mace (1998)?"

UNIVERSAL DESIGN IN INTERIOR ARCHITECTURE CURRICULUM

Diversity is a main discourse of our age and it is also popular among designers. Unfortunately, there are still people excluded from designers' considerations whether consciously or unconsciously. This could possibly be related to the conventional approach adopted by some designers wherein Vitruvius' drawing of a white, healthy, adult man serves as the measure by which architectural design based on it. Despite the regulations that have been set in place, our living environment does not concern user differences in terms of physical and/or mental abilities. As is the case in many fields the governing norms are not enough to solve the problem. Rather, there is a need to raise awareness about the value of empathy at the initial stages of design. "Empathy is also linked to spending time with people" (Strickfaden & Devlieger, 2011, p. 225). UD approach tries to consider users' differences in terms of abilities, characteristics and desires on the basis of empathy in all built environments.

Interior architecture undergraduate program is as popular as architecture. This is because; interior architects are one of the indispensable members of the professional team responsible of the built environment. Unfortunately, as it happened in other design based undergraduate curricula, user centered design approach is still scarce in Turkey. UD precepts are introduced mostly in an elective course within the curriculum, but; this is very common in universities all around the world (Manley, 2013). In the USA, they overcome this barrier during the accreditation process. Foundation for Interior Design Education and Research (FIDER), with recognition by the US government's Council on Higher Education Accreditation (CHEA), specify interior architect's qualifications and accredit interior architecture programs in universities in both the US and Canada (Jones, 2001). According to FIDER, interior architecture students' work must demonstrate understanding of UD concepts and principles (Jones, 2001).

WHAT IS UNIVERSAL DESIGN?

Universal design's motto by Ronald Mace -concept creator- "it means the design of products, environments, programs and services to be usable by all people to the greatest extent possible" without the need for adoptation or specialized design (Mace, Hardie & Place, 1996, p. 3). It is a new point of view which stops special or adaptive solutions as it was targetted in barrier free design or accessible design. Universal design evokes the idea of designing for people with disabilities, especially considering that its creator, Mace, is a wheelchair bound architect. This view, however extremely narrows and limits the full breadth of the concept, as "universal design does not mean special products for a certain group of people, but rather good design for all phases and circumstances of life. The term universal design addresses this desire and demands intelligent solutions for every area of life and all age groups" (Herwig, 2008, p. 17).

Universal design, inclusive design or design for all are used interchangeably in different countries of the world. They all refer to a philosophy and design process rather than to a legal code, as it is commonly mistaken for (Kelly et al. 2013).

It is important that interior architect emphasize universal design principles in their proposals for shopping center which is nowadays one of the indispensable social place in urban life. As the focus of these proposals needs to center on making life easier for all citizens: consideration should be directed towards the features and variety of activities constituting the life of shopping center as; access to services, reach shelves, fit costumes, eat and drink with a friend, pay at the cashier to name several. This is also related to the people's quality of life as they concern usability, user friendly and age friendly features, freedom from stigma, market acceptance and joy of use (Herwig, 2008). Designers should also keep in mind that part of the population is getting older. Thus, design must adapt to and simplify the daily living environment. Universal design can achieve this demand given that the concept includes the idea of simplicity and complexity in design for everyone.

Kelly et al. (2013) list the following instrumental activities of daily shopping:

- Lowering or making height adjustable the electronic devices used in typical purchasing transactions (e.g. credit card reader)
- Larger print on signs indicating aisle numbers and locations of goods, and on packaging of items
- Wider aisles
- Automatic powered doors at entrances and exits

Furthermore, universal design approach also benefits older people. In other words, application of universal design to our built environment profits our aging population as well.

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METHOD

The aim of this study is to analyze the approaches used by interior architecture students to meet the diversity of people's needs in the society focusing in a sample design of an apparel store. In this context, the study was conducted with the students who had to have knowledge about the fundamental principles of store design, and have made store designs in their project lesson from the previous semester. The students were not specifically provided with the principles of store design. This study was conducted within the context of an ergonomics lesson taught in one class offered within the Interior Design department. Instruction in the lesson was given under four main titles: anthropometry, ergonomic environmental conditions, accessibility, and universal design. The study was conducted after completion of a 14-week program. Therefore, students have already basic knowledge about UD principles. The study sample included 33 junior-level students (21 females and 11 males). The students were asked to express in writing and sketches the points to be considered when designing a main street apparel store, one that was equipped to accommodate the use of everybody. The main limitations of the study included its small sample size, and the fact that the findings were limited to the examples taken from curriculum studies and universal design research in interior architecture education and therefore cannot be generalized.

FINDINGS

Results from the study showed that the students' solutions for an inclusive store fell under the 9 categories such as interior architecture layout, store entrance, circulation, direction, graphical practices, shape, size and qualities of interior architecture reinforcements, shop windows, restrooms and others (Table 1).

Table 1. The students' suggestions for store design in context of inclusive design

	STUDENTS' STORE DESIGN DETAILS	Percent of students who took design detail into considera-tion	Percent of students who did not take design detail into considera-tion	Universal design principles associated by researchers
INTERIOR ARCHITECTURE LAYOUT	Aesthetic concern	56	44	Adding to human delight/Functional and

				aesthetic integration*
	Location of the cashier counter	41	59	Equitable use/Flexibili-ty in use
	Location of the changing rooms	34	66	Equitable use/Flexibili-ty in use
	Place/location of the items on display	31	69	Equitable use/Flexibili-ty in use
	Reinforcement for resting (e.g. armchairs, ottomans)	47	53	Tolerance for error
STORE ENTRANCE	No door sill at the entrance	22	78	Equitable use
	Placement of a disabled access ramp	72	28	Equitable use
	Size of the entrance door-being opened to the outside/using sensor	19	81	Low physical effort/ Size and space for approach and use
CIRCULATION	Wheelchair circulating area	34	66	Low physical effort/ Size and space for approach and use/ Equitable use
	Broadness of the circulation area	72	28	Low physical effort/ Size and space for approach and use/ Equitable use
	Width/height of the steps on the stairs	6	94	Low physical effort/ Size and space for approach and use/ Equitable use
	Handrail for stairs	3	97	Equitable use/Flexibili-ty in use
	Inclusion of an elevator/lift in multi-flat stores	34	66	Equitable use
	Elevator size	9	91	Equitable use/Size and space for approach and use

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	The controls and warnings related to the elevator	3	97	Tolerance for error
DIRECTION	Plaques for the exit, elevator, changing rooms, and product types	31	69	Simple and intuitive use/Percep-tible information
	Direction by products	9	91	Simple and intuitive use
	Arranging the products on shelves by category	13	87	Simple and intuitive use
	Direction by floor signs or ceiling hangings	13	87	Simple and intuitive use
GRAPHICICAL PRACTICES	Font size on tags/audio-visual barcodes	16	84	Flexibility in use/Percep-tible information
	Using braille alphabet on tags	16	84	Equitable use/Flexibili-ty in use/ Perceptible information
	Usage of magnifiers	0	0	Equitable use/Flexibili-ty in use/ Perceptible information
SHAPE, SIZE, AND QUALITIES OF THE INTERIOR ARCHITECTURE REINFORCE-MENTS	Height/size of the cashier counter	59	41	Flexibility in use/ Size and space for approach and use
	Size of the changing rooms-height of the hangers	59	41	Flexibility in use/ Size and space for approach and use
	Opening mode of the changing room doors	25	75	Low physical effort
	Height-width of the shelves	84	16	Low physical effort/ Equitable use/Flexibili-ty in use
	Shape of the products on display (rounded edge)	9	91	Tolerance for error
	Ventilation	19	81	Functional and aesthetic integration*
	Lighting	47	53	Functional and aesthetic integration*
	Color (walls, floor, ceiling)	19	81	Adding to human delight/Func tional and

				aesthetic integration*
	Color (e.g. shelves, armchairs)	6	94	Adding to human delight/Functional and aesthetic integration*
	Safety/fixing the shelves	22	78	Tolerance for error
	Non-slippery floor/tactile paving	22	78	Tolerance for error
SHOP WINDOW	Design and lighting of the shop window	50	50	Equitable use/ Tolerance for error
	Height of the shop window or the product in it	19	81	Equitable use
RESTROOM	Implementing a restroom for the disabled	19	81	Equitable use
	Size of the restroom	3	97	Size and space for approach and use
	Childcare room/restroom	9	91	Equitable use
OTHER	The relation between the brand and the store design	3	97	Functional and aesthetic integration*
	The success in expressing the brand	16	84	Perceptible information
	Playing soothing music	22	78	Adding to human delight*
	Height of the ceiling	3	97	Adding to human delight*
	The assistance of the employees to disabled customers	16	84	Social cohesion and participation*
	Playground for children	3	97	Flexibility in use

* Added principles to main 7 universal design principles.

Interior Architecture Layout

It was observed that the students' suggestions incorporated aesthetic and commercial concerns within the inclusive approach. The students anticipated that customers would first go to the right when entering the store, since almost 90% of the people in Turkish society are right-handed, and they made sure not to place the cashier counter near the entrance, believing, on the basis of

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commercial concerns, that the cashier counter should be located at the rear of the store, where it would be less visible. The consideration for the interior architecture layout was 56% for aesthetic concern, 47% for the necessity of the presence of the reinforcement for having a rest, 41% for the position of the cashier counter, 34% for the position of the changing rooms, and 31% for place/location of the items on display.

Store Entrance

In the study, 72% of the students emphasized the need to have a ramp, along with stairs, at the entrance, 19% expressed that the opening mode of the entrance door should open from the outside or be equipped with sensors for automatic opening, and 22% indicated that there should not be a revolving door at the entrance.

Circulation

The main concern of the students was the broadness of the circulation area in the store (72%), while the turning space for wheelchairs (34%) and the presence of an elevator in multi-flat stores (34%) were their secondary concerns. However, they expressed few opinions about the size of the elevator (9%) or the height and/or width of the steps on the stairs (6%).

Direction

Students suggested the use of plaques, to direct customers to specific areas (e.g. emerging exists, elevators, changing rooms). The breakdown by percentage of the students who offered these suggestions was 31% for the use of plaques to direct customers to emergency exits, elevators, changing rooms or product types, 9% for product placement in directing customers, and 13% for direction by spatial tools, like floor signs or ceiling hangings. The students also suggested that products could be arranged on the shelves by their categories (13%).

Graphical Practices

The students particularly considered visually disabled and older people in addressing the issue of the readability of the instructional use notes and tags on products. However, there were only a few students who expressed opinions about this issue. The usage of the Braille alphabet, enlargement of the font size on the tags, and the application of audio-visual barcodes were suggested by 16% of the students. There were no suggestions, though, for placing magnifiers in the departments.

Shapes, Sizes and Qualities of the Interior Architecture Reinforcements

The highest numbers of suggestions (84%) were addressed to the height and/or width of the shelves, the finding of which is an indication that the students were strongly aware of the potential difficulties certain customers have in accessing the shelves. The second highest number of suggestions for this issue (59%) was related to the height of the cashier counter and the size of the changing rooms. In reference to the changing room, a small number of the students offered suggestions about the height of the hangers. Moreover a few number of students (25%) mentioned about the opening mode of the changing room doors. In the context of inclusiveness, the students also made suggestions about the environmental conditions of the store, specifically focusing on the level of lighting (47%), and, though not as commonly suggested, the colors of the walls, floor and ceiling (19%) and ventilation (19%). In addition to the environmental conditions, some of the students considered security (fixation of the shelves: 22%; non-slippery floor/tactile paving: 22%; display type for products 9%) to be important.

Shop Window

Half of the students (50%) offered suggestion regarding the lighting of the shop window, and they were mainly concerned about the attractiveness of the store and ensuring a good perception of the products on display. Furthermore, 19% of the students talked about the height of the shop window and the window presentation of the products to the public. The findings demonstrated the consideration they gave to making the products visible to people of different body heights and from a variety of distances.

Restrooms

The students offered suggestions about designing a restroom for people with disabilities (19%) and providing a childcare room (9%).

Other

Included under the uncategorized suggestions offered by a lower percentage of the students were playing calming music in the store to foster a peaceful store atmosphere (22%), offering of helpful service by the store workers to the people with disabilities and the older people (16%), and enriching the expression of the brands (16%).

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UNIVERSAL DESIGN PRINCIPLES

The second aim of this paper is to assess students' awareness about universal design principles. For this purpose, 11 universal design principles were classified according to students' suggestions about an inclusive store design. As it is known the first seven principles revealed by Mace (Story, 2001), the other four ones developed respectively by Manley (2000), Degertekin (2010) and Evcil (2014) to generalize the idea of design for all (see details about the principles of UD Evcil, 2014; Manley, 2000). While making this classification, all possible principles that conform to the students' statements (writing and sketches) were listed by the researchers. 13.7 % of the students expressed design details concerning equitable use. Tolerance for error principle is the second mostly covered universal design principles in students' store design (11.3 %). 9 % of the students explained design details concerning both equitable use and flexible in use together. The principle of simple and intuitive use comes after with 6.8 %. In students design details, functional and aesthetic integration was given 6.8 % as the previously mentioned universal design principles. It is also valuable to cite that 3 universal design principles together (low physical efforts, size and space for approach and use, and equitable use) are concerned by students as 6.8 %. Table 2 shows the frequency of universal design principles that students mentioned in their design details. None of the students stated any design details covering renewable energy resources to protect and sustain natural resources and ensure social equity. A few number of students suggested employee's assistance for customer with disabilities during their shopping experience. Though at first glance it may seem like a proposal opposing universal design, we may accept student's suggestion as a Turkish tradition. Helping and assisting to elderly is an old tradition in the society, which is probably related to universal design principle as social cohesion and participation. Indeed, students mentioned more or less other universal design principles in their statements. Therefore, it is pleasing to discover students' intention on different users' needs in design process but, on the other hand, it is also recovered that students cannot adequately adopted universal design principles.

Table 2. Universal design principles overlapping with students' suggestions for store design

Universal design principles	How many times the relevant universal design principle is used in students' suggestions	Percentage
Equitable use	6	13,7
Flexibility in use	1	2,3
Simple and intuitive use	3	6,8
Perceptible information	1	2,3
Tolerance for error	5	11,3
Low physical effort	1	2,3
Size and space for approach and use	1	2,3
Adding to human delight	2	4,5
Functional and aesthetic integration	3	6,8
Social cohesion and participation	1	2,3
Renewable energy resources to protect and sustain natural resources and ensure social equity	0	0
Adding to human delight Functional and aesthetic integration	3	6,8
Equitable use Flexibility in use	4	9
Low physical effort Size and space for approach and use Equitable use	3	6,8
Low physical effort Size and space for approach and use	1	2,3
Simple and intuitive use Perceptible information	1	2,3
Flexibility in use Perceptible information	1	2,3
Equitable use Flexibility in use Perceptible information	2	4,5
Flexibility in use Size and space for approach and use	2	4,5
Low physical effort Equitable use Flexibility in use	1	2,3
Equitable use Tolerance for error	1	2,3
Equitable use Size and space for approach and use	1	2,3
	44 times in total	100%

RESULTS

The case study showed us that interior architecture students have knowledge about UD precepts but according to their choices in the apparel store design, we can say that they are yet on the initial steps. In the study, the interior design students attached the highest importance to factors related to the accessibility of wheelchair users, older people, and persons with physical disabilities, such as the height and width of the shelves (84 %), placement of a disabled access ramp beside the stairs at the entrance (72 %), the size of the circulation area (72 %), height and size of the cashier counter (59 %), and size of the changing rooms and the hanger heights in them (59 %). The students placed a great degree of importance on aesthetic concerns related to the space in question and addressed them within the context of universal design. Their suggestions regarding these concerns included the aesthetic layout of the store, (56 %), the design and lighting of the shop window (50 %), and the use of light to bring greater visibility to the store and the products and thereby make them more attractive (47 %). Piotrowski and Rogers (1999) noted

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that store design was highly important in securing commercial success. Today, many companies indicate in their product advertisements that their products are user-friendly, accessible, and of universal design. As an example, the company, VirtACombo, markets their shower/bathtub with statements promoting their "ergonomic usage and universal design line" (Karakoç, 2015).

When considering the users with different needs, the students largely focused on wheelchair users, persons with physical disabilities, visually impaired individuals, older people, and families with children. Their primary suggestions regarding these groups included the provision of broad circulation areas for physically disabled persons, determining suitable width for the ramp and size for the elevator and changing rooms, with suitable hanger heights in the latter, and positioning the cashier counter partly for wheelchair users to enable them accessing and communicating. Only 34 %, however, proposed including an elevator. They also made suggestions addressed to the readability of the price tags for the visually impaired and older adults (using Braille alphabet: 16 %; enlarged font size of the tags/audio and visual barcodes: 16 %) and proposed using non-slippery flooring, as well as tactile paving (22 %). The students attached great importance to including resting areas for older people, especially, to placing armchairs or ottomans for them in the waiting areas in front of changing rooms and cashier counters (47 %).

While the students offered many suggestions about the circulation in the store, they expressed only a few about the automatic opening mode of the door, door size, or the opening direction of the door (19 %). Since the shopping malls in Istanbul are mostly located in the city center and the stores in these areas usually do not have the type of entry-way doors seen in conventional shopping centers, the students presumably had only limited opinions about doors in a study like this, which was conducted in a very short span of time. Shopping streets especially in historical areas need some other design considerations such as new additions to old building etc. are excluded in this study.

Proposals offered by the students on directions included direction plaques (31 %), arrangements of the products by category (13 %), and spatial direction methods, such as floor signage or ceiling hangings (13 %), in addition to the more obvious directions provided by the shop employees and the assistance they give to customers with disabilities in reaching the products (16 %).

Ensuring the psychological comfort of the customers as they shop was another point considered to be important by the students.

Playing soothing music (22 %), securing the privacy of the customers, especially in the placement of the changing rooms (34 %), providing optimal ventilation (19 %), and determining the color of the space (19 %) were the other points that students, rarely though, thought about.

The students were very limited in their suggestions on safety. Their proposals included fixation of the shelves (22 %), non-slippery floor/tactile pavement (22 %), opening direction of the entrance door/motion sensor (19 %), and shape of the display items (rounded edges) (9 %).

Circulation, approaching the cashier counter, reaching the shelves, and size of the changing rooms were the biggest considerations of the students, and they searched solutions that would obey the 'Size and Space for Approach and Use', 'Equitable Use' and 'Low Physical Effort' principles of universal design. With their suggestions of fixation of the shelves and tactile pavement and non-slippery flooring for security within the context of universal design, the students aimed to comply with the principle of 'Tolerance for Error'. Moreover, they applied the 'Flexibility in Use' principle with the suggestions of offering cashier counters with different heights, arranging a suitable height for shelves that could be accessible by everyone, and using the Braille alphabet in product tags. They also suggested different methods such as graphical and spatial solutions, to make product access simple and clear (in context of the principles 'simple and intuitive use' and 'perceptible information').

CONCLUSION

This study has focused on the evaluation of the needs of different users based on store design case, and revealing the approaches of interior design students towards the inclusive design subject. The students expressed opinions in a very short period of time on a wide range of subjects including the size of the circulation area, the music to be played in the interior space, lighting of the shop window, font size of the product tags, ventilation, and the height and fixation of the shelves.

The study concluded that the participants were sensitive about the matters that needed to be considered in meeting the physical and psychological needs of different individuals. It was also determined that although the participants addressed the fundamental human categories prepared by Null (2003) (adults, children, older adults experiencing age-related changes and people of all ages with disabilities), they were unable to go into much details. The participants made their suggestions on the

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assumption that interior architecture design is one of the elements responsible for the commercial success of a store. The points that the students were most sensitive about were circulation and the accessibility of shelves and cashier counters. Their aesthetic concerns about the commercial success and customer appeal of the store were related to shop window design and lighting.

The students were aware of the fact that store design should both satisfy the needs of users and meet the commercial expectations of the client (employer). Briefly, the students demonstrated that not only accessibility and universal design but also aesthetic principles should be followed in the effort to reach customers. Outside of the aesthetic elements that play a role in competition, many commercial companies highlight that their products are user-friendly, that is, can be used by anyone, for the purpose of differentiating their products from others as well as of making their products successful.

Store design is obviously a commercial issue, and to this end, the interior architect is tasked with coming up with a design capable of meeting both the physical and the psychological needs of store employees and customers, in addition to the commercial expectations of the store owner. The architect is also responsible for devising proper ergonomic environmental conditions, which, in satisfying the aesthetic needs, makes use of anthropometric data for the purpose of providing optimal physical and psychological comfort. Other strategies for ensuring the commercial success of a store include positioning the cashier counter in such a way as to present no payment pressure on the store customers, placing the shelves, exhibition tables and other fitments in a proper fashion, and lighting the products correctly. The suggestions made by the students on the type of music to be played in the store can be included in this context.

This study has demonstrated the importance of including an analysis of universal design and different user characteristics as part of the interior architecture curriculum. Moreover, lessons on developing inclusive propositions should not only involve the theoretical dimension, and design lessons (e.g. interior architecture projects, furniture designs) should be directed towards generating solutions to design problems. In 2011, The Turkish Higher Education Council proposed that universal design be taught at the undergraduate level in design, architecture and urban design departments (document date: 09/30/2011; document number 041995), and in 2013, the Accessibility Observation and Supervision Regulation was put into force

(Official Gazette; date 07/20/2013; number: 28713). These two actions serve to demonstrate the importance of this subject and prove the value of training new employees in the areas of design and architecture. As stated by Null (2003), universal design has created new career opportunities for the alumni of design departments. Universal design offers a process wherein user differences are seamlessly incorporated into the structure of society through supportive, adaptable, accessible and safe applications, as expressed by Mace (1998), and supports social sustainability.

Likewise in Yalçın Usal & Evcil's study (2016) there is an immediate need to present students different user needs, wants and abilities not only in one course but also in different courses continuously within the 4 years comprehensive undergraduate program. Interior architecture education is one of the discipline indispensable having the potential to direct the design of products, buildings and environments. Unfortunately, there are very limited examples where UD integrated to interior architecture program seriously and continuously. In this sense, sharing good practice and assessing by a competition could be a motive since both students and tutors had been convinced of the importance of inclusively designed environments. For the last words, "in an ideal world the integration of inclusive design principles would be embedded into the design curriculum" (Manley, 2013:45).

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Resume

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Research Article

Transformation of the Space in the context of Neoliberal Urbanization: The Case of Izmir New City Centre, Turkey

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Abstract

The neoliberalism process of Turkey, the intersection point of the Global South and the Global North, which dates back to the 1980s when neoliberalism became a dominant paradigm in the world, began to rapidly transform urban space in the 2000s. With the transformation of capital out of İstanbul, the main application area of neoliberal urbanization in Turkey, the other metropolitan cities of Turkey have been involved in the process of neoliberalization. In İzmir, the third largest metropolitan city of Turkey, the area which is declared New City Centre (NCC) in 2003 has become one of the important application areas of neoliberal urbanization policies. The neoliberalization process of NCC is carried out through large-scale urban projects which are one of the important implementation tools of neoliberal urbanization policies and intervene in the economic, social and cultural areas as well as urban space. In this context, the aim of this study is decipher neoliberal urbanization-oriented process and variables of neoliberal urbanization

Keywords: *Neoliberal urbanization, large-scale urban projects, reproduction of space, Izmir new city centre, Turkey*

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process in NCC and to reveal the neoliberal spatial transformation in the region on the basis of reproduction of the space.

INTRODUCTION

In the neoliberalization process, where the relationship between capital and state has been redefined in favor of economic growth, cities have become very important as the institutional laboratories of neoliberalization (He & Wu, 2009). Because neoliberalism is not only an economical approach, it is also intertwined with urban political life (Theodore & Peck, 2011). The neoliberal cities, which correspond to the reflection of the political and economic transformations on the space, undertook the task of meeting the needs of capital accumulation (MacDonald, 2011). Along with the neoliberalism that began to dominate the world in the 1970s, it was observed that the city was located at the centre of the neoliberal urbanization policies and transformed within the axis of these policies (Kozanoğlu, Gür & Özden, 2008). In the twenty years, cities have been embedded in a geoeconomic framework characterized by positioning strategies and rapidly increasing inter-regional competition (Brenner & Theodore, 2002). Internationalization of neoliberalism reproduces inequalities in global wealth and power and causes duality in economic and political atmosphere, similar to historical colonial empires (Radice, 2007). It is possible to talk about the polorized world: Global North which is mentioned by wealth, democratic governance, peace, technology, creativity, stability and Global South which is seen as a confusion, war, conflict, poverty, anarchy and oppression zone (Odeh, 2010). In this economic and political framework, cities in the South adopt the criteria set by the North, in order to integrate into the global economy and ensure competitiveness despite the risk of increasing social and spatial polarization (Lemansk, 2007). And today, no matter where the city is located in the world, the way of neoliberal approach to the city is the same with global cities and the ongoing neoliberalization process is similar but with larger negative consequences.

The concept of global city that emerged in this process aims to make cities more attractive for international capital and international companies (Burgers & Van Der Vaal, 2008). With the popularization of the global city vision, the speculative real estate sector all by itself has become one of the most powerful accumulation tools of capital (Harvey, 2015). For this reason, neoliberal urbanization is defined briefly as a re-scaling of functions, activities and relations in the process of transforming urban land into a direct rent-generating commodity (Smith,

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2002). Mayer (2017) points out that neoliberal urbanization rises on four basis: growth-oriented urban strategy, entrepreneurial management, privatization and intensifying social polarization. Neoliberal urbanization process corresponding to a creative devastation leads to creative transformations such as destruction and /or intense surveillance of urban public areas on the built environment and urban form, creation of new privatization areas of destructive and elite consumption such as abandonment of community-oriented planning initiatives, production of large-scale urban projects, production of purified areas where closed urban settlements and social structures are reproduced, intensification of socioeconomic polarization by the expansion of the gentrification boundary and the determination of the principle of “the highest and the best use” as the basis of large land usage decisions (Brenner & Theodore, 2002, 371). The old port and industrial areas are transformed into business quarters with museums and other buildings of culture to attract creative class and capital investments (Andersen & Røe, 2017). In the process of transformation, public spaces evolved into alternative public spaces, including shopping centers, on the grounds that they cannot fulfill their roles. And with this change, it is possible to talk about the exclusion of “undesirables” and control in public space (Gomes, 2019).

City centres are seen as “live, work and play” areas for the wealthy middle and upper classes (Marquardt & Füller, 2012). Therefore, entrepreneurial urbanization policies, encouraged by neoliberal policies, are put into practice through the construction of prestigious large-scale projects (Enright, 2014). In order to create the consumption areas needed by neoliberal urbanization, attract the creative class to the city, bring more profits to the enterprises and provide urban rent increase, large-scale urban projects have become an important strategy in the market leadership for economic development (Rankin & Delaney, 2010). Large-scale urban development projects are highly risky investments for the city due to their speculative economic viability and the dynamics of the real estate sector (Swyngedouw, Moulaert & Rodriguez, 2002). In addition to the risks they have, they cause displacement of urban residents and gentrification processes that cannot tolerate the rent to be earned because they are rent-based acquired from the re-evaluation of urban land (Evans, 2005). The commodification of urban land, which is an important feature of neoliberalism, has become a state project widely applied in many cities of the world (Lin & Zhang, 2015). While the gentrification is now becoming an application that is more institutionalized, facilitated by the state and encountering less resistance, it has made all cities, regardless of scale, disambiguate to social polarization (Hackworth, 2007). The urban elite's indifference to impoverishment and greed against the rent in spite of the growing despair of the urban poor and its anger towards the system, increase the visibility of the differences between the social groups, causing the conflict becoming more violent (Sassen, 1998).

Cities shaped by neoliberal urbanization are transforming into ‘extraordinary wealth and privilege islands with their rising skyscrapers such as millions of square meters of office areas and towers’ (Harvey, 2015, 70). The most socially destructive result of the process was the reorganization of the urban centers for the upper and upper-middle classes, while the lower classes were pushed to the outer walls of the city (Kozanoğlu and other, 2008). Due to the exclusion of the productive class from urban space, the neoliberal city forms the basis for the overcoming of social divisions (MacDonald, 2011). In theory, while creating cities in conformity with world standards, in practice, elite cities that are becoming enemy for the urban poor, are being created focused on new wealthy citizens and consumption-oriented lifestyles (Ellis, 2012). The residential displacement of slum areas occurs on a massive scale in the Global South compared to the Global North due to large-scale urban development projects undertaken by entrepreneurial states (Borsuk & Eroğlu, 2019). It is possible to say that neoliberalization, which is defined as the driving force of the re-creation of urban space on the world scale, works unequally for different groups of society (Bénit-Graffou, Didier & Peyroux, 2012).

In this framework, Turkey the intersection point of the Global South and the Global North, has not historically undergone colonialism and post-colonial political processes like Latin America, Africa or South Asia, is special case in the era of neoliberalization and global imperialism. However, the port cities of Turkey, are subject to a process similar to colonialism due to capitulation in the late Ottoman period (Yıldız, 2014). Therefore, it is possible to say that the port cities of Turkey has a close experience with the Global South. Cities in Turkey offer unique examples rather than cities of North or South, due to unique political, economic and geographic features of country. Especially with the acceleration of Turkey's neoliberalization process in the post-2000 period, it is seen that both neoliberal urbanization will find application area with the large areas in the metropolitan cities with the support of the state. In this paper, New City Centre of İzmir (NCC), the focus of the neoliberal urbanization in Turkey, has been selected as case study due to providing a unique example in terms of changing the location of hundreds of years old city centre and an area of 480-hectare, tabula rasa, for neoliberal

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urbanization applications. Study aims to decipher the ongoing neoliberalization process in NCC which has quite different dynamics than North or South, in the light of large-scale projects as neoliberal application tools finding application area under these unique city dynamics. Privatization processes and large-scale urban projects, which are one of the important application tools of neoliberal urbanization, and it can be said that these are the embodiment of neoliberalization as they provide maximum profitability in minimum area as well as transfer the profit in the field to capital. In this direction, the objectives of the study are concentrated on revealing the concrete and abstract outputs of the large-scale projects, important application tools of neoliberal urbanization, located in NCC throughout the planning periods of NCC.

At this point, the plans are very important because they contain the land use decisions and construction conditions that enable the construction of large-scale projects through the decisions taken. Therefore, it is necessary to take into consideration the organizations where the plans are approved as well as the contents of the plans. Because, in addition to the plans approved by the local government, the plans prepared by the central government provide important data for the deciphering of the relationship between public and capital, as well as the privatization processes which are one of the important tools of neoliberal urbanization. In this paper beside the brief planning history that enable the construction of large-scale projects, changes in land use pattern, urban rent, city silhouette and property pattern, the parameters of the spatial, economic and social outputs can be read easily, are examined as indicator of reproduction of space in order to measure the concrete and abstract effects of the large-scale projects on the city. Within the scope of the study, these parameters are considered as important outputs in the transforming the space process of neoliberal urbanization due to the fact that they change the spatial, economic and social texture of the city in addition to being easily readable.

A NEW STOP IN NEOLIBERAL URBANIZATION: İZMİR

Turkey entered the process of neoliberalization with 1980s but concrete outcomes of neoliberalization on the space have emerged along with the acceleration caught in 2000s. Turkey's urbanization experience after 1980 can be defined as ‘early neoliberal urbanization phase’ between 1980-2000 and ‘neoliberal urbanization phase’ covering the post-2000 and the city where the clear reading of the signs of neoliberal urbanism in this process in Istanbul, the focus of capital (Bal, 2011, 1). In

Turkey's neoliberal urbanization phase of that affect the urban development process, capitalism and entrepreneurship come into prominence as keywords. Turkey's urban development at this point, giving a response in a different way than in the West; the bottom-up hybrid model, in which 'authoritarian power combined with horizontal patronage and networking capacities of individuals, creating new opportunities for the power-holders, while the power-holders are producing for themselves (Şanlı & Townshend, 2018, 1247-1248).

Turkey's increased global functions and foreign capital inflow as a part of the effort to integrate into the global economy in 1980s resulted in İstanbul to become the focus of neoliberal urbanization (Eraydın, 2011). However, in the neoliberalization process of İstanbul the ghetto areas, exclusion and struggle in the background were ignored while constructing the highways, shopping centers, hotels and modern buildings (Robins & Aksoy, 1995). In the period after 2000, with the capital moved out of İstanbul at the same time, the other large metropolitan cities of the country started to be the focus of neoliberal urbanization. In this period, urbanization in Turkey carried out by large-scale projects in areas attracting urban elites and capital (Güzey, 2016). Large-scale projects, whether urban renewal projectsor gated communities, make visible the border of spatial segregation, which is a long time in Turkey (Güzey, 2014). İzmir, Turkey's third largest city, is seen to become prominent in this regard, to become one of the most popular cities in terms of top-scale real estate investments of the large-scale construction companies. İzmir showed a tendency to be far and behind the neoliberal urbanization tendencies in the historical process, but in the 2000s, aforesaid policies started to be effective in the city and the concrete outputs that require large capital investment became prominent in the post-2010 period (Bal & Altun 2016). It is important to analyze urban local dynamics within the context of urbanization processes in order to reveal the trends of the city in the neoliberal urbanization process and the changes experienced in this context.

NEW CITY CENTRE AS THE MOST POWERFUL REFLECTION OF NEOLIBERAL URBANIZATION IN İZMİR

The neoliberal urbanization process of İzmir gained a great acceleration with the 2000s. In parallel, the expansion of sustainable urban development practices in the world was reflected as the adoption of port-oriented urban development strategies in the planning process of İzmir and carried the port, that is located in the centre of the city geographically and its close

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surroundings to the focus of planning studies. The position of the region in urban development strategy has become very important with the establishment of the new urban centre with the 1/5000 scale İzmir New City Centre Master Plan, which was approved in 2003, and the 480-hectare area including the Turan, Salhane and Alsancak Port Back Regions. NCC that is connected to Kemeraltı, which is the traditional city centre of Izmir and Karşıyaka and Bornova, which are the city's secondary centres, through the main arteries of the city, has become an attractive area for realizing the neoliberal urbanization practices not only because of its geographical location, but also having an appropriate land inventory for the positioning of the uses required by the city centre. The fact that the private sector, which is the most powerful actor of the neoliberal urbanization process, turned its route into NCC, shows that the city has started to be considered as an alternative to Istanbul in terms of investment opportunities and potentials.

In the neoliberal urbanization process of İstanbul, it is possible to talk about the pioneering role of a single actor in drawing a new route, although the behavior of each actor does not constitute a clear pattern (Taşan-Kok, 2015). Parallel to this, it is very important to reveal the effects of the individual movements of the actors who manage the process, as well as the behaviors of the public, private sector and civil society, which form part of a whole, to explain the neoliberal urbanization process in İzmir, which is an alternative to Istanbul on the neoliberal urbanization agenda. For this reason, in order to understand the neoliberal urbanization process experienced in the NCC, it is necessary to evaluate the plans, which are the legal basis for enabling the production of space and the large-scale urban projects that have become significant as the most basic implementation tool of the intervention to the space in question together.

Figure 1. NCC's location in the city and NCC Zones (Drawing by author)

Brief Planning Story of NCC

The plans as a legal basis of the transformation in NCC, play a critical role in the transformation process of NCC due to the construction conditions and usage decisions in proportion to their vision. In addition to this, it is important to know the planning history of the area in order to monitor the development of projects which are the dynamos of the transformation process of NCC. At this point, planning history of NCC shows that the area is subject to transformation after 2001 (Figure 2). Therefore, the study focused on the large-scale projects are announced between 2000 and 2018 and the conditions that enable large-scale projects to be implemented.

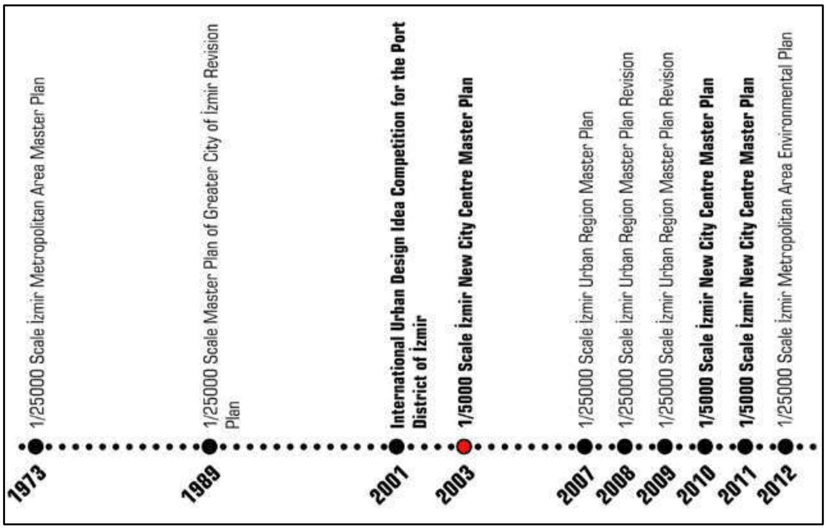

Figure 2. The process of shaping NCC vision (References, Plans)

The integration of the north and south of the city, give acceleration to the development of the city, changing the view of the city and increasing the urban life quality, which are among the targets of the 1/5000 scaled İzmir New City Centre Master Plan, approved in 2003, which has declared the area as NCC and which is the first plan that focused on the area, are basis for the subject planning works and at the same time, showing the vision of NCC in the city. Reorganizing the idle industrial and storage areas as CBD, being flexible about the building height and creating a new identity, which are among the targets of the 1/5000 Scaled İzmir New City Centre Master Plan shows the vision related to NCC, also provided obtaining plots that will provide making new projects through decentralization of the industry and the basis of the spatial transformation indirectly (Izmir Metropolitan Municipality, 2003). Although the current plan targets were preserved to a large extent with the vision of the 1/5000 Scale İzmir New City Centre Master Plan, which was approved in 2003, reaching to the quality of 'not the place being transited, but came for it', that was included in the plan at the 1/5000 Scale İzmir New City Centre Master Plan approved in 2010, a more comprehensive city vision is seen to be

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adopted with the objectives of creating the city centre that offers the new urban images in accordance with the developing international status of İzmir (İzmir Metropolitan Municipality, 2010). 1/5000 Scale İzmir New City Centre Plan, which was approved in 2011, which has small differences between the 1/5000 Scale İzmir New City Centre Plan, which was approved in 2010 in terms of spatial decisions and from which the statement of 'transfers can be done among the uses' was removed, is in effect with the version with partial plan changes (İzmir Metropolitan Municipality, 2011).

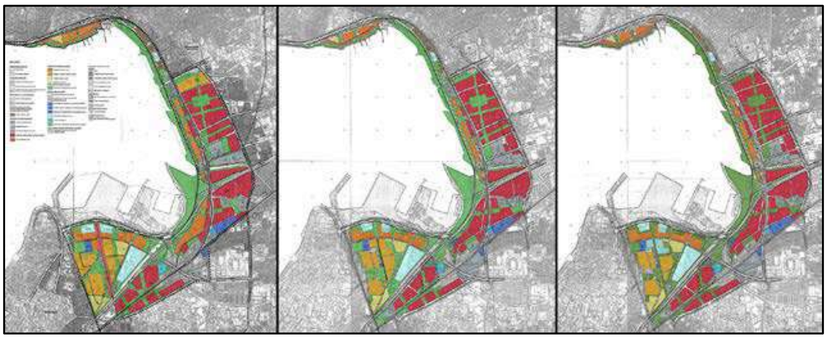

Figure 3. 1/5000 Scale İzmır New City Centre Master Plan from 2003, 2010 and 2011 (References, Plans)

The 1/5000 Scale Master Plans for the NCC contain information on land use decisions and construction conditions. For this reason, the plans give an idea about the dimensions of the physical transformation projected by NCC in addition to land use. Regarding the use of CBD in the 1/5000 Scale Master Plans, Turan, Salhane Region and a large part of the Port Back Region, 'all kinds of trade, downtown, office, office block, commercial storage, bank, insurance, multi-storey shops and entertainment places, housing, multi-storey vehicle park and private hospital may take place. One or more of these uses can be found in the same plot' statement takes place. Despite the regionalization, it is seen that the concept of mixed use has been adopted throughout NCC when the definitions related to the uses on the area are taken into consideration. Related to the minimum plot size in the plans, 'the size of the minimum zoning lot will be 5000m2 for CBD (central business area), tourism + trade and tourism + trade + culture areas (except for special planning areas)' statement takes place (İzmir Metropolitan Municipality, 2003; İzmir Metropolitan Municipality, 2010; İzmir Metropolitan Municipality, 2011). It is possible to say that when the conditions given for the different uses in NCC and the minimum plot size are considered together, it is foreseen that high-rise construction is foreseen.

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Table 1. Construction conditions of 1/5000 Scale İzmir New City Centre Master Plans from 2003, 2010 and 2011 (Edited from data of References, Plans)

Land Use	2003		2010		2011	
	PC[1]	FAR[2]	PC	FAR	PC	FAR
CBD	0.30	3.50	0.40	3.50	0.40	3.50
Tourism, Commercial	0.35	3.00	0.35	3.00	0.35	3.00
Tourism, Housing	0.50	2.50	--	2.50	--	2.50
Tourism, Commercial, Culture	0.35	3.50	0.45	3.00	0.45	3.50
Commercial	0.50	1.00	0.30	0.60	0.30	0.60
Housing	0.50	3.00	0.50	3.00	0.50	3.00

[1]Plot Coverage
[2]Floor Area Ratio

After the announcement of the area covering Turan, Salhane and Liman regions as İzmir New City Centre, many plans and plan changes were in question. However, there are plans and plan changes related to the areas subject to privatization, which are not included among the large-scale plans, but indicate that the area has been reshaped in the neoliberal urbanization axis (Table 2). Plots located at different points of NCC through plans are privatized by the central government in order to produce projects by private and public sector. It is seen that prestigious and big projects such as Folkart Towers, Mahall Bomonti İzmir and İzmir Cruise Port-İzmir Freight Port are located in the privatized areas. In this context, it is possible to consider these projects as the tendencies of the central government in the framework of neoliberal urbanization to facilitate the private sector's activity in NCC.

Table 2. Plan changes related to privatizations in NCC (Edited from data of References, Plans)

Plan	Approve
İzmir Province Karşıyaka County Salhane District 1134 Islands, 4 Parcels 1/5000 Scale Master Plan	28/01/2008
İzmir Province Konak County Halkapınar 1443 Island 37 and 1454 Island 23 Parcels 1/5000 Scale Master Plan Change	25/06/2012
İzmir Cruise Port Area Master Plan Change (1/25000 Scale)	30/04/2012
İzmir Cruise Port Area Master Plan Change (1/5000 Scale)	30/04/2012
İzmir Province Konak County Mersinli District 2876 Island 12 Parcel Master Plan Change	24/02/2014
İzmir Freight Port Izmir Metropolitan Area Environmental Plan Change	03/11/2015
İzmir Cruise Port Area Master Plan Change	03/11/2015
İzmir Freight Port Area Master Plan Change	03/11/2015
İzmir Freight Port Izmir Metropolitan Area Environmental Plan Change	02/05/2016
İzmir Cruise Port Area Master Plan Change	02/05/2016
İzmir Freight Port Additional and Revision Master Plan	02/05/2016
İzmir Province, Konak County, Kuruçay and Umurbey Districts, 7839 Island 1 Parcel, 7840 Island 1 Parcel, 1384 Island Various Parcels, 1445 Island Various Parcels, 1448 Island Various Parcels and Perimeter of 1/5000 Scale Master Plan Change	10/05/2017

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When the lower and upper scale plans are taken as a whole based on the planning history of the area, it is seen that there is a situation contrary to the plan hierarchy. However, the fact that the NCC vision is based on the International Urban Design Idea Competition for the Port District of Izmir instead of the upper scale plans, shows that the fragmentary plans developed in contradiction with the planning hierarchy are the product of a projective approach. In this context, it is possible to say that a radical transformation of NCC is foreseen in terms of both land use texture and construction conditions and in this process, transformation is shaped within the vision of making the city attractive for capital by means of large-scale projects based on mixed use and high-rise construction.

Large-Scale Urban Projects with Neoliberal Urbanization in NCC

The upper and lower scale plans developed for NCC have prepared the appropriate legal ground and conditions for the implementation of neoliberal urbanization practices and have drawn the general framework of the dimensions of the transformation. In order to be able to read the neoliberal urbanization process in detail, it is necessary to examine large-scale urban projects. At this point, the physical qualities of the projects, the area chosen, investment costs, investors, the years of their realization and the elements of prestige are of great importance. In addition, the projects not only lead some basic transformations to the plot they are located in, but also in the immediate vicinity and indirectly over the city.

It is expected that the total value of the investments that have chosen place in NCC in the year 2030, which is the target year of the NCC plans preparing the appropriate legal ground for neoliberal urbanization, will exceed 18 billion dollars. This situation shows that NCC capital being the main focus in Izmir, also show that it is targeted for Izmir to come to an important point in capital inflows in Turkey. In determining the dimensions of the transformation in the NCC, land use decisions within the scope of large-scale urban projects, increase in urban rent and change in urban silhouette stand out as important parameters. In this study, the process of re-production of urban space is tried to be explained; by taking the periods in which the projects were implemented in consideration that the concrete and abstract outputs of the city that can be observed, in the axis of 20 large-scale urban projects that have chosen place in NCC. These 20 large scale projects stand out from other projects in the city with their investment costs, total construction sites and investor profiles. However, the fact that the projects are clustered in a certain area instead of single parcels scattered within the city provides important data for neoliberal urbanization that transforms the space of NCC.

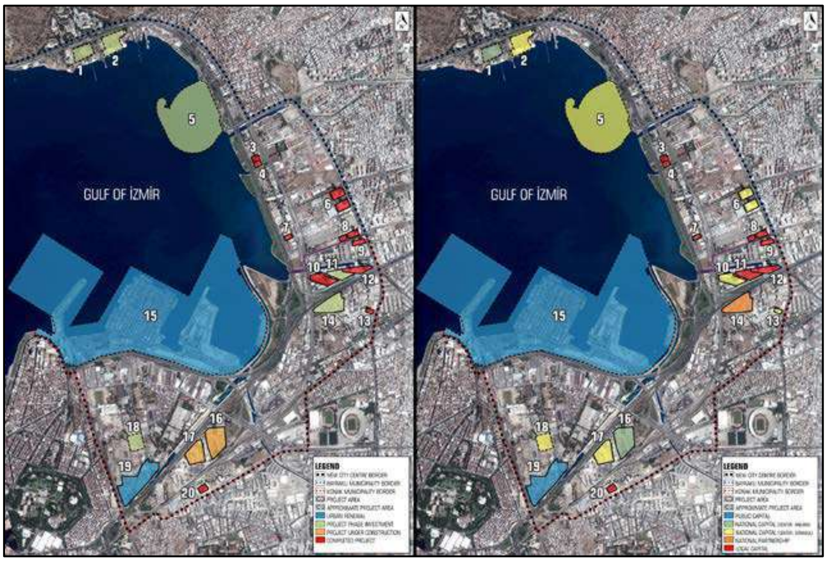

Figure 4. Distribution of large-scale urban projects in İzmir NCC (Drawing by author)

Table 3. Featured Projects in Izmir New City Centre[1], locations in 1/1000 scale implementary development plans and project details[2]

No	Project	Investor[3]	Cost (Million[4])	Total Area (m²)	Year of Start	Functions
1	İzmir Turan Karma Kullanım *(İzmir Turan Mixed Use)*	Renaissance Development	600 TRY (111 USD)	38,000	2016*	Office, Housing, Shopping Centre
						
2	İzmir Marina Park	Sur Yapı	610 TRY (122 USD)	121,000	-	Office, Housing, Shopping Centre, Hotel, Marina
						

[1] *References, Online Resources 1*
[1] *References, Online Resources 2*
[1] *If there is difference between original titles and international titles of companies, international titles was used.*
[1] *Approximate value considered (1 USD= 5.42 TRY in 11/01/2019)*

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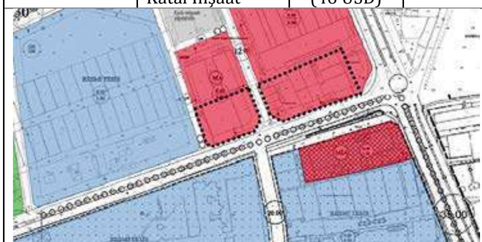
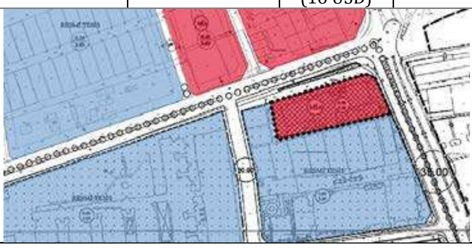
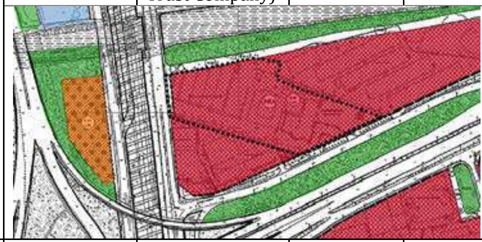
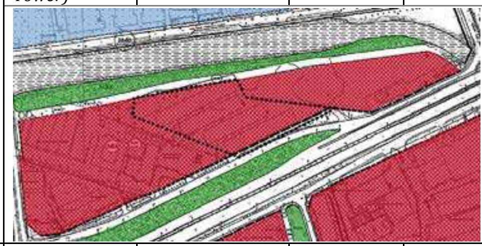
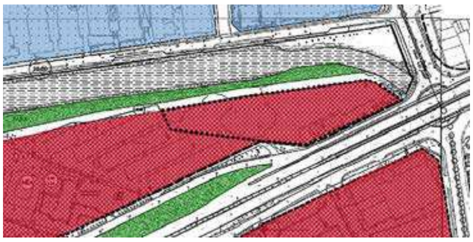
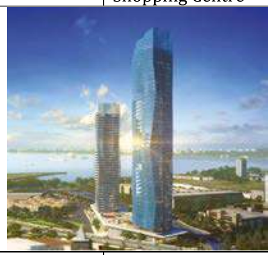
3	My Plaza	First Class Gayrimenkul	50 TRY (1 USD)	20,000	2000	Office
						
4	Megapol Tower	Megapol Group	45 TRY (8 USD)	31,250	2009	Office
						
5	Bayraklı Yat Limanı Projesi *(Bayraklı Marina Project)*	Ministry of Transport and Infrastructure	-	103,500	-	Marina
6	Folkart Towers	Folkart Yapı	450 TRY (83 USD)	150,000	2011	Office, Housing, Shopping Centre
						
7	Hilton Garden Inn	Yapıtsan İnşaat	85 TRY (16 USD)	18,000	2013	Hotel
						
8	Novus Ventus	Adnan Kılıçoğlu-Katal İnşaat	250 TRY (46 USD)	59,000	2014	Office, Shopping Centre
						
9	Sunucu Plaza	Megapol Group	85 TRY (16 USD)	38,107	2006	Office
						

10	Ege Perla	İş REIT (Real Estate Investment Trust Company)	475 TRY (88 USD)	55,000	2014	Office, Housing, Shopping Centre
						
11	MyWay Bayraklı Kule *(MyWay Bayraklı Tower)*	Gözde Group	-	-	-	-
						
12	Mistral İzmir	Mistral GYO	950 TRY (175 USD)	122,000	2013	Office, Housing, Shopping Centre
						
13	Ater Tower	Reanka İnşaat & Gayrimenkul	300 TRY (55 USD)	5,000	2015	Office, Shopping Centre
						
14	İzmir Konak Karma Kullanım Projesi *(İzmir Konak Mixed Use Project)*	Tekfen Real Estate Development-Renaissance Development	690 TRY (127 USD)	200,000	2017*	Office, Housing, Shopping Centre
						
15	İzmir Limanı Projesi *(İzmir Port Project)*	İzmir Metropolitan Municipality	-	-	-	Cruise Port and Freight Port

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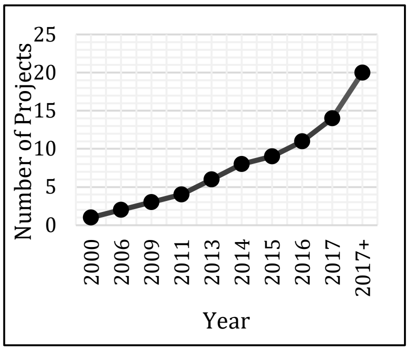
16	Mahall Bomonti İzmir	Türkerler Holding	790 TRY (146 USD)	182,189	2016	Office, Housing, Shopping Centre
						
17	Folkart Vega	Folkart Yapı	850 TRY (158 USD)	148,000	2018	Housing, Shopping Centre
						
18	Tariş Tower	TARİŞ Zeytin ve Zeytinyağı Birliği	900 TRY (166 USD)	140,000	-	Office, Housing, Shopping Centre
						
19	Ege Mahallesi Kentsel Dönüşüm ve Gelişim Projesi *(Ege District Urban Transformation and Development Project)*	İzmir Metropolitan Municipality	-	17,500	2019	Office, Housing, Shopping Centre
						
20	Megapol Çarşı Kule *(Megapol Çarşı tower)*	Megapol Group	110 TRY (20 USD)	43,000	2017	Office, Housing, Shopping Centre
						

In the light of the projects examined within the scope of the study, three main periods have been determined by taking into consideration the planning process related to the area in order to reveal the transformation in NCC:

- Period Before 2003: The period before 1/5000 scale İzmir New City Centre Master Plan, in which the area is declared as NCC and there is no separate plan related the area within the boundaries of NCC.
- Period Between 2003 - 2011: The period between the 1/5000 scale İzmir New City Centre Master Plan and the date when the 1/5000 scale Master Plan studies related to the area were completed.
- Period After 2011: The period after the completion of the 1/5000 scale Master Plan related to the area.

When analyzed according to years, it is seen that there has not been a large capital mobility until the legal basis was prepared in 2011 within three periods that NCC has experienced. However, with the preparation of the legal base, it is seen that the number of projects that have chosen place in NCC has increased rapidly as the national capital begins to tend towards to NCC. Nevertheless, four main parameters are emphasized in order to determine the nature of the transformation and the interest of capital in the area:

Investment Cost: When the investment costs, which are one of the most powerful parameters that show the capital size of the projects in NCC, are examined, it is seen that the investment costs of NCC projects have increased over the years. It is seen that 900 million TRY, which is the value of the total investment made to the area until the year 2011, the date the planning process of NCC was completed, then reached 5 billion TRY, which was approximately six times in six years, rapidly growing after the legal basis is prepared. In this increase, especially in 2013 and 2016, the breakpoints coincide with the projects of high prestigious mixed-use projects such as Mistral Izmir (950 million TRY) and Mahall Bomonti Izmir (790 million TRY) which are among the highest investment cost projects of NCC.



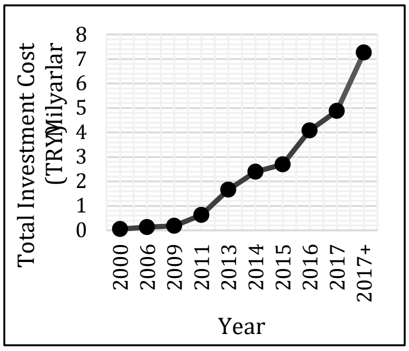


Figure 5. The number of projects produced in NCC during the year and the total investment amount according to project start years (Drawing by author)

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Investor Group: In addition to the investment value of NCC projects, the nature of the investing capital group is also very important in terms of neoliberal urbanization dynamics. With the completion of NCC plans in 2011, the number of national capital groups investing in the area has increased. However, it is observed that local capital efficiency has reached approximately twice as compared to previous periods. This shows that the NCC has reached an important point for capital on a local and national scale. In addition, in response to 8 national capital groups that were present after 2011, 10 national capital groups are operating on the area. This shows that after 2011, the national capital began to lead the transformation process of the area, which was carried out by the local capital in the period before 2011.

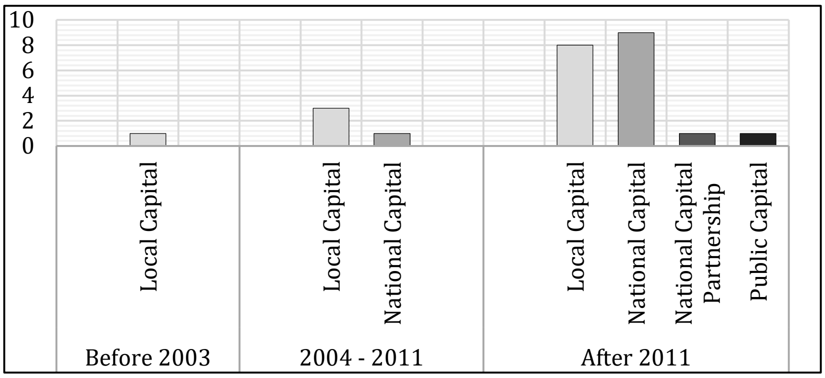

Figure 6. Distribution of capital groups according to periods (Drawing by author)

Functions Included in Projects: NCC shows an increase in investment costs and investor profile after 2011. Parallel to this trend, the functions of the projects after 2011 were diversified. 80% of the projects produced prior to 2011 are seen to have office use only, only 20% of the projects produced after 2011 are seen to have office use. More than 80% of the projects produced after 2011 have the office, residence and shopping mall use while the remaining projects have office and shopping mall use. However, after 2011, there are different uses such as hotels and marinas in mixed-use projects. From this point of view, it is possible to say that the projects have been transformed into a more complex structure with the projects being designed to have more functions over time.

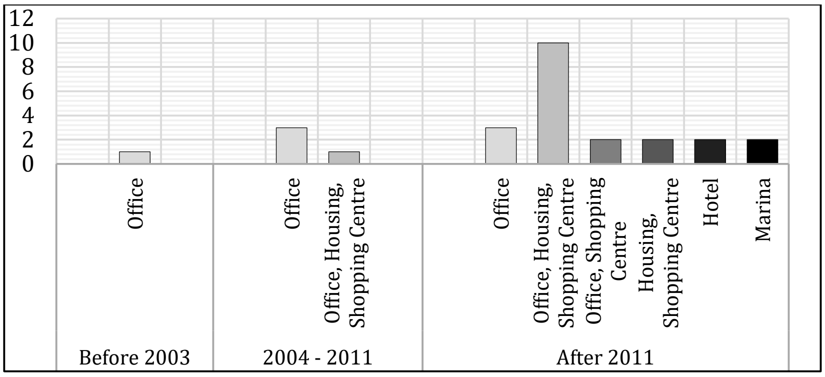

Figure 7. Distribution of functions according to periods (Drawing by author)

Building Heights: In parallel with the tendency to create more complex projects by diversifying the functions over time, the building height is increasing. Considering the projects produced after 2011, the number of buildings higher than 200 meters increased significantly. However, after 2011, there was a large increase in the number of high-performance structures with a height of less than 200 meters. Considering both cases, it is possible to say that the height of the projects in NCC has increased. When these two trends are taken into consideration, it is seen that the resulting table coincides with the objectives of the projects to be high prestigious in terms of investors.

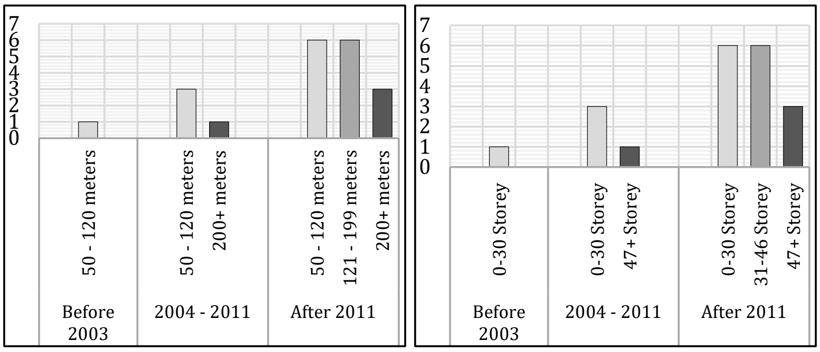

Figure 8. Distribution of building heights and floor quantities according to periods (Drawing by author)

In the light of the four parameters examined, the spatial change, which was clearly realized in the NCC and planned to be realized, is the fact that the city centre transformed its economic and social environment, especially the spatial, within the framework of neoliberal urbanization. It is seen that the private sector and the public sector take place among the actors of this change carried out on the urban place on the basis of large national and local capital groups. The increase and diversification of private sector actors over time has accelerated the process of transformation of space by enabling larger investments and larger projects to choose place in space.

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Parameters to Transformation of Space in NCC

The NCC vision, in which the planning process draws the lines of its limits, is realized through large-scale projects that are especially investments belonging to the private sector. The vision that is being realized corresponds to the spatial, social and economic transformation of NCC. However, in order to reveal the process of re-production of space in NCC, it is necessary to reveal the concrete reality in the space and the effects of this change. For this reason, the process of re-production of space in NCC is explained through four basic factors as the change in land use pattern, the change in property pattern, the change in the urban rent fabric that the new spatial structuring on revealing the change in effects of economic structure of NCC and İzmir, and change in urban silhouette which have effects on urban identity and sense of belonging of urban residents as well as physical effects. These four basic parameters correspond mostly to the spatial, social or economic transformations, but each parameter has multidimensional effects on the city and its inhabitants due to characteristics of the paremeters.

Change in Land use pattern in NCC

When NCC's existing land use texture and plan decisions are compared, it is possible to say that there will be radical changes in spatial scale in NCC. There is an increase in the use of green areas, roads, education, health, cultural facilities and public institutions. However, although the increase in the functions is positive for the city, there is no data on whether this is a benefit for public. On the other hand, when the table is examined, the existing housing and trade units in the area are decreasing, while the utilization of CBD, which can accommodate both functions has a large proportion of 18.48% in the area, presents data on the dimensions of the transformation. In addition to these, functions connected with the main arteries divided into zones in a compatible manner with each other created a positive situation for the organization of the space of NCC. However, despite the increase in the total area, the fact that new connections are not established to feed the main arteries and reduce the increased burden on NCC raises the question of whether the roads within the NCC can tolerate the increasing number of users.

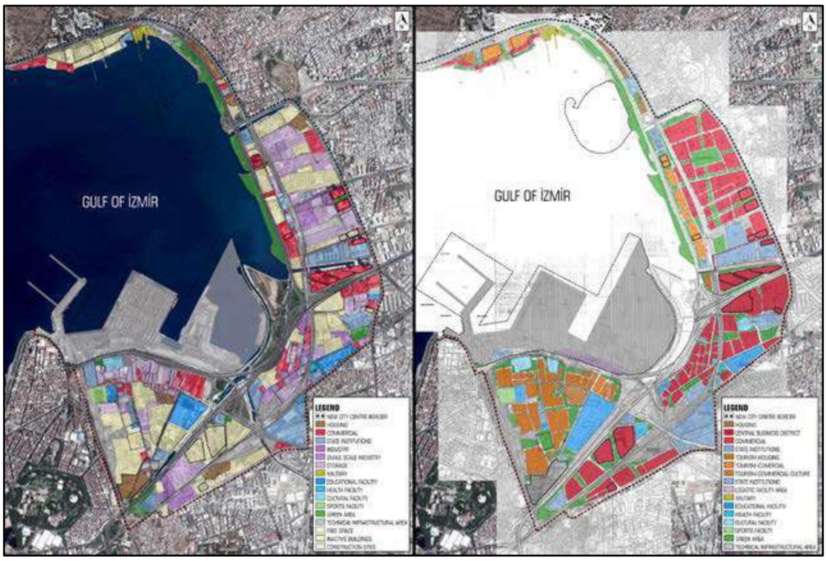

Figure 9. NCC's existing general land use and land use according to the implementation plan of NCC (Drawing by author)

Table 4. Values of NCC's existing general land use and land use according to the implementation plan of NCC

Land Use	Existing Land Use (hectare)	Percentage	Land Use According to the Plan (hectare)	Percentage
Housing	12.52	2.61%	2.39	0.50%
Central Business District	0	0,%	88.73	18.48%
Commercial	34.55	7.20%	2.82	0.59%
State Institutions	30.23	6.30%	32.57	6.79%
Industry	6.53	1.36%	0	0%
Small Scale Industry	9.79	2.04%	0	0%
Storage	51.91	10.81%	0	0%
Military	2.00	0.42%	2.00	0.40%
Educational Facility	12.58	2.62%	15.92	3.32%
Health Facility	0.60	0.12%	1.53	0.32%
Cultural Facility	2.53	0.53%	5.10	1.06%
Sports Facility	2.07	0.43%	2.07	0.43%
Green Area	14.93	3.11%	54.32	11.32%
Technical Infrastructural Area	129.52	26.98%	129.52	26.98%
Tourism-Housing	0	0%	2.85	0.59%
Tourism-Commercial-Culture	0	0%	17.21	3.59%
Tourism-Commercial	0	0%	19.28	4.02%
Logistic Facility Area	0	0%	3.96	0.82%
Roads	72.80	15.17%	92.78	19.33%
Free Space	52.22	10.88%	0.00	0
Inactive Buildings	28.72	5.98%	0.00	0
Construction Sites	16.50	3.44%	0.00	0%
Special Project Area	0	0%	7.00	1.46%

The change in land use pattern, which is one of the radical changes foreseen by NCC plans, causes a great change in space user profile with the organization of the space. From this point of view, the process of converting storage and industrial areas into CBD and tourism use means the change of the user group as well as the physical change in the area that accounts for about 70% of NCC. However, the storage and industrial areas covering a large part of

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the area being replaced by the use of the central business area and tourism-commerce area, tourism-trade-culture area points out that the production potential of the area is completely eliminated. Thus, it is possible to say that the spatial transformation in NCC affects the whole area and also that it proceeds in a multi-dimensional way enough to change the balance of the production-consumption activities and change the user profile correspondingly.

Change in Property pattern in NCC

The change of land use pattern in NCC has revived the change of property pattern. The property pattern is very important because it is closely related to the user profile of the area as well as the distribution of rent to be obtained. Although a large part of the projects in NCC have previously chosen a place on the plots belonging to private property, approximately half of these plots are composed of plots belonging to private ownership. During the handover of the property, the floors are usually increased and the high-rise buildings are provided by this way. When the ownership data for the project areas are analyzed quantitatively, it is not possible to fully see the extent of the change of the ownership of public ownership. However, it should not be overlooked that the Izmir Port Project, which is one of the selected projects, has a large area of 163 hectares directly affects the quantitative data. In light of this information, it is clear that public areas in the area have been privatized and that private sector ownership in the area has tripled by means of both procurement and privatization.

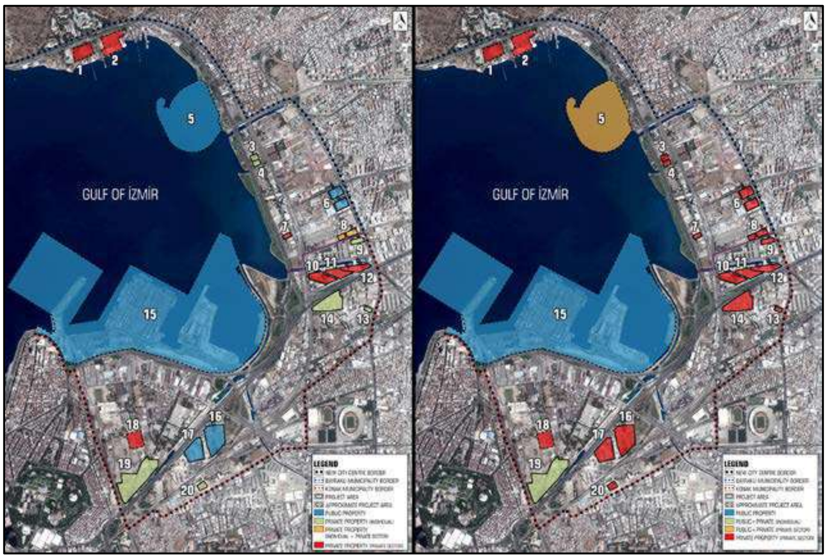

Figure 10. Property status before and after selected projects (Drawing by author)

Table 5. Value of property status before and after selected projects

Property Status	Before Projects (hectare)	Percentage	After Projects (hectare)	Percentage
Public Property	197.56	89.42%	163.69	74.09%
Private Property (Individual)	11.43	5.18%	0	0%
Private Property (Public Sector)	11.11	5.03%	25.23	11.42%
Private Property (Individual+Private Sector)	0.82	0.37%	0	0%
Public Property+ Private Property (Individual)	0	0%	6.38	2.89%
Public Property+Private Property (Private Sector)	0	0%	25.63	11.60%

Although the public-private balance in the property pattern has been generally preserved, in the areas belonging to private ownership, property has emerged from large-scale investors or individuals and the ownership changed to large-scale capital groups. In addition, it is observed that the previously publicly owned areas (certain parts of the coastal strip with public plots) are privatized directly through projects carried out by the private sector or through joint projects with the private sector. It is possible to say that the change in the property pattern created by the privatization process realized is multidimensional when it is taken into consideration that the projects of Folkart Towers and Mahall Bomonti Izmir in subject areas that have transferred from public property to private property and Bayraklı Marina Project in the coastal area that have transferred from public property to public and private property have chosen place.

Change in Urban Rent in NCC

The transformation in NCC brings along the increase of urban rent. In order to clarify the increase in rent transparently, m2 unit rent prices of residential and commercial areas of İzmir, Bayraklı, Konak and Adalet districts that whole of it is within the NCC boundaries and Alsancak, Kültür, Mansuroğlu and Tuna districts located around the NCC have been taken into consideration. When the changes in the real estate index are considered, it is seen that the settlements in the housing and trade areas have quite different values in the last four periods. When examined on the basis of district, it is seen that the trade index (%75.69) of the Adalet District, where mostly projects with office functions are produced, is approximately 1.5 times that of the provincial (47.30%) and county (59.66%) values. Besides, Mansuroğlu District, that is adjacent to Ege Perla and Mistral İzmir, which are the highest prestigious projects in NCC is coming into prominence among the other neighborhoods in terms of residence (77.29%) and trade indexes (113.17%).

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Table 5. Value of property status before and after selected projects (Sahibinden, 2018)

Location	Housing		Commercial	
	1 Year	4 Year	1 Year	4 Year
İzmir	4.86	70.72	10.05	47.30
Bayraklı	4.49	56.95	7.00	59.66
Konak	6.51	74.97	10.62	47.77
Adalet District	9.86	28.23	6.17	75.69
Alsancak District	6.77	37.37	10.17	47.85
Kültür District	-1.44	43.88	8.62	34.10
Mansuroğlu District	9.07	77.29	9.50	113.17
Tuna District	15.97	54.81	11.29	74.68

It is seen that the increase in the amount of rent has reached the highest level in NCC and its immediate vicinity. However, it is foreseen that the existing industrial and storage areas within the NCC will be transformed as CBD and tourism areas with plans; because the industrial and storage areas need large floor space by their structure, they have direct effects on urban rent increase in the process of land use pattern transformation. It is possible to say that these plots have a target market consisting of only large-scale investors as they have very high sales prices ranging between 71,560,000 TRY and 538,050,000 TRY. However, when the price range is evaluated, it is seen that the sales prices of the residence (855,001 TRY - 1,600,000 TRY) and commercial (2,672,316 TRY - 8,000,000 TRY) units in the immediate vicinity of NCC are lower than residence (1,600,001 TRY - 2,152,200 TRY) and commercial (8,000,001 TRY - 15,000,000 TRY) units in large scale projects.

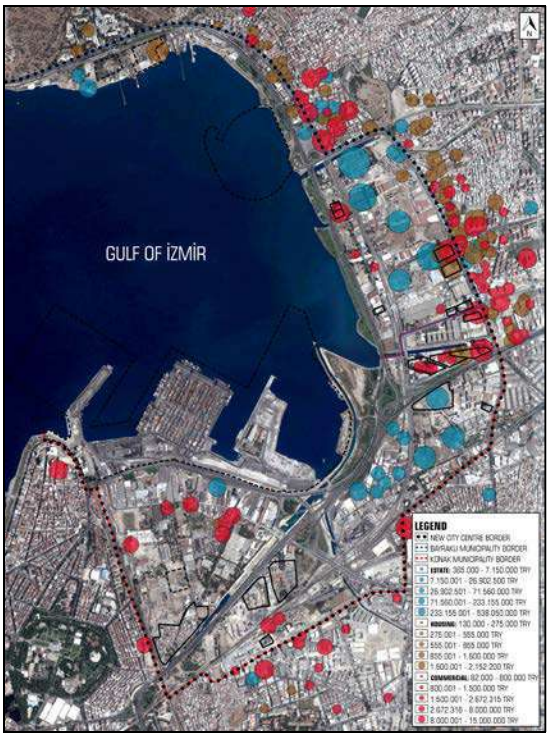

Figure 11. NCC and surroundings land for sale, housing and trade unit prices (Edited from data of Sahibinden, 2017)

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There is a significant relationship between the increase in rent in NCC and large-scale urban projects. When the changes in the real estate indexes of the selected settlements are examined, it is possible to tell that there is direct proportion between changes in the real estate indexes and the closeness of the settlements to NCC and thus the prestigious projects within. In addition, it is observed that urban rent is rapidly transformed within NCC and around it, especially in Salhane Region, where the land, residence and trade units are mainly concentrated in sales. Hence, it is possible to say that the encountered process will make NCC a significant capital accumulation point in the city both locally and nationally.

Change in the City Silhouette

The change of the city silhouette in Salhane Region, which is the area where the effects of the projects are clearly read, started with the first high-rise building, My Plaza, which started construction in 2000 and accelerated with the completion of the master plans for the area in 2011. Although the silhouette of the Salhane Region started to develop in the vertical direction, because of the fact that the buildings are scattered throughout the area, it is seen that it disrupts the continuity on the city silhouette. While the continuity of the silhouette is expected to be provided in 2030, which is the target year of the plans, it is seen that the structures remaining on the coastline will play a predominant role on the silhouette of the city.[1]

https://www.emlaksayfasi.com.tr/izmir-emlak-haberleri/izmir-bayrakli-da-yeni-kent-merkezi-projesi-bolgedeki-fiyatlari-arttirdi-h34187.html, Accessed18 May 2018; http://www.thepicta.com/media/1365149897523166231_1612534262, Accessed 18 May 2018; http://www.egehaber.com/izmir/yeni-kent-merkezi-ucacak-h63660.html, Accessed 18 May 2018

Figure 12. NCC view before 2011, The present state of the NCC silhouette and the silhouette planned to be owned by 2030

The transformation in the Salhane Region, where the impact of the projects on the city silhouette is clearly read, is relatively slow in Turan and Alsancak Port-Back Area and provides foresight about the change. When the future projects that are expected to select place in NCC are examined, it is possible to say that the planned investments will gradually increase the urban silhouette in the vertical plane. This blazing transformation in the city silhouette can be evaluated as the spatial manifesto of neoliberal urbanization in İzmir.

CONCLUSION

Along with the direction of the capital to big metropolitan cities, especially Istanbul in the context of neoliberal urbanization trends in Tukey, İzmir NCC stands out as one of the most important areas of application of neoliberal urbanization. When the process in İzmir NCC is examined closely; it is seen that the

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plan decisions that are shaped around the vision of making the city attractive for capital, especially in the context of land use decisions and the production-consumption activities in the area, form a basis for the start of a major transformation process in the Turan, Salhane and Port Back Regions that are within the boundaries of NCC. Large-scale urban projects, which are implemented on the basis of plan decisions, are the main carriers of the neoliberal spatial transformation process in NCC due to both project contents and their spatial effects. These projects have become larger scale, more complex in terms of their functions and have high investment costs and have become the focus of neoliberal urbanization.

It is possible to classify the effects of the transformation process executed under the leadership of large-scale urban projects of the private sector on the NCC and therefore the city:

- The city of İzmir, with its 1/5000 İzmir New City Centre Master Plan, which was approved in 2003, has acquired a new centre under the name of NCC which is the product of a partial planning approach in addition to the traditional city centre which has a long history in the city. This decision signifies a very radical change for all city and citizens. This situation has left an area, that lacks the necessary conditions to become a city centre, under pressure. In the region, at the very time, the main decisions that are placed in the focus of neoliberal urban policies and the office, luxury housing, shopping mall, marina, hotel etc. brought by these decisions have created a city centre that will enable the neoliberal production-consumption relations in which the underlying functions are integrated into a splendid architecture vertically.
- As a requirement of the functions attributed to NCC, the land use pattern completely differentiates from the current situation and changes in favor of consumption areas, which in turn brings with it a new user group that can meet the costs of this new spatial structuring.
- Due to the conditions of structuring that facilitate high density, the city undergoes a transformation in this region in a vertical direction which differs considerably from other parts of the city, which changes the urban silhouette rapidly and radically.
- Through the privatization, which is one of the most basic tools used by neoliberal urbanization to transform the space, some public property areas in NCC are seen to be privatized. Thus, whether through privatization or purchase, many plots in the area go directly into the

control of large-scale capital, which leads to the change of property pattern in favor of large-scale capital.

- On the basis of all these developments, there is an increase in urban rent in the area and the change in urban rent operates in favor of large-scale capital groups operating in the speculative real estate sector.
- Subject transformations cause urban residents, who cannot tolerate the increase in urban rent and cannot be resistant against this process, not to make their presence felt and also cause urban disintegration.

In this context, the urban space in NCC is undergoing a radical transformation in the neoliberal urbanization axis. The re-production process of the space in NCC creates areas that will meet the needs of neoliberal urbanization. On the basis of the above parameters, the new functions that the New City Centre brought on the space and the language of planning it has established related to the placement of these functions, along with the new architectural view it has put on, it has become more specialized for citizens living in that region, its immediate vicinity and whole city in terms of physical, economical and sociological, lead to a neoliberal spatial pattern, which the use value has transformed in favor of higher income groups. This makes the principle of the use of all urban space on the basis of the principle of public interest, which is one of the fundamental principles of urban planning for all classes in the city, to be questioned. In this context, it is important that all national and local initiatives, especially residents and local governments that produce plan decisions to show awareness and develop positive solution offers in this respect. At this point, the study draws attention to the drawbacks of the process of neoliberal urbanization in NCC while revealing transformation of the space process of neoliberal urbanization with its outputs. In this respect, the study emphasizes that the process of the NCC in a broad perspective, which has recently found a place itself in the literature, and that urban actors should approach the future of the city in terms of public interest, not capital. In addition to its importance at the local level, the study is located at an important point on the global scale in terms of revealing the effects of neoliberal urbanization processes under the leadership of large-scale urban projects in developing countries.

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Research Article

A Simulation-Based Accessibility Modeling Approach to Evaluate Performance of Transportation Networks by using Directness Concept and GIS

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Abstract

Ranging from simple to sophisticated, numerous types of accessibility measures are found in the accessibility modeling literature which helps to understand accessibility of people, place and transportation networks. Transportation network directness (reciprocal is “circuity”), which is defined as the ratio of the shortest Euclidean distance over network distance between demand (origin) and destination (supply) points, could be considered as an important type of measure for understanding accessibility for a variety of context.

Keywords: *GIS, accessibility modeling, simulation, urban planning, transportation network directness, circuity, test of transportation network performance, Euclidian distance, bird flight distance, network distance*

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Although there are several research and literature on transportation network directness and accessibility modeling, the research that integrates transportation network directness concept into accessibility modeling process in such a way to provide understanding of the overall accessibility performance of the transportation networks without losing the local interactions is quite limited.

Based on this idea, the basic aim of this research is to propose a new transportation network directness-based accessibility modeling methodology that could be used to test both the local and the overall accessibility performance of transportation networks in a simple and comparable manner by using GIS. By considering regularly produced virtual origins and destinations on the transportation network in a "simulation" manner, the proposed methodology could produce "travel time/distance" based accessibility measures that could operate without a need for real time supply/demand or origin/destination data.

The advantage of using a virtual regular data set instead of real time data is that; it is more simple, easy to operate and most importantly, more realistic to understand performance of transportation networks as most of the possible origin/destination scenarios could be represented in the proposed model. The outputs of the model could be widely used by the decision-makers who are supposed to deal with accessibility, location/allocation, and service/catchment area related issues by several aims such as; to test the overall/partial performance of the transportation networks, to understand the weakly connected parts of the transportation network and/or to compare the accessibility performance of different networks with each other.

The proposed methodology is applied in 3 cities with different types of transportation network which are Paris, FRANCE (radial network); San Francisco, USA (grid network) and Ankara, TURKEY (mixed network) in order to able to demonstrate the performance and efficiency of the proposed model. The main focus of the case study is not to evaluate specific accessibility conditions or transportation network performance in a detailed manner but to provide a methodological discussion about the proposed directness based accessibility modeling process.

INTRODUCTION

Understanding accessibility of people, place and transportation networks is a challenging research area. Ranging from simple to sophisticated, numerous types of accessibility measures are found in the accessibility modeling related literature such as;

a) Travel time/distance based measures or service/catchment areas (consider travel time or distance to nearest supply/demand calculated by using Euclidian/Network-based costs) (see AultmanHall, Roorda, & Baetz, 1997; Liu & Zhu, 2004; Tsou, Hung, & Chang, 2005; Bagheri, Benwell, & Holt, 2006; Vandenbulcke, Steenberghen, & Thomas, 2009; Chang & Liao, 2011; Ertugay &

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Duzgun, 2011; Boscoe, Henry, & Zdeb, 2012; Monzon, Ortega, & Lopez, 2013; Niedzielski & Boschmann, 2014; Teunissen, Sarmiento, Zuidgeest, & Brussel, 2015; Yamu & Frankhauser, 2015; Ford, Barr, Dawson, & James, 2015; Cetin, 2015; Thevenin, Mimeur, Schwartz, & Sapet, 2016; Saghapour, Moridpour, & Thompson, 2017)

b) Cumulative opportunity measures (consider the total amount of demand/supply inside the catchment area of a location) (see Liu & Zhu, 2004; Curl, Nelson, & Anable, 2015; Bok & Kwon, 2016; Macedo & Haddad, 2016; Wei, 2017; T. E. Laatikainen, Piiroinen, Lehtinen, & Kytta, 2017; Kalantari, Khoshkar, Falk, Cvetkovic, & Mortberg, 2017)

c) Population to provider ratio measures (supply to demand ratio calculated inside a catchment area) (see Luo, 2004; Scott, Larson, Jefferies, & Veenendaal, 2006)

d) Kernel density measures (use the Gaussian kernel approach to calculate the density value of each demand/supply) (see Guagliardo, 2004; Yang, Robert, & Ross, 2006; Gibin, Longley, & Atkinson 2007; Delso, Martin, Ortega, & Otero, 2017)

e) Gravity-based measures (a combined indicator of accessibility and availability by considering the attractiveness of supply/demand) (see Kwan, 1998; Guagliardo, 2004; D. B. Hess, 2005; Moya-Gomez & Garcia-Palomares, 2015)

f) Two-step floating catchment area measures/2SFCA measures (repeat the process of catchment area calculation for both supply and demand points considering the overlay zones etc.) (see Wei Luo, 2003; W. Luo & Wang, 2003; Luo, 2004; McGrail & Humphreys, 2009; J. Luo, 2014; Dony, Delmelle, & Delmelle, 2015; Xu, Ding, Zhou, & Li, 2015; Luo et al., 2018)

(For a detailed review about accessibility measures, see W. Luo & Wang, 2003; Guagliardo, 2004; Bagheri, Benwell, & Holt, 2006; McGrail & Humphreys, 2009)

Whether simple or sophisticated, accessibility measures are widely used by geographers, economists, and urban and transportation planners to "identify regions that have inadequate or excessive service", "to select appropriate sites for new or re-located services" or "to evaluate the performance of the transportation networks".

Transportation network directness (reciprocal is "circuity"), which is defined as the ratio of the shortest Euclidean distance over shortest network distance between demand (origin) and destination (supply) points, could be considered as an important type of travel time / distance based measure for understanding accessibility (Levinson and El-Geneidy, 2009; Barthelemy, 2011; Huang, & Levinson, 2015).

The directness ratio (DR) scores between origins and destinations could be calculated by using the following formula (Equation 1) (Barthelemy, 2011).

$$DR_{i\,j} = \frac{D_{ij}^{e}}{D_{ij}^{n}} \qquad \text{Equation 1}$$

According to equation 1; $DR\,(i,j)$ represents Directness Ratio between Origin(i) and Destination(j); D_{ij}^{e} represents Eucledian based distance between Origin(i) and Destination(j) and D_{ij}^{n} represents network based distance between Origin(i) and Destination(j).

The reciprocal of the DR (i,j) (directness ratio) is the CR (i,j) (circuity ratio) which can be defined as the as the ratio of the shortest network distance over the Euclidean distance between (origin (i) and destination (j) points (Equation 2) (Huang, & Levinson, 2015).

$$CR_{i\,j} = \frac{D_{ij}^{n}}{D_{ij}^{e}} \qquad \text{Equation 2}$$

There are several research and literature considering transportation network directness / circuity for a wide variety of context. For example; Ballou, Rahardja, and Sakai (2002) explained that road distances estimated from distance functions must be corrected by a circuity index considering road network density, connectivity, and travel obstacles such as mountains, lakes etc, in order to approximate the actual travel distances which could be useful in designing logistics networks, routing vehicles, and planning geography based applications. Dill (2003) applied “Pedestrian Route Directness” in Portland, Oregon region to understand the connectivity / accessibility / attractiveness level of urban regions for cycling and walking. The research also summarizes the literature about measures of connectivity, drawn from transportation, urban planning, geography and landscape ecology etc. Levinson and El-Geneidy (2009) used circuity measure for better understanding of the choice of residential location relative to work in a comparable manner. The findings contribute to residence choice and location theory and help to understand how workers tend to locate with respect to network conditions. Barthelemy (2011) reviewed the spatial properties and constraints of the many important measures and models about spatial networks and mentioned about the evaluation of the

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directness and circuity indexes. Bejleri, Steiner, Fischman, and Schmucker (2011) presented a GIS based methodology that analyzes children travel to school as a function of network distance considering the role of constraints/barriers and facilitators to understand accessibility/walkability between origin and destination. Papinski and Scott (2011) used GPS based inputs and generated some variables as outputs describing route characteristics such as distance, travel time, speed statistics, number of intersections, number of turns, number of stop signs/stop lights, and a measure of route circuity, etc. by using GIS. Lin et al. (2014) used "walking or driving route directness" to understand accessibility around train stations for the elderly population. Y. J. Lee, Choi, Yu, and Choi (2015) develop a geographical presentation method to demonstrate which parts of the city need to be improved in terms of directness / circuity of the transit services. Huang and Levinson (2015) analyze the circuity of transit networks to understand the accessibility performance of urban transit systems in the metropolitan areas. Giacomin and Levinson (2015) also measure the circuity of the fifty-one most populated Metropolitan Statistical Areas (MSAs) in the United States and tried to understand trends in circuities. (see also other examples; (P. M. Hess, 1997); (Randall & Baetz, 2001); (K. Lee & Ryu, 2004); (Gutierrez & Garcia-Palomares, 2008); (Y. Lee, Washington, & Frank, 2009); (Sparks, Bania, & Leete, 2011); (Bejleri et al., 2011); (Levinson, 2012); (Salonen & Toivonen, 2013); (Vadali & Chandra, 2014); (Balijepalli & Oppong, 2014); (T. Laatikainen, Tenkanen, Kytta, & Toivonen, 2015); (Giacomin & Levinson, 2015); (Cui et al., 2016)).

Although there are several research and literature that use transportation network directness / circuity measure to understand accessibility level of people, place or transportation networks in a "partial" approach, there has been limited research that integrates transportation network directness / circuity concept into accessibility modeling process in such a way that consider most of the possible origin destination combinations in the transportation network in a simulation manner and provide understanding of the "overall" accessibility performance of the transportation networks without losing the local interactions.

Based on this idea, the basic aim of this research is to propose a new directness-based accessibility modeling methodology in a simulation logic, in such a way that consider most of the possible origin destination combinations in the network by using the regularly produced virtual origins and destinations on the transportation network and provide understanding of the "overall" accessibility performance of the transportation networks without losing the "partial" interactions.

The basic advantage of the proposed directness-based accessibility modeling methodology is that; the proposed methodology could produce directness-based accessibility measures in a simple, comparable and easy to operate manner and most importantly, it is more realistic to understand overall and/or partial performance of transportation networks as most of the possible origin/destination scenarios could be represented in the model without a need for additional supply/demand or origin/destination data.

The outputs of the model could be widely used by the decision-makers who are supposed to deal with accessibility, location/allocation, and service/catchment area related issues by several aims such as; to test the overall/partial performance of the transportation networks, to understand the weakly connected parts of the transportation network and/or to compare the accessibility performance of different networks with each other.

The proposed methodology is applied in 3 cities with different types of transportation network which are Paris, FRANCE (radial network); San Francisco, USA (grid network); and Ankara, TURKEY (mixed network) in order to able to demonstrate the performance and efficiency of the proposed model and to provide a comparison in terms of accessibility performance of different types of transportation networks.

THE METHODOLOGY

The general framework of the proposed methodology is given below (Figure 1).

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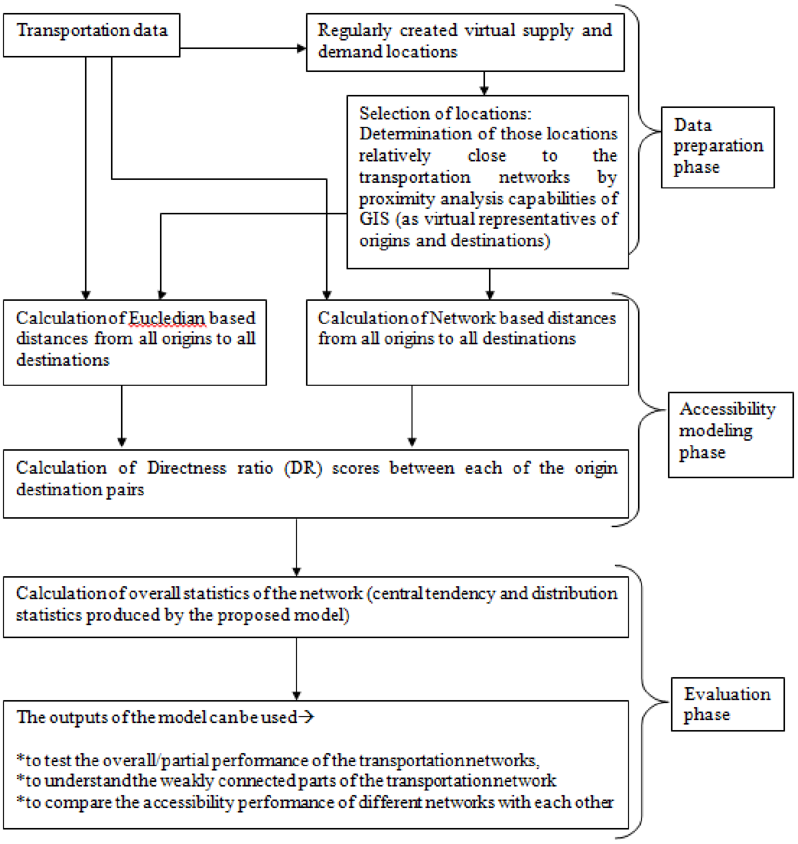

Figure 1. The general framework of the proposed methodology

According to Figure 1, the developed methodology consists of 3 major steps which are 1) data preparation phase 2) accessibility modeling phase 3) evaluation phase.

METHODOLOGY

Data Preparation Phase

This section contains preparation of the data needed for the model's operation. The main input data of the proposed model is the centerlines of a transportation network in GIS environment. Such data could be requested from transportation related departments of local/ central administrations or downloaded from several web based data servers.

By considering the size/boundary of the used transportation network data, the proposed model a) generates regularly created virtual supply and demand locations, b) determines of those close to the transportation networks by proximity analysis capabilities of GIS, c) decides which origin and destination locations will be included in the model in an automated process.

Virtual supply and demand locations are created by fishnet function of ArcGIS software. The function needs a geographic extent to operate and creates rectangular cells of polygon features with centroids according to the parameters of number of rows/columns or cell size width/height (see Figure 2). Created locations are considered as both origin (demand) and destination (supply) locations and used as input datasets for calculation of directness based accessibility scores.

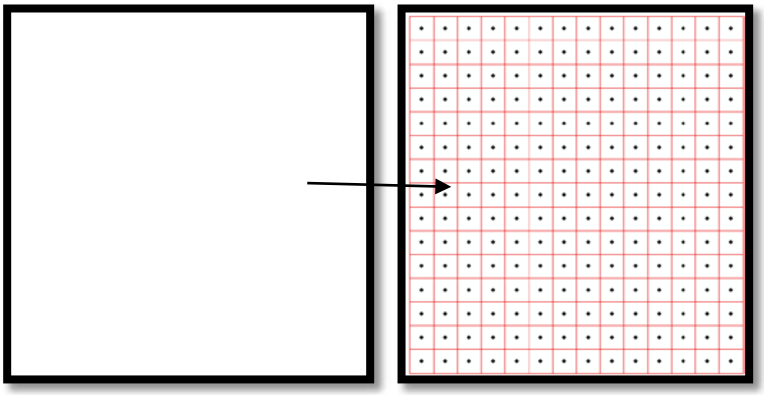

Figure 2. Virtual supply and demand locations are created by fishnet function of ArcGIS software which needs a geographic extent to operate and creates rectangular cells of polygon features with centroids according to the parameters of number of rows/columns or cell size width/height

The model does not use all regularly created origin/destination locations but use ones relatively close to the transportation network. For determination of those virtual locations close to the transportation networks, the proximity analysis and spatial query capabilities of GIS are used. The model first creates buffer polygons considering the scale of the transportation network, and then eliminates the virtual locations that are out of buffer polygon boundaries (see Figure 3).

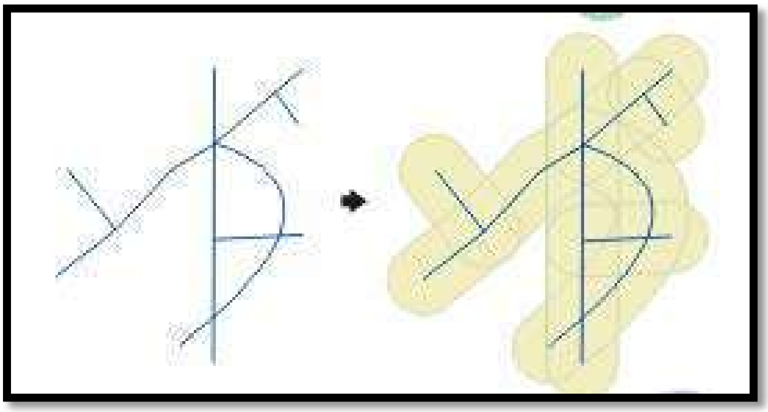

Figure 3. Buffer polygon generation in GIS used for determination of virtual locations close to the transportation networks (Source: ESRI, 2010)

The following part summarizes the data preparation steps related with the case study area. The transportation network datasets used in the case study (Paris, San Francisco and Ankara) is directly downloaded from "OpenStreetMap; https://www.openstreetmap.org", which is one of the free, commonly used web based GIS data server, in July 2016 (see Figure 4). The site covers up to date land use data and transportation network data of most of the cities in the world in GIS environment.

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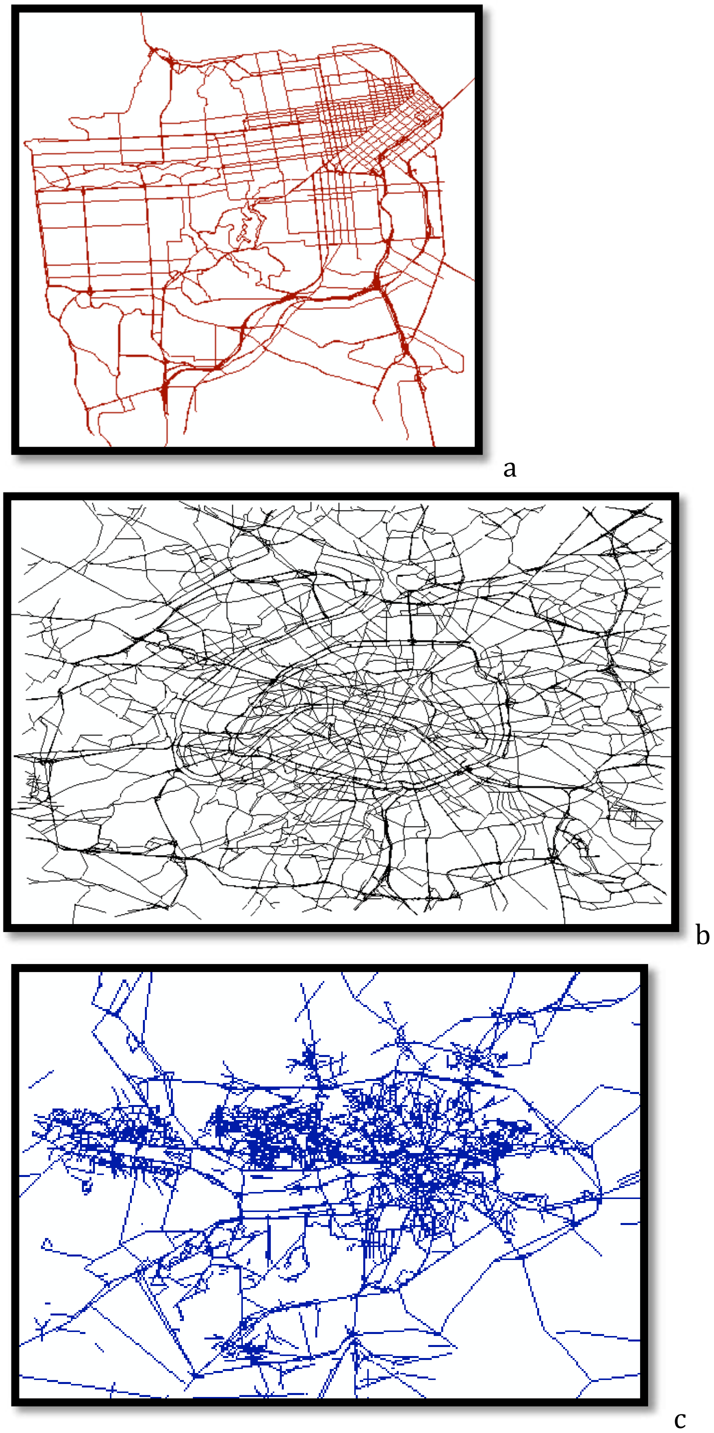

Figure 4. The input transportation network datasets of the model: (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

The reason for using several network datasets is to provide a comparison in terms of accessibility performance of different types of transportation networks in such a way that; San Francisco network carries characteristics of a “grid” based system, Paris network carries characteristics of “radial” or also called “spider web” based system, Ankara network carries characteristics of a mixed system that use partial grid, partial radial and partial organic systems.

In the first step of data preparation phase; by considering the size/boundary of the transportation network data sets, virtual supply and demand locations are created in a regular manner by using regular/random point generation capabilities of GIS (Figure 5).

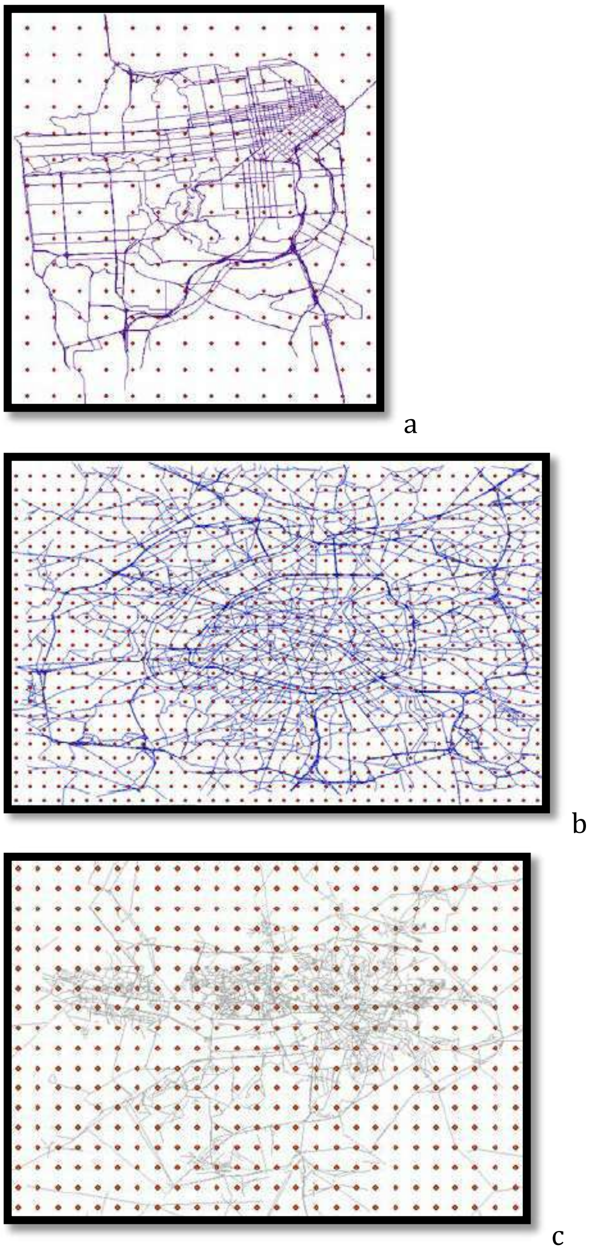

Figure 5. Regularly created virtual supply and demand (origin/ destination) locations considering the size/boundary of the related transportation network data (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

The advantage of using a regularly created virtual origins and destinations to model accessibility is that; it is simple, easy to operate without a need for real time supply/demand or origin/destination data and most importantly, more realistic to understand overall or partial performance of transportation networks as most of the possible origin/destination scenarios could be represented in the proposed model.

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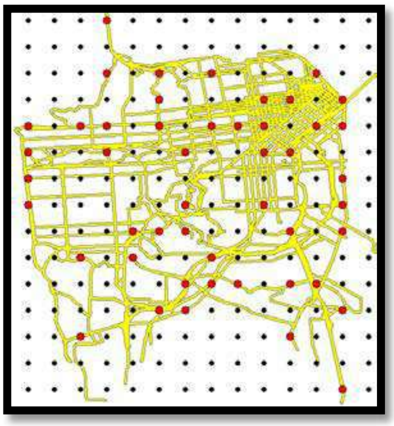
In the second step; regularly created locations are subject to a selection process according to their proximity to the transportation networks by using spatial query capabilities of GIS. This step helps to eliminate the origin destination locations which are definitely far from transportation networks (Figure 6). The highlighted (red) locations in Figure 6 show the ones which are relatively close to the transportation networks. The threshold for the buffer operation is considered as 50 meters for each of the transportation network. However the buffer threshold could be increased or decreased by the decision makers according to the aim, detail need and transportation network characteristics of the research.



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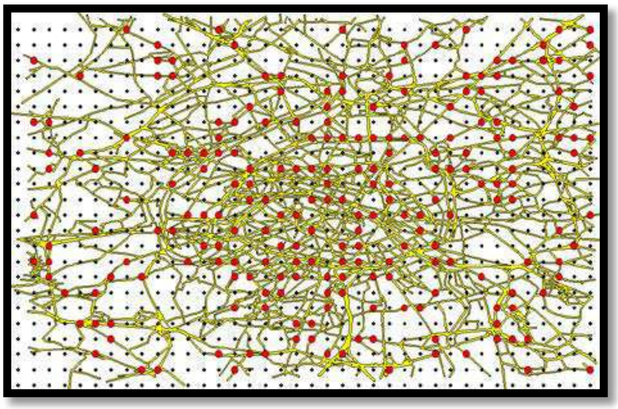

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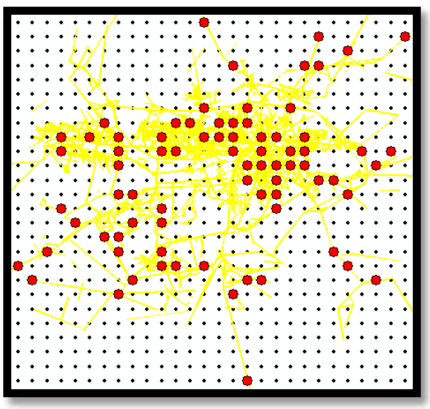

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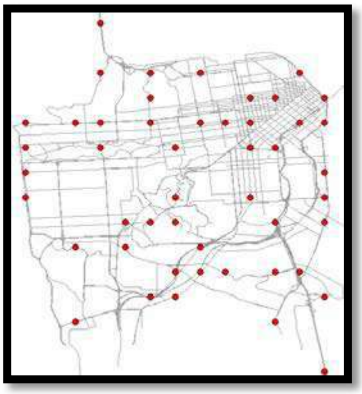
Figure 6. Selection process for the regularly created locations according to their proximity to the transportation networks by using spatial query capabilities of GIS (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

In the final step, origin/destination locations which are relatively far from transportation networks are eliminated and closer ones are maintained to be used as input datasets in "accessibility modeling phase" (see Figure 7).



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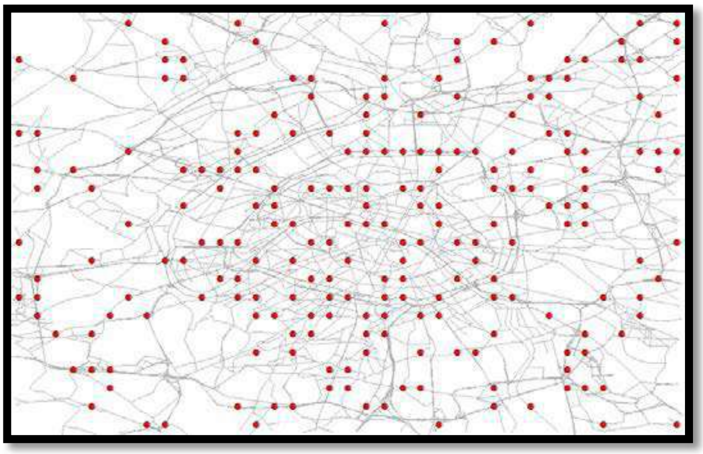

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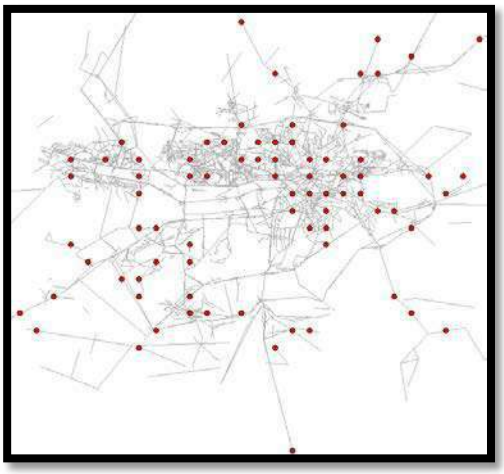

c

Figure 7. Elimination of origin/destination locations which are relatively far from transportation networks; closer ones are maintained to be used as input datasets in accessibility modeling phase (red locations) (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

Accessibility Modeling Phase

This section covers directness-based accessibility modeling steps in GIS environment. By using the network analysis capabilities of GIS, both Euclidian and network based distances between each of the regularly created origins and destinations on the transportation network is calculated. All of the spatial output

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pairs produced by the model are stored in a spatial database which allows comparison of the Euclidian and network based costs between each of the origins (i) and the destinations (j) on the transportation network. The directness ratio (DR) scores between origins and destinations are calculated by using the "Equation 1", mentioned in the introduction part of the research and stored in the spatial database to be used in the evaluation phase of the model.

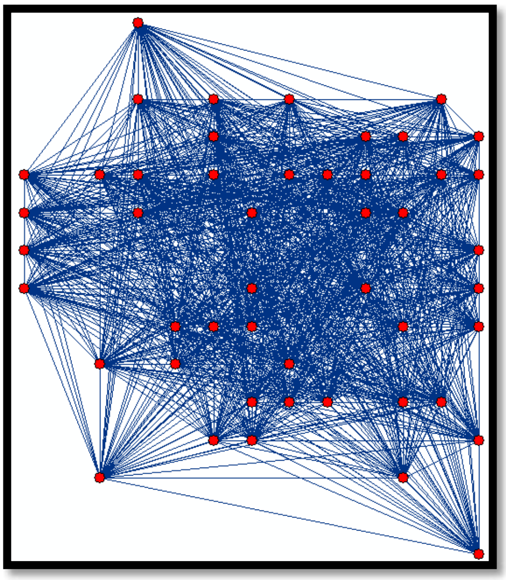
All directness ratio (DR) scores are between 0 and 1 which means that the higher the score, the better the accessibility between origin and destination pairs in terms of directness. When the DR score is getting closer to 1, this means that network based cost is very close to Eucledian based cost and the accessibility in terms of directness is very high. When the DR score is getting closer to 0, this means network based cost is far to Eucledian based cost and the accessibility in terms of directness is low.

All calculation steps are also automated in GIS environment in order to create accessibility related decision support tool for the decision makers in terms of directness or circuity.

The part below summarizes the accessibility modeling phase related with the case study area:

By using the datasets obtained/created from data preparation phase, accessibility modeling phase calculates a) Euclidian based distances between each of the origins and destinations on the transportation network b) Network based distances between each of the origins and destinations on the transportation network c) partial and overall directness ratio (DR) scores by using Equation 1.

Euclidian and Network based distances between each of the origins and destinations are calculated by using Origin Destination Cost Matrix calculation capabilities of ArcGIS network analyst. The origin destination locations which are relatively close to the transportation networks are used as input datasets in the proposed model and both Eucledian and Network based costs are calculated for each of the network data sets (see Figure 8, Figure 9).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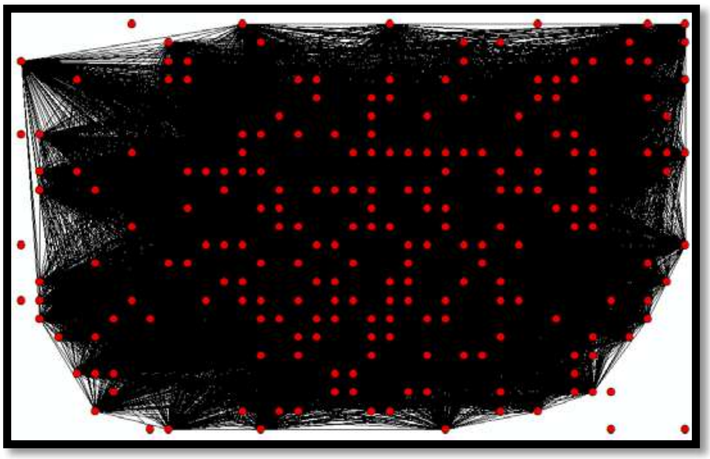
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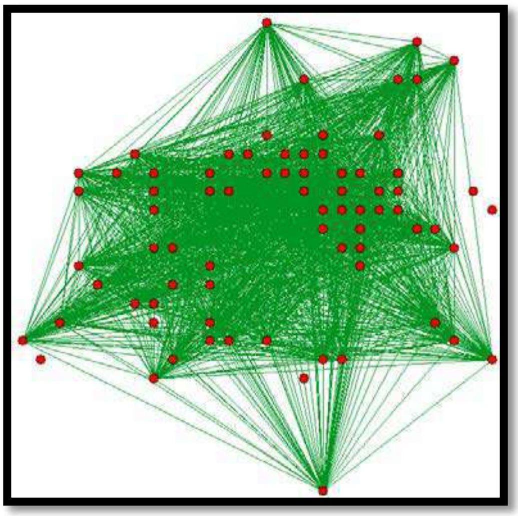
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Figure 8. Euclidian based distances between each of the origins and destinations (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

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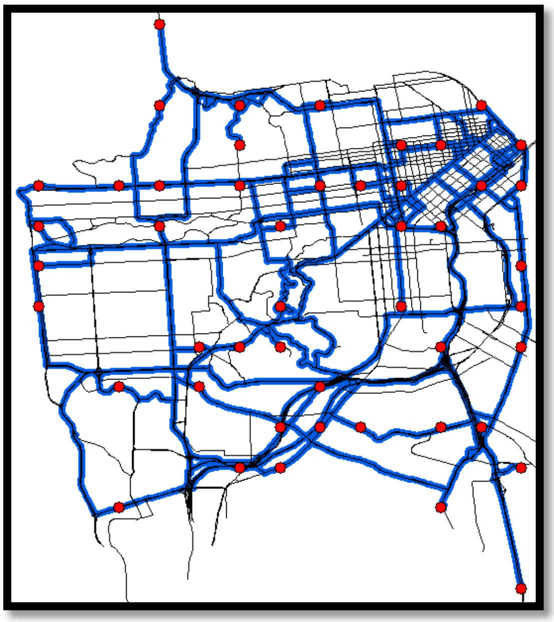

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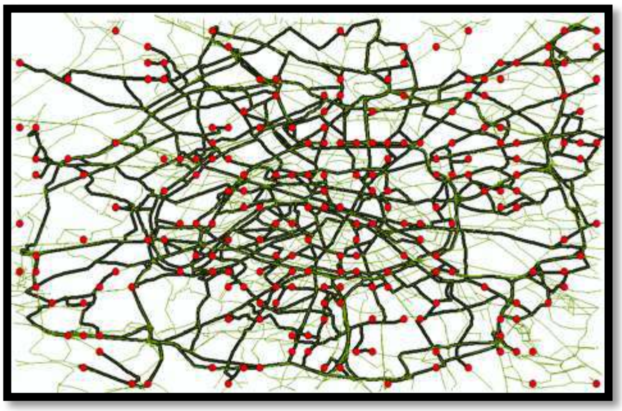

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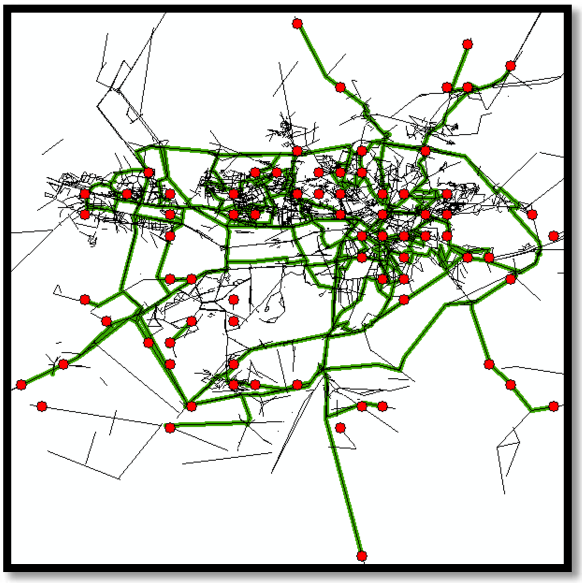

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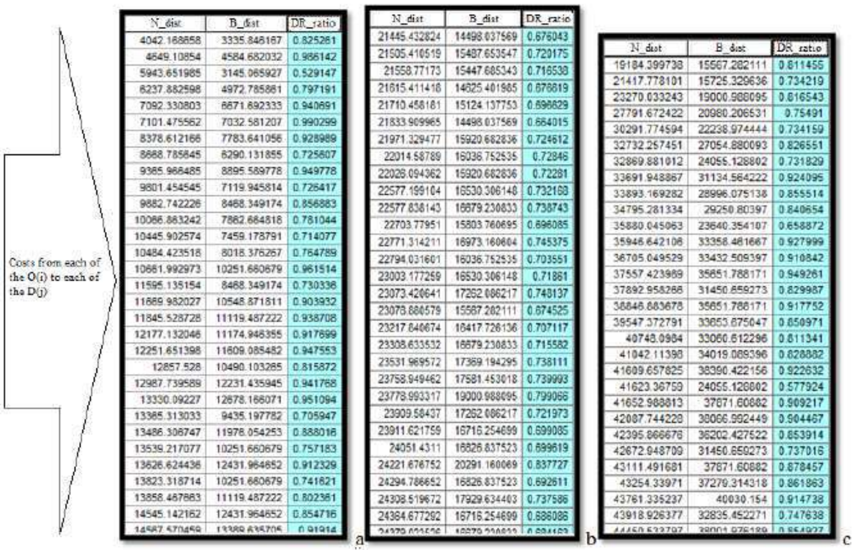
Figure 9. Network based distances between each of the origins and destinations (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

As a final step in this phase, both of the GIS databases of Euclidian and Network based datasets are joined by using "object id" information of origins and destinations. This process enables calculation of partial or overall Directness ratio (DR) scores between origins and destinations in a comparable manner (see Figure 10).



a

N_dist	B_dist	DR_ratio
4042.168858	3335.848167	0.825261
4649.10854	4584.682032	0.986142
5943.651985	3145.065927	0.529147
6237.882598	4972.785861	0.797191
7092.330803	6671.892333	0.940691
7101.475562	7032.581207	0.990299
8378.612166	7783.641056	0.928989
8668.785845	6290.131855	0.725607
9365.966485	8895.589778	0.949778
9801.454545	7119.945814	0.726417
9882.742226	8468.349174	0.856883
10086.883242	7882.684818	0.781044
10445.902574	7459.178791	0.714077
10484.423518	8018.376267	0.764789
10661.992973	10251.660679	0.961514
11595.135154	8468.349174	0.730338
11669.982027	10548.871811	0.903932
11845.528728	11119.487222	0.938708
12177.132046	11174.946355	0.917699
12251.651398	11609.085482	0.947553
12857.528	10490.103285	0.815872
12987.739589	12231.435945	0.941768
13330.09227	12678.166071	0.951094
13385.313033	9435.197782	0.705947
13486.306747	11978.054253	0.888016
13539.217077	10251.660679	0.757183
13626.624436	12431.964652	0.912329
13823.318714	10251.660679	0.741621
13858.487863	11119.487222	0.802361
14545.142162	12431.964652	0.854716
14587.570459	13389.635705	0.91914

b

N_dist	B_dist	DR_ratio
21445.432824	14498.037569	0.676043
21505.410519	15487.653547	0.720175
21558.77173	15447.685343	0.716538
21615.411418	14625.401965	0.676619
21710.458181	15124.137753	0.696629
21833.909965	14498.037569	0.664015
21971.329477	15920.682836	0.724612
22014.58789	16036.752535	0.72846
22026.094362	15920.682836	0.72281
22577.199104	16530.306148	0.732168
22577.838143	16679.230833	0.738743
22703.77951	15803.760695	0.696085
22771.314211	16973.160604	0.745375
22794.031601	16036.752535	0.703551
23003.177259	16530.306148	0.71861
23073.420641	17262.086217	0.748137
23078.880579	15567.282111	0.674525
23217.840674	16417.726136	0.707117
23308.633532	16679.230833	0.715582
23531.969572	17369.194295	0.738111
23758.949462	17581.453018	0.739993
23778.993317	19000.988095	0.799066
23909.58437	17262.086217	0.721973
23911.621759	16716.254699	0.699085
24051.4311	16826.837523	0.699619
24221.676752	20291.160069	0.837727
24294.786652	16826.837523	0.692611
24308.519672	17929.634403	0.737586
24364.677292	16716.254699	0.686086
[illegible]	16679.230833	[illegible]

c

N_dist	B_dist	DR_ratio
19184.399738	15567.282111	0.811455
21417.778101	15725.329636	0.734219
23270.033243	19000.988095	0.816543
27791.672422	20980.206531	0.75491
30291.774594	22238.974444	0.734159
32732.257451	27054.880093	0.826551
32869.881012	24055.128802	0.731829
33691.948867	31134.564222	0.924095
33893.169282	28996.075138	0.855514
34795.281334	29250.80397	0.840654
35880.045063	23640.354107	0.658872
35946.642106	33358.481667	0.927999
36705.049529	33432.509397	0.910842
37557.423989	35651.788171	0.949261
37892.958268	31450.659273	0.829987
38846.883678	35651.788171	0.917752
39547.372791	33653.675047	0.850971
40748.0984	33060.612296	0.811341
41042.11398	34019.089396	0.828882
41609.657825	38390.422156	0.922632
41623.36759	24055.128802	0.577924
41652.988813	37871.60882	0.909217
42087.744228	38066.992449	0.904467
42395.866676	36202.427522	0.853914
42672.948709	31450.659273	0.737016
43111.491681	37871.60882	0.878457
43254.33971	37279.314318	0.861863
43761.335237	40030.154	0.914738
43918.926377	32835.452271	0.747638
44450.633797	38001.976189	0.854927

Figure 10. Some examples of calculated directness ratio (DR) scores between each of the origins and destinations (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network) (N_dist: Network based distance; B_dist: Birdflight / Eucledian distance)

All directness ratio (DR) scores are between 0 and 1 which means that the higher the score, the better the accessibility between that origin and destination in terms of directness.

Evaluation Phase

This section covers calculation of central tendency, dispersion and distribution statistics of the produced DR scores between each of the origins and the destinations on the transportation network by using statistical calculation capabilities of GIS.

The statistics calculated from DR scores are very useful to understand both "overall" and "partial" performance of transportation networks. They also enable to compare the accessibility performance of different networks with each other. When the mean of the DR scores is analyzed as central tendency statistics, the higher mean could mean better accessibility performance for the transportation network. Similarly, when the skewness of the DR scores is analyzed as distribution statistics, the right skewed distribution could mean better "overall" accessibility performance for the transportation network. This means that most of the ratio values are closer to 1 and Network based costs between supply and demand locations are very close to the Euclidian based costs. When the standard deviation of the DR scores is analyzed as dispersion statistics, the lower standard deviation in a right skewed distribution mean better "overall" accessibility performance in a transportation network when

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compared with a higher standard deviation score in a right skewed distribution.

The calculated statistics generated by the proposed model could be widely used by the decision makers who are supposed to deal with accessibility, location/allocation, and service/catchment area related issues by several aims such as; to test the overall/partial performance of the transportation networks, to understand the weakly connected parts of the transportation network and/or to compare the accessibility performance of different networks with each other. Such information is crucial for the decision makers to support accessibility related policy making efforts.

By using statistical calculation capabilities of GIS, the mean, standard deviation and skewness of DR scores are calculated for Paris, FRANCE (radial network), San Francisco, USA (grid network) and Ankara, TURKEY (mixed network) (see Figure 11).

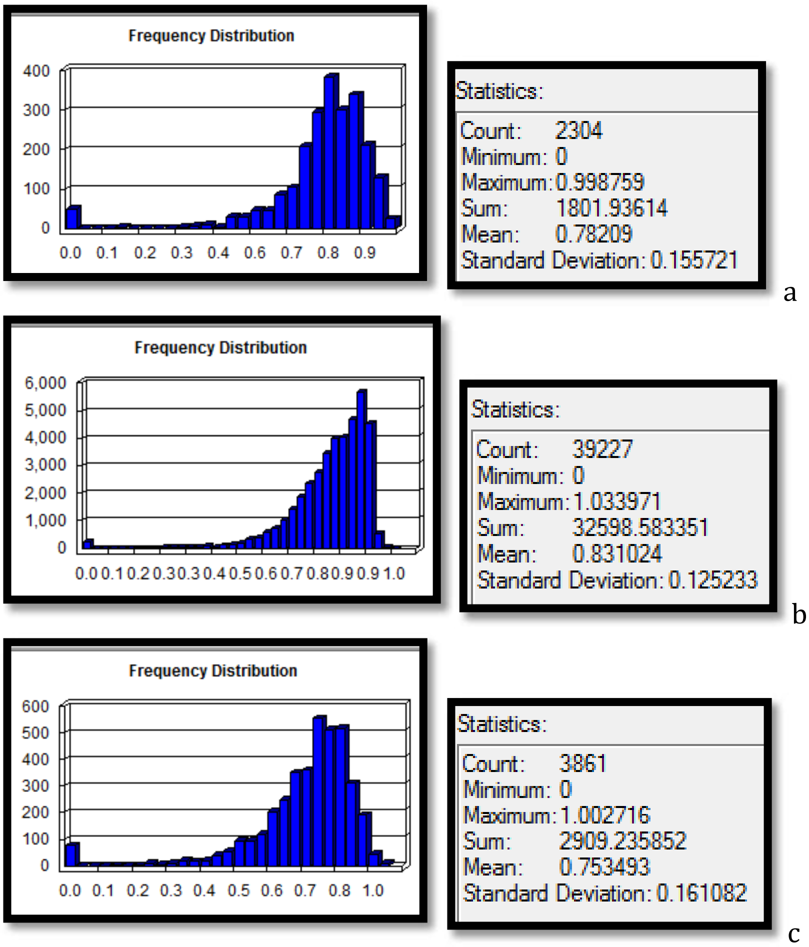

Figure 11. Calculation of central tendency, dispersion and distribution statistics from the spatial DR database between each of the origins and destinations in the transportation network (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

When the mean of the DR scores is analyzed as central tendency statistics, the higher DR mean could mean better overall accessibility performance for the transportation network. According to this information, Paris (radial network) has the highest mean DR score with 0.83, San Francisco, USA (grid network) has the second highest mean DR score with 0.78 and Ankara (mixed network) has the third highest mean DR score with 0.75 value.

Similarly, the skewness of the DR's distribution could also give significant information about the overall accessibility performance of the transportation networks. When the distribution is right skewed (most of the tail is on the left side), this means that most of the DR values are close to 1, most of the network based costs are close to Euclidian based costs and the accessibility between origins and destinations in terms of directness is relatively high. When the distribution is left skewed (most of the tail is on the left side), this means that most of the DR values are close to 0, most of the network based costs between supply and demand locations are far to Eucledian based costs and the accessibility between origins and destinations in terms of directness is low. According to this information, the accessibility in terms of directness can be considered as high in Paris (radial network), San Francisco, USA (grid network) and Ankara (mixed network) on the whole as they all have right skewed DR distribution.

When the standard deviation (stdev) of the DR scores is analyzed as dispersion statistics, the lower standard deviation in a right skewed distribution could mean better "overall" accessibility performance in a transportation network when compared with a higher standard deviation score in a right skewed distribution. According to this information, Paris (radial network) has the lowest stdev with 0.12, San Francisco, USA (grid network) has the second lowest stdev with 0.15 and Ankara (mixed network) has the third lowest stdev with 0.16.

When all of the statistics (the mean of DR's, stdev of DR's and skewness of DR's) are evaluated in an integrated manner, it can be said that Paris (radial network) has the highest overall accessibility performance, San Francisco, USA (grid network) has the secondly highest overall accessibility performance and Ankara (mixed network) has the thirdly highest overall accessibility performance in terms of directness.

As well as the proposed methodology can help decision makers to understand partial/overall accessibility performance of transportation networks in a comparable manner, it also enables to understand the weakly connected parts of the transportation networks. By the help of the proposed methodology, decision maker could demonstrate which of the origin/destination locations have relatively low DR scores and could use this

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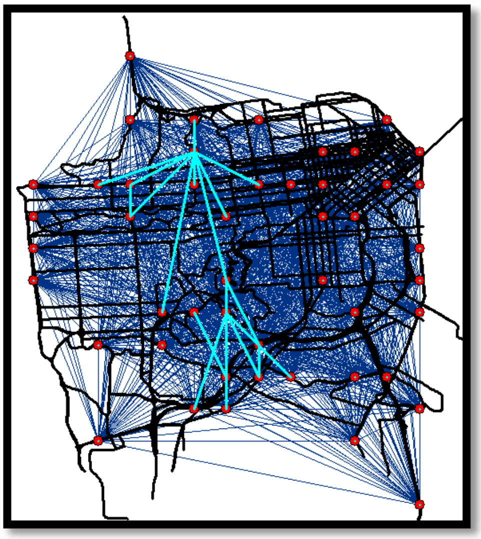
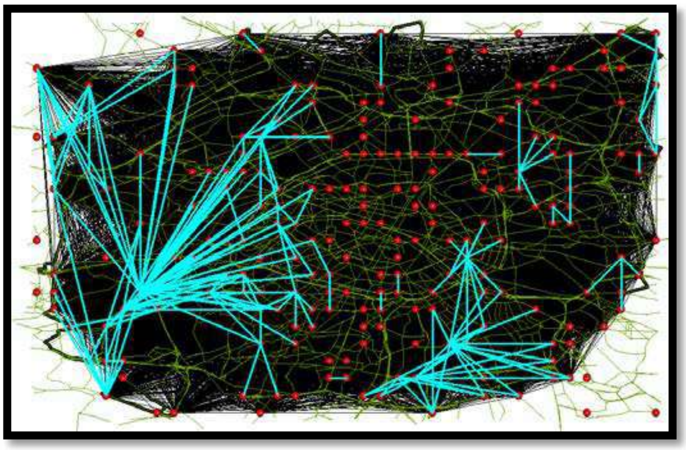
information to define intervention zones and create strategies to increase accessibility between problematic locations. For example the origin destination pairs which have low DR scores (0 < DR < 0.5) are demonstrated as highlighted blue polylines in Figure 12.



a



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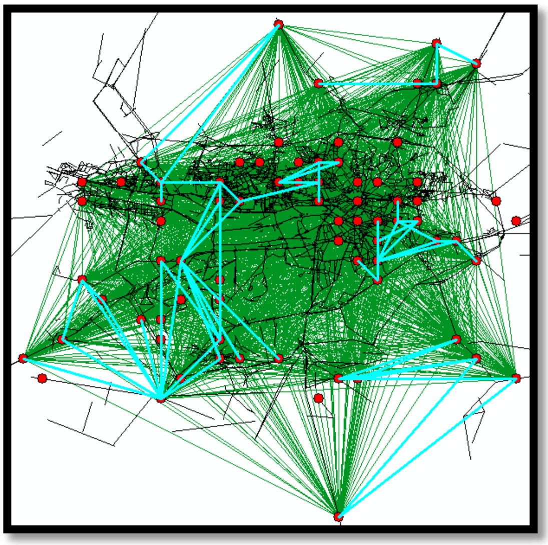

c

Figure 12. The origin destination pairs which have low DR scores (weakly connected parts of the transportation network are demonstrated as highlighted blue polylines) (0 < DR < 0.5) (a→San Francisco (grid network, b→Paris (radial network), c→Ankara (mixed network)

CONCLUSION

Although there are several research and literature that use transportation network directness / circuity measure to understand accessibility level of people, place or transportation networks in a "partial" approach, there has been limited research that integrates transportation network directness / circuity concept into accessibility modeling process in such a way that provide understanding of the "overall" accessibility performance of the transportation networks without losing the local interactions.

Based on this idea, this research proposed a new directness-based accessibility modeling methodology in a simulation logic, in such a way that considers most of the possible origin destination combinations in the network by using the regularly produced virtual origins and destinations on the transportation network and provide understanding of the "overall" accessibility performance of the transportation networks without losing the "partial" interactions.

The basic advantage of the proposed directness-based accessibility modeling methodology is that; the proposed methodology could produce directness-based accessibility measures in a simple, comparable and easy to operate manner and most importantly, it is considerably realistic to understand overall and/or partial performance of transportation networks as most of the possible origin/destination scenarios could be represented in the model without a need for additional supply/demand or origin/destination data.

By considering regularly produced virtual origins and destinations on the transportation network, the proposed methodology could produce "travel time/distance" based accessibility measures (DR scores) that could operate without a need for real time supply/demand or origin/destination data. The advantage of using a virtual regular data set instead of real time data is that; it is more simple, easy to operate and most importantly, more realistic to understand performance of transportation networks as most of the possible origin/destination combinations could be represented in the proposed model.

Although the proposed methodology is applied in 3 cities with different types of transportation network which are Paris, FRANCE (radial network) and San Francisco, USA (grid network) Ankara, TURKEY (mixed network), the main focus of the case study is not to evaluate specific accessibility conditions in a

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detailed manner but to provide a methodological discussion about the proposed directness based accessibility modeling process in order to able to demonstrate the performance, efficiency and usability of the proposed model.

In the light of the results obtained, it can be said that the aim of the research was reached. The outputs of the model could be widely used by the decision-makers who are supposed to deal with accessibility, location/allocation, and service/catchment area related issues by several aims such as; to test the overall/partial performance of the transportation networks, to understand the weakly connected parts of the transportation network and/or to compare the accessibility performance of different networks with each other.

The detail, type and complexity of the used transportation network data and regularly created virtual origin (demand) and destination (supply) locations can be modified by the decision-makers according to the aim, the budget, and the specific detail needs of the study. For example; the proposed model can be operated by several types of networks such as public transportation, pedestrian, bicycle, car etc. and/or by randomly created origin destination pairs. As the real-life transportation supply and demand relationships may not be homogeneously distributed throughout an entire city or there may even be more important zones or flows in some areas than others within the city, the proposed model can also be operated by using real-life origin destination datasets instead of using regularly created virtual origin destination pairs and/or by “different weighted” approaches instead of “equal weighted” approaches, which could also be seen as some suggestions for the future work.

Finally, it must be underlined that; the main focus of the research brings about certain assumptions for other factors that affect the performance of the transportation network. Although there are many factors that could affect the accessibility performance of the transportation network such as; topography (flat / sloped city), landuse characteristics (mono-centric / poly-centric city), traffic density, supply and demand conditions (distribution of the industry, retail, housing etc), the proposed model provides understanding of the accessibility performance of the transportation networks from only “directness/circuity” point of view. The main focus of the research is not to evaluate specific accessibility conditions or transportation network performance in a detailed manner but to provide a methodological discussion about the proposed directness based accessibility modeling process. Hence, the results of the proposed model should be evaluated by the decision makers in the light of this awareness.

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Research Article

Recoding The Characteristics of Public Spaces: The Case of İstanbul

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Abstract

This study proposes a quantitative assessment method to ascertain urban square potential at 12 gates of the historic city wall where different typologies, characteristics and periodic features are observed in Fatih district of Istanbul. The quantitative assessment method is based upon a series of indexes including 7 factors in total consisting of 35 indicators. The proposed method developed an “urban square potential index”, making use of “transport and accessibility”, “convex size”, “built-up environment”, “purpose of use and density”, “morphology”, “landscaping character” and “identity” factors. This index enables assessment of a square according to a) historical-cultural heritage richness and identity, b) functional diversity, c) accessibility, and d) vitality and spatial quality. This paper presents a base for “decision-support system” for decision-makers in determination of the most suitable square with a limited budget, time, labor and equipment during urban square development, design and improvement activities. Furthermore, it allows determination and implementation of the necessary interventions/improvements in order for the available undefined urban spaces to gain urban square functions.

Keywords: *Urban Square Potential, urban spaces, urban design, İstanbul*

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INTRODUCTION

Etymologically, 'sharing' means partition or communization of things. For human beings, this concept refers to emotional and physical sharing and thus, constitutes a critical cornerstone in their lifetime. In the context of the cities where people carry through their daily dynamics, the concept of an urban square comes to the fore as the definition of sharing. Urban squares have great significance for the cities in that they are among the most important sub-components of public spaces experienced in cities (Zeka, 2011). To provide a definition, urban squares are the focal points for activities in the heart of the intense urban pattern, having direct relations with the surrounding structures and streets. In this regard, urban squares have the characteristics to attract attention of people – main users of the city – and facilitate gathering of people.

Urban squares have always existed, from past to present, as areas which reflect identities of cities and common histories of cultures, and where people can experience common activities. The fact that urban squares are experienced by all urban residents for different purposes and in different ways also increases the importance of them. According to Madanipour, urban squares are the public spaces where groups of people with different class and ethnicity, sex and age find the opportunity to come together, interact and communicate (Madanipour, 1996). On the other hand, Carr, Francis, Rivlin and Stone construe the squares as a stage upon which the idea of communal life is exhibited for both ordinary daily routines or periodic rituals of people (Carr, Stephen, Francis, Rivlin, & Stone, 1992). According to Walzer, urban squares are the peaceful communal areas that we share with people we do not know, or with our friends, relatives and colleagues and that we can experience for many daily activities (Walzer, 1986).

Satisfying the common needs of the urban residents, urban squares go beyond the concept of a mere location and become a place, and thus form a spatial cornerstone feeding socio-cultural character of the cities to an important extent. In other words, urban squares are the areas strategically located at the nodes of public space, laying common ground for economic and social relations and thus, playing a key role in self-expression of the communities ("Development Type – Urban Squares," 2009). When urban squares are examined from a historical perspective, periodic differences stand evident in the dynamics and characters of the urban squares. Considering the changing/transforming/ evolving concept of urban square throughout the 6000-year urban history, they were initially located at the intersection of the

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important trade routes. Having first emerged as “agora” in Greece, with the closest meaning to the present, urban squares were seen as urban spaces where political, economic and social activities were experienced. Mostly in square or rectangular, agoras used to host many urban activities from arts to politics. Similarly, “Roman forums” were the open spaces where social, political and economic activities took place and daily discussions were held among people. Roman forums were more like a combination of Agora and Acropolis in that they included more activites presented in more integrated manner (Xing & Siu, 2010).

Following collapse of the Roman Empire in Middle Age, basilicas were converted into churches, and thus churches and cathedrals became the center of the daily activities, which initiated concentration of all open spaces that may be called an urban square around religious structures. Therefore, urban squares and urban spaces were mostly used to host religious ceremonies at that time. Even some important squares located in Europe were shaped at this period (İlkay, 2007). Renaissance and Baroque periods reveal remarkable changes in the context of urban morphology. Renaissance period witnessed a paradigm shift in urban design and planning as a result of the changes of social, economic and political perspectives.

Secular and individual values which emerged as a social impact of Renaissance and Enlightenment period were also effective in the design of urban open spaces and squares. Urban squares of that era were settled near the housing areas and in a way to appeal them (Carmona, De Magalhaes, & Hammond, 2008; Carr et al., 1992; Crouch, 1981). Formal design principles prevailed in the design of the cities and urban squares at the time, and symmetry and order stood out as the most effective concepts in the design of squares. In particular, the Italian piazzas that demonstrate aesthetic concerns are the most important urban squares of that period. As to the Baroque Period which concentrated on spatial balance and axis-based development and provides a clear observation of spatial hierarchy, the basic motivation of square design was to provide visual harmony and produce an effect. At this point, it shares some similarities with the Renaissance period.

In the 19th century, the Industrial Revolution, the most important thing to happen in that era without doubt, had also implications for the cities and urban planning. Development of the railways caused a population boom and overcrowding in cities, which was followed by the emergence of the bourgeoisie class with the establishment of industrial areas around the cities, and increase of the economic efficiency of the residents therein. Therefore, urban squares were shaped in line with the dynamics of use of this class. The areas hosting shopping centers, shopping streets or markets started to transform into a square. In the following period, especially by the end of the 19th century, cities could not meet the needs of the ever-increasing population, and stucked with such problems as over pollution and weak infrastructure, which brought about sudden shifts in the perception of urban squares. As a result, large open/green areas met the need of public space instead of urban squares and streets. Although having continued partially until the 20th century, the situation witnessed a change as the car ownership increased in the 20th century and cities became car-dominant, which, in return, restricted the movements and freedom of walkers, and eventually led to emergence of the squares as the areas at the intersection of the important roads rather that the spaces with a specific character.

Urban squares, one of the main experience/communal areas of the city, have existed with different characteristics throughout the history, and such dynamics have directly affected the forms of utilization of the squares (Krier, 1979). Sometimes located at the intersection of the important trade routes and sometimes reflecting a common history, urban squares have gained significance for the cities and now become the most frequented spaces for the growing urban population. In this regard, many theories are put forth for the urban squares that have become a primary study area of the urban design and planning disciplines, and strategies are developed to create functional urban squares. For instance Carr et al. state that all the public spaces should have following criteria in order to be successful urban squares;(Carr et al., 1992)

1. Responsive: A public place should have an ability to meet the needs of the community; it should provide spaces that could be useful for multipurpose activities such as relaxation, discovery, and active and passive engagement.

2. Democratic: Public spaces should be accessible for all user groups.

3. Meaningful: Public place should have characteristics that help people to make connections between the place, their lives and the world (Memluk, 2013). PPS, an organization working on public spaces, has found that successful open spaces generally include four components: accessibility, uses & activities, comfort & image, and sociability. PPS has developed the Place Diagram tool to help people judge any place as good or bad (Project for Public Spaces,

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2005). According to PPS, there are certain principles in order to create better functional urban squares;

1) Image and identity, 2) Attractions and destinations, 3) Amenities, 4) Flexible Design, 5) Seasonal Strategy 6) Access, 7) The inner square & the outer square, 8) Reaching out like an Octopus, 9) Central Role of Management, 10) Diverse funding sources

Different studies recently conducted on urban squares and public spaces also indicate effective use of these strategies. It is essentially important to create sustainable public spaces and thus, design the urban squares within a sustainable framework. However, creation of sustainable and lively urban squares is based on certain abstract and concrete elements. Strategies laid down by PPS, at this point, shape the characteristics of the urban squares and define which parameters may be used to reveal the specific character of the square (Sepe, 2017). Dynamics of use of people in urban squares and patterns of behaviors in public spaces can also be determined through such strategies and consequently establishes a defined framework for creation of functional urban use areas. Determination of behaviors of pedestrians through different analysis methods and design of the urban squares accordingly and making use of the relevant strategies during designing are considerably important for creation of the more actively used urban squares (Nasution, Zahrah, & Ginting, 2018; Vroman & Lagrange, 2017).

On the other hand, it is also a requirement for the urban squares to be experienced by all user groups. The strategies mentioned above provide this through their integrated approach and ensure design of the multi-layer structure of urban squares in a way to appeal to each user group. Thus, it becomes possible to create urban squares where daily cultural dynamics are experienced and strong social relations are established, and hence owned by urban residents (Peacock, Anderson, & Crivellaro, 2018).

History of the urban squares, one of their characteristics revealing specific sides of them, can also be evaluated in line with these strategies, and physical quality of the urban squares can be verified based on the strategies pur forth by PPS. Thus, urban squares with historical value can be used actively by urban residents while characteristics of the same are preserved (Omar, Ramlee, Yunus, & Samadi, 2018). Although these strategies basically set forth sub-characters of the urban squares, they actually prepare a basis, in an analytical framework, to provide a comprehensive response to the question of how to create a functional urban square. This body of strategies, which covers "public space design" by explaining physical components of the squares and "public space management" by revealing relations of the said components with one another, includes all necessary and adequate units for designing an urban square.

Exposing character of the urban square is of critical importance for development of design and control strategies for squares. Well-establishment of the properties that turn an urban open space into a square will clearly shape the subsequent design and inspection interventions, which requires handling of such properties in a way to guide the process (Carmona et al., 2008). At this point, building spatial analysis upon the correct framework, examining the space in line with the pre-determined criteria and determining the spatial design & control strategies should form the parts of a fully coherent and integrated process. This is the only possible way to ensure the due functioning of "public space design & management" concept.

With reference to the conceptual and theoretical framework that has drawn so far, it would be possible to argue that public spaces have some specific features that reflect its inherent characteristics. In this context analyze of such characteristics is becoming increasingly important to understand the real potentials of public spaces better. There are different studies that analyze the characteristics of the public space regarding with different dimensions. In this manner, when the literature of urbanism and urban design is examined, it is seen that there are studies examining the physical properties of the squares over morphological relations and indicators (Erten, Torun, Gurleyen, Akbas, & Zunbiloglu, 2016), and these studies are mostly revealed by making inferences from the analysis of structural relations on the second and third dimensions (Kang, 2005; Yang & Kang, 2005). On the other hand, there are several studies on the internal and external accessibility of public space, and those that the determination of the effect of the internal features of the area on the access of the area is investigated (Brambilla, Maffei, Di Gabriele, & Gallo, 2013; Kubat, Ozer, & Ozbil, 2013). In addition, the landscape characteristics of the public space have been analyzed and its effects on the use of the public space has been also evaluated (Bemanian, Ghasemi, Saremi, & Sattarpour, 2016; Liang, Hu, & Sun, 2013; Nowak et al., 1996; Rašković & Decker, 2015). Brambilla et al., (2013) uses certain indicators together to analyze the features of urban squares. However, it is seen that more comprehensive approach is required to reveal the main characteristics of urban squares-as a form of public space based on qualitative and quantitative methods. This research reveals a very operational analysis technique with its comprehensive

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components and indicators set. The method used in this paper demonstrates the spatial characteristics of urban squares quantitatively and presents different indices on specific topics related to the square potentials. In particular, it provides decision-makers with the opportunity to develop quantifiable, objective solutions for the implementation of redesign, improvement and development strategies for selected urban squares. In this way, it allows both the improvement of the quality of the existing urban squares and re-functionalizing and redesigning the spatial patterns of undefined urban spaces as urban squares.

This study aims to develop a series of indices to measure urban square potentials at 12 Gates of the City Wall of Istanbul bearing the traces of different historical and cultural heritage, and, making use of these indices, put forward strengths and weaknesses of each square based on certain factors. Urban Square Potential Index (USPI) was developed as the main index of the study, and then Historical-cultural heritage richness and identity, Diversity, Accessibility, Vitality and Spatial Quality indices were developed as the sub-components of the main index for more specific subjects.

This method is expected to provide inputs for design, improvement and development strategies for the application studies regarding the urban squares chosen as samples. These indices were used to discuss design and control interventions to increase dynamics of use of these urban squares.

CASE STUDY: BACKGROUND INFORMATION ON SELECTED URBAN SQUARES IN ISTANBUL

Having hosted various urban life activities of people since the early ages, urban squares are the most important public spaces reflecting identity of the cities and revealing socio-cultural structure and characteristics of communities. These public spaces have embodied reflections of urban and socio-cultural characteristics throughout the history with the inherent architectural design elements and spatial character, and thus they contribute to image and prestige of the city.

Walls constructed to protect/defend a city in the past are called “city walls”, and doors on the city walls providing connection with the outside world are called “gates”. Istanbul is known to have the most powerful city wall system, consisting of three sections; namely Land, Sea and Golden Horn Walls (Dilbaz, 2018). Limiting the peninsula on which the city is established and extending from the Golden Horn to Yedikule, some of the Land Walls still subsist and form “Suriçi” (walled city) known as Historical Peninsula.

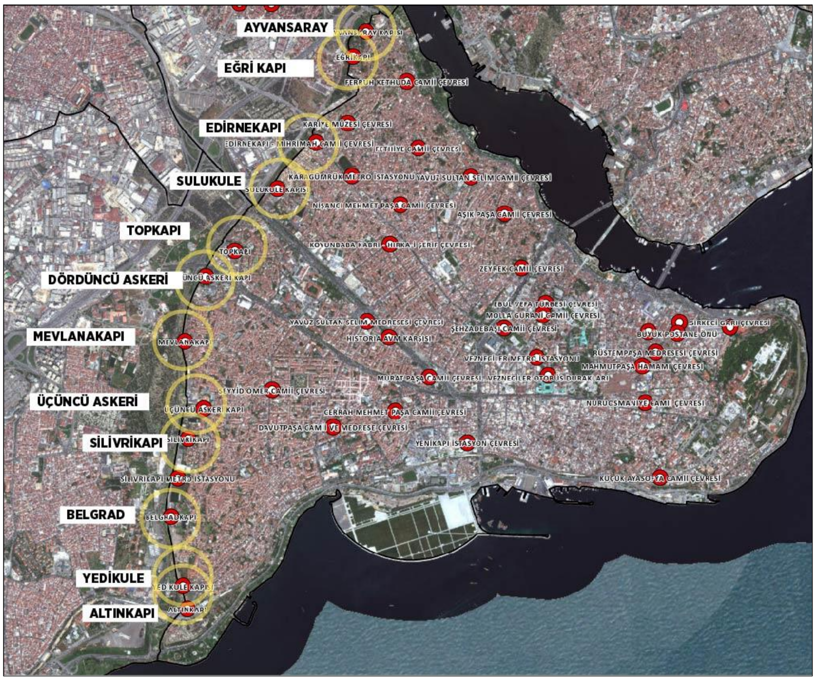

Figure 1. 12 Gates located on the Land Walls surrounding the Historical Peninsula and Walled City (Satellite Map source:Esri, 2019)

Walled City, a multicultural and multilayer historical center having gone through the periods of Byzantine (Eastern Roman) Empire and Ottoman Empire, has still an essential function in tourism with its commercial and cultural heritage. It is highly preferred for urban activities, and forms the pioneer area of Istanbul for representation of urban identity on the architectural and socio-cultural level. Therefore, the gates and their surroundings are considered creating the public spaces with characteristics to contribute to image and prestige of the city. Before indicating urban square potentials of these public spaces, it would be suitable to review their basic functions from past to present, functional transitions between the periods, forms of spatial uses, and their socio-cultural background as well as their spatial characters.

There are a total of 12 gates on the Land Walls surrounding the Historical Peninsula and Walled City: Ayvansaray Gate, Eğrikapı, Edirnekapı, Sulukule Gate, Topkapı, Fourth Military Gate, Mevlanakapı, Third Military Gate, Silivrikapı, Belgradkapı, Yedikule Gate and Altınkapı. Ayvansaray Gate that could not reach the present is the last gate of the historical walls on the north while Yedikule Gate and Altınkapı are the last gates on the south (Figure 1).

Each gate presents potential urban squares together with the surrounding public spaces, and serves to the city and residents with a different function and spatial character. Generally named after the neighbourhoods in which they are located or socio-cultural and/or socio-economic characters of their

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neighbourhoods, gates were either used for military purposes during historical periods or open to public use (Dilbaz, 2018). Both in the previous periods and today, they are especially important and valuable in that they host special day and official ceremonies, bear the characteristics of a religious center, constitute the trade axis of the city and they are located on the main arterial roads.

For example, it is mentioned that Altınkapı, which was used as a ceremonial gate in the Byzantine Empire and adorned with gold gilding and named after these decorations, was the gate where soldiers and emperors, who triumphed in the war, entered the city flamboyant and various victory celebrations took place at the entrance area (Dilbaz, 2018). Also known as the most important victory gate/empire gate of the Byzantine Period, Altınkapı and its surroundings are understood to be used as a prestigious gathering area for ceremonies. Altınkapı lost that character as of the Ottoman Period and started to be used for different purposes, mainly presenting a transportation-oriented urban potential laying at the center of crossroads. The still-existing gate forms an urban symbol with the historical remnants and architectural elements nearby and also undertakes cultural and recreational functions.

Edirnekapı replaced Altınkapı during the Ottomon period, and the former was used for all official entrances and exits, including those of sultans (Dilbaz, 2018). Accepted as the beginning of the road to Edirne and thus named, and used for entrance of goods and passengers to Istanbul during the Ottoman period, Edirnekapı was also considered as the customs gate of the city (Yavuztürk, as referred to in 2013a). The gate and its surroundings have reached the present day from the Byzantine and Ottoman periods, and even if they have lost the official significance and no longer used as the ceremonial area, this place is still used for transportation purposes, located on one of the important crossroads of the city. Furthermore, location of such architectural elements as historical church, holy spring, monastery, baths and theater adds a symbolic value to the urban square arising from its historical and cultural importance, and increases the potential of use for cultural and recreational purposes across the city. From a comprehensive perspective, organic street patterns, and mansions and palaces implying a settlement of wealthy people in the region indicate unique values for settlement pattern of the area. However, it is observed that as of the 1970s, the wooden buildings were replaced with reinforced-concrete structures in line with the needs, the number of floors increased and certain shifts occurred in the settlement pattern of the region (Yavuztürk, as referred to in 2013).

Similar to Edirnekapı and its surroundings, Silivrikapı stands out as the place hosting official festival celebrations in the historical periods, and Topkapı and its surroundings as a military gate opened to the area where cannonballs were stocked (Dilbaz, 2018; Gözeller, 2013).

Apart from the official and military functions, gates and their surroundings can have various forms of uses for daily life activities, and sustaining similar functions today, create potential urban squares with cultural, commercial and recreational facets. For example, Silivrikapı and its surroundings are known to host grain trading in the previous periods, and it is called gate of trade by local people (Dilbaz, 2018). Similarly, the gate holding the water tower providing a flow of the out-coming water through the city walls was named as Sulukule Gate, and the gate nearby opened to the Mevlevi Lodge and having sufistic significance was named as Mevlâna Gate. Even though Sulukule Gate has not reached the present day, the surrounding area is said to be densely populated by the Romans who played a key role in fulfilling the need of labor for trading activities during the Ottoman period (Güncüoğlu & Yavuztürk, as referred to in 2013). Although there were large vegetable gardens and limited settlements during the historical periods, this area mostly hosts, for the time being, basic urban functions such as houses, municipal services buildings and dormitories. In similar, Mevlanakapı was called Russian Gate during the Byzantine period because of the Russian-origin population settled in the region (Hayrullah, 2013). Mevlanakapı and its surroundings share also similarity in terms of spatial development and change in that there were vegetable gardens, green spaces and picnic areas before the 1950s, but now it has transformed into a densely built-up areas.

Ayvansaray Gate which was not open to public during the Byzantine period but rather used by high-level authorities to reach Blachernae Palace was officially important at that time; however, it assumed a functionality for daily life as it was transformed, during the Ottomon period, into a region with animal shelters, resulting in a change of both use, and character and meaning (The Mayorship of Fatih, 2013). The name of the neighbourhood "Ayvansaray" has the traces of the Byzantine period and also refers to 'hayvan sarayı' (*in eng.* animal palace) in Turkish (Eyice, 1991; The Mayorship of Fatih, 2013). This neighbourhood has hosted, from past to present, various

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communities with different beliefs and means of living such as a seafaring and industry. Although Ayvansaray Gate and the surrounding area bore the historical and cultural stamp of the past until the 1980s, it has lost many of its characteristics (The Mayorship of Fatih, 2013).

Ayvansaray Gate still has a worshipping and culture-centered position on urban-scale as a result of the combination of different beliefs during historical periods, a reflection of this socio-cultural structure to the space and concentration of the architectural elements symbolizing many religious beliefs. Therefore, it can be said that gates and their surroundings reflect the social structure they have previously hosted besides their spatial values and forms of uses. As a matter of fact, this is also the case for Mevlanakapı and Sulukule Gate and their surroundings. Similarly, the names of Eğrikapı and Belgradkapı come from the settlement of families, in particular artisans, respectively from Eğirdir and Belgrade, and they went through spatial development reflecting their socio-cultural structures (Turnbull, 2004; Yavuztürk, as referred to in 2013a, 2013b).

Having social, economic and cultural similarities with Ayvansaray neighbourhood and being among the first settlement areas, Eğrisaray and its surroundings are known for the local palaces and churches, but very few of the architectural structures such as small mosques, mosques, lodges, tombs, fountains and baths could reach the present day. Upon settlement of the Muslims in the region, churches were transformed into mosques, and water cisterns into vegetable gardens and residential area (Yavuztürk, 2013b). Consequently, it can be said that Eğrikapı, with its surrounding area, is a focal point for worshipping and culture, and has recreational potential.

While some of the urban squares are still used as in the past, some of them are now used for different purposes. Topkapı and Silivrikapı have transportation-oriented character but at the same time provide culture, trade and recreation space across the city. However, Altınkapı has completely lost its importance, and has turned into an urban symbol focused on transportation. Some other gates such as Third Military Gate serve as worshipping-oriented urban squares for location of many actively used religious facilities in their immediate vicinities.

In addition to their forms of use, and historical and cultural values, characters of the gates and the surrounding areas have a decisive role for urban potential. At this point, it can be said that these squares generally have a monocentric urban character, driving the users to gather in the same space. Ayvansaray Gate, Edirnekapı, Fourth Military Gate, Third Military Gate, Belgradkapı, Yedikule Gate and Altınkapı reveal such character while Eğrikapı, Sulukule Gate and Mevlanakapı have amorphous square character, and Topkapı and Silivri have multicentric urban square character. Due to its multicentric structure, Topkapı Urban Square allows entrances from the highest number points.

City walls, gates and their surroundings have long lost their past forms of use and become an urban symbol only reflecting historical and cultural background. In the areas having undergone functional transformation, the newly developed forms of uses have brought dynamism, mobility and a new focal point for the region. The growth of population in the region which is still defined as the heart of the city for trade and service sector, has also increased the need for public spaces where urban life activities will take place. The urban squares covering these gates and their surrounding areas are essentially important for preservation of the historical identity, creation of cultural consciousness and interaction of people from different socio-cultural background.

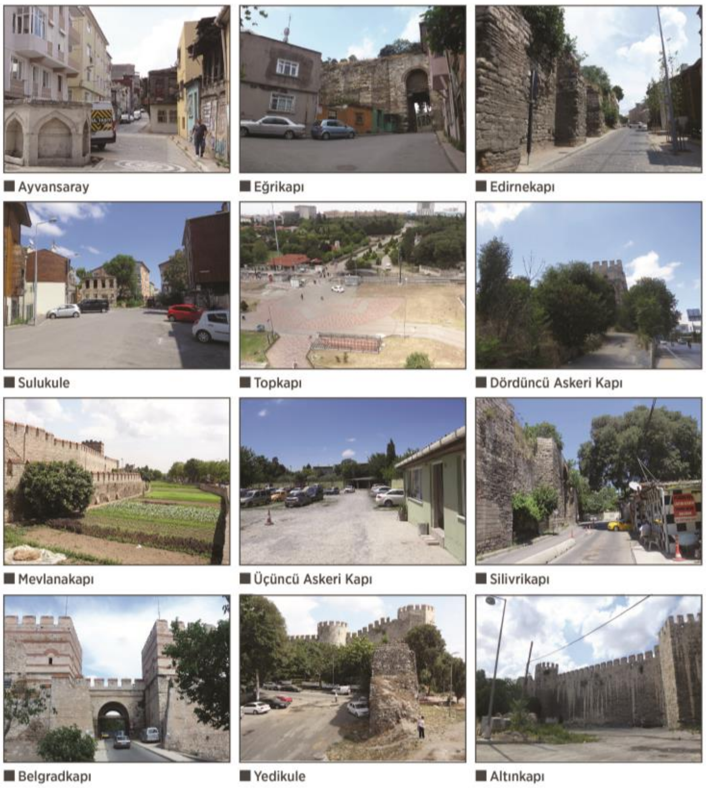

Figure 2. Photographs from the 12 Wall Gates (Photographs by author)

DATA AND METHODOLOGY

In order to measure urban square potentials of the 12 Gates of the City Wall with multivariate quantitative method, a main index -

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Urban Square Potential Index (USPI) – and five sub-indices - Historical-cultural heritage richness and identity, Diversity, Accessibility, Vitality and Spatial Quality indices - were developed. Degree of influence of the indicators used for each index was scored based on the opinions of the experts and converted into a numeric value. Scores of the indicators converted into numeric values were added together based on the relevant index, and total index value was obtained after the standardization (Terzi et al., 2017)(Terzi et al., 2016).

Data

In this study, existing maps, historical maps, satellite images and GIS (Geographical Information System) based building data were taken from the Directorate of Cultural Heritage Preservation of Istanbul Metropolitan Municipality. The other observational data-vehicle counting, pedestrian counting, identification of a characteristic object/structure etc. were collected by the project team through field study. All the data were standardized and combined in the GIS-based database. All analytical studies were produced as thematic analyzes in the GIS environment and statistical calculations in SPSS.

An Index for Urban Square Potential: Recoding the Characteristics

Urban squares are the most important image elements of cities and urban areas where the interaction of individuals is at the highest level. In this context, urban squares should have certain qualities. The higher these qualities, the greater the success and functionality of the urban squares. In this study, an index is proposed to demonstrate how the potential of an urban square can be calculated under certain components and sub-indexes are developed as to how the features of urban squares can be defined. The indices proposed in this study helps to develop the design strategies for urban squares.

In this study, a "multivariate quantitative method" is proposed, which identifies the characteristic features of an urban square by seven components and measures these seven components with 39 indicators. The seven components are *"accessibility", "size", “characteristics of building", "density", "morpohology", "landscape”* and *“identity”.* A total of 39 indicators developed to measure each of the aforementioned components were scored by experts on a scale ranging from 1 to 10 (Table 1), upon which an "urban square potential index" was calculated.

Urban square potential index is calculated as follows:

$$\sum USP = \sum a + \sum s + \sum cb + \sum d + \sum m + \sum l + \sum i$$

Where,

USP: Urban square potential index
a: accessibility
s: size
cb: characteristics of building
d: density
m: morpoholgy
l: landscape
i: identity

Following the calculation of USP, the seven components in the urban square potential index were configured with different combinations and new sub-indexes were calculated to better explain the features of urban squares. Thus, it is possible to understand what different characteristics are dominant and which features need to be improved for each urban square. The sub-indexes and their calculations are explained as follows:

Historical-cultural heritage richness and identity index (HCI): This index is developed to ascertain the level of historical and cultural heritage located in an urban square, whether it hosts historical works that can form a reference and to reveal structural conditions of the existing historical works in the square. Inclusion of these components in any urban square is really meaningful for reflecting historical and cultural characteristics of a community and bridging the past with the present. It gains importance to develop strategies for preserving and maintaining the historical environment in the squares with a low index value – unless it is a recently built urban square.

In this index, harmony level of the urban square with the past texture (current condition, compared with the oldest map of the urban square – pervitich, German blue maps, etc.), the number of historical works per unit area, the number of basic elements contributing to the character of the urban square per unit area (clock tower, fountain, monumental tree, wall) are taken into consideration as a representation of the identity, and indicators of the characteristics of building associated with HCI index are included in the calculations and defined as cb'. Those indicators are the number of registered civilian architectural works, the number of monumental architectural works, and the ratio of registered lost and ruined works to total registered works. Historical-cultural heritage richness and identity index is calculated as follows:

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$$\sum HCI = \sum i + \sum cb'$$

Equation 1. Historical-cultural heritage richness and identity index

Diversity index (D): This index aims to demonstrate different uses of buildings (house, commercial, office, etc.), urban services, recreational opportunities and density of use. Those parameters help to measure the level of activities and vitality in any urban square and refers to individual impacts and activity level of individuals in the urban life. This index uses all of the charateristics of building indicators mentioned above as well as the purpose of visiting the urban square as a related indicator from density component displayed as d'.

$$\sum D = \sum d' + \sum cb$$

Equation 2. Diversity index

Accessibility index (A) measures the accessibility performance of urban square, depending on transportation options, mode and ease of access to the urban square. The coefficient of average distance to the stops or stations, the number of two-way people passing through the unit section, the number of two-way vehicles passing through the unit section, the number of observation-based intense pedestrian routes in the urban square, the global and local integration ratio and the number of axles opened to the urban square are used in the calculation of this index. As an additional component, pedestrian and vehicle density indicators of the density component are taken into account in order to determine the level of use of the urban square, and displayed as d''.

$$\sum A = \sum a + \sum d''$$

Equation 3. Accessibility index

Vitality (V) measures, the vitality of the place, the pedestrian mobility and the level of effective and attractive pedestrian environments in urban square. This index uses all of the landscape indicators mentioned above as well as the purpose of visiting to the urban square as a related indicator from density component displayed as d' , and pedestrian and vehicle density indicators of the density component are taken into account in order to determine the level of use of the urban square, and displayed as d''.

$$\sum V = \sum l + \sum d' + \sum d''$$

Equation 4. Vitality index

Spatial Quality (SQ) measures the form, comfort, aesthetics of an urban square focusing on the size of urban square, pedestrian area, convex area and visible area with spatial enclosure rate, geometry of the square as well as topography, current plant material, distribution of urban furniture and lighting performance. This index uses all of size, morphology and landscape component indicators.

$$\sum SQ = \sum s + \sum m + \sum l$$

Equation 5. Spatial quality index

Table 1. The indicators, definitions and scores of multivariate quantitative assessment method (Terzi et al., 2017)(Terzi et al., 2016)

	INDICATORS	DEFINITIONS	SCORE[1]				
A. Accessibility	A1. Distance to public transport stops	Coefficient of air distance to the stops as of the convex area border [(Number of Stops x Distance to Stop)/Total Distance]	10	6	4	2	0
	A2. Pedestrian counts	The number of two-way people passing through the unit section (person/hour)	10	8	6	4	2
	A3. Vehicle counts	The number of two-way vehicles passing through the unit section (vehicle/hour)	10	8	6	4	2
	A4. Intense pedestrian movement axis	The number of observation-based intense pedestrian movement routes in the square	10	8	6	4	2
	A5.1. Global Integration	Topological integration ratio with the entire area	10	8	6	4	2
	A5.2. Local Integration	Topological integration ratio up to 8 axis (step) (approx. 500 m)	10	8	6	4	2
	A6. Entrances and exits of squares	The number of axis opened to the square	10	6	4	2	0
B. Size	B1. Area	Area of the square (x10.000 m2)[2]	10	8	6	4	2
	B2. Size of the pedestrian area	Size of the pedestrian area per unit convex area (m2)	10	8	6	4	2
	B3. Size of the convex area	Size of the convex area (m2)	10	8	6	4	2
	B4. Size of the visible area	Visibility rate of the square-limiting elements in the two dimension	10	8	6	4	2
C. Characteristics of the building	C1.1. Building usage types	The number of residential usage type per unit area (x0.0001 m2)[2]	10	8	6	4	2
	C1.2. Building usage types	Area of residential usages per unit area (x0.01 m2)[2]	10	6	4	2	0
	C1.3. Building usage types	The number of non-residential usage type per unit area (x0.0001 m2)[2]	10	8	6	4	2
	C1.4. Building usage types	Area of non-residential usage type per unit area (x0.1 m2)[2]	10	8	6	4	2
	C2. Registered civil architecture works	The number of different registered civil architectural works per unit area (x0.0001 m2)[2]	10	6	4	2	0
	C3. Registered monumental architecture works	The number of different monumental architectural works per unit area (x0.00001 m2)[2]	10	6	4	2	0
	C4.1. Pattern of property	The number of public property per unit area (x0.00001 m2)[2]	10	8	6	4	2
	C4.2. Pattern of property	Area of public property per unit area (x0.01 m2)[2]	10	8	6	4	2
	C5.1. Distribution of public facilities	The number of public facilities per unit area (x0.0001 m2)[2]	10	6	4	2	0
	C5.2. Distribution of public facilities	Area of public facilities per unit area (x0.01 m2)[2]	10	6	4	2	0
	C6. Restoration condition of the historical buildings	Ratio of registered lost, demolished and ruined works to total registered works (x0.01 m2)[2]	2	4	6	10	0
D. Density	D1. Pedestrian density	The number of pedestrians per unit convex area (x0.1 m2)[2]	10	6	4	2	0
	D2. Vehicle density	The number of vehicles per unit area (x0.01 m2)[2]	10	8	6	4	2
	D3. Main usage aim of the square	The number of dominant usages	10	8	4	2	0
E.Morpohology	E1. Enclosure /3D Enclosure ratio	Ratio of building height to width of open space	6	10	8	2	0
	E2. Geometry Singular/Plural/Amorphous Square	Ratio of the biggest convex area to the second biggest convex area	4	6	8	8	10
	E3. Ratio of interaction with the surface of square	Ratio of the peripheral length of the square to the total area (scores increases in parallel)	10	8	6	4	2
F.Landscape	F1. Topography	Average rate of an inclined surface (%)	2	4	6	8	10
	F2. Existing plant material	Ratio of plant diversity per unit area (x0.0001 m2)[2]	10	6	4	2	0
	F3. Distribution of urban furniture	The number of lighting, sitting places, informative panel, efficiency of stops	10	8	4	2	0
	F4. Lighting elements	The number of lighting elements per unit area (x0.0001m2)[2]	10	6	4	2	0
G. Identity	G1. Dominant monumental works	The number of dominant works per unit area (x0.00001 m2)[2]	10	6	4	2	0
	G2. Usages with historical backgrounds	Rate of originality (%): Level of harmony with the pattern in the past	10	6	4	2	0
	G3. Basic components giving character	The number of basic components giving character per unit area (x0.00001 m2)[2]	10	6	4	2	0

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Findings and Discussion

Considering the characteristics of each urban square based on the indices, we obtained the highest value for Ayvansaray Gate in HCI, Belgradkapı in diversity index, Edirnekapı-Mihrimah Sultan Mosque in accessibility index, Topkapı and Edirnekapı-Mihrimah Sultan Mosque in vitality index, Topkapı in spatial quality index and again Topkapı in urban square potential index (Table 2).

Table 2. Calculated values of the indicators (Terzi et al., 2017)(Terzi et al., 2016)

	INDICATORS	CALCULATED VALUES				
A. Accessibility	A1. Distance to public transport stops	2	1	0.5	0.25	0
	A2. Pedestrian counts	15000	10000	5000	1000	500
	A3. Vehicle counts	20000	10000	5000	1000	500
	A4. Intense pedestrian movement axis	5	4	3	2	1
	A5.1. Global Integration	0.44- 0.40	0.39- 0.35	0.34- 0.29	0.28- 0.24	0.23- 0.17
	A5.2. Local Integration	1.75- 1.22	1.21- 1.12	1.11- 1.02	1.01- 0.88	0.87- 0.33
	A6. Entrances and exits of squares	15	10	5	1	0
B. Size	B1. Area	30	20	10	8	3
	B2. Size of the pedestrian area	2	1	0.8	0.4	0.2
	B3. Size of the convex area	80000	40000	20000	10000	5000
	B4. Size of the visible area	30000	10000	4000	2000	<2000
C. Characteristics of the building	C1.1. Building usage types	40	20	15	10	5
	C1.2. Building usage types	50	30	15	5	0
	C1.3. Building usage types	70	50	30	20	10
	C1.4. Building usage types	15	10	8	5	1
	C2. Registered civil architecture works	40	20	10	5	0
	C3. Registered monumental architecture works	150	50	10	5	0
	C4.1. Pattern of property	250	100	50	20	10
	C4.2. Pattern of property	170	100	50	30	5
	C5.1. Distribution of public facilities	10	8	5	1	0
	C5.2. Distribution of public facilities	120	50	20	5	0
	C6. Restoration condition of the historical buildings	100	60	30	15	0
D. Density	D1. Pedestrian density	180	100	20	5	0
	D2. Vehicle density	40	20	10	5	1
	D3. Main usage aim of the square	4	3	2	1	0
E.Morphology	E1. Enclosure /3D Enclosure ratio	<1/5	1/5	1/3	3/7	>1/1
	E2. Geometry Singular/Plural/Amorphous Square	>10	10	5	3	2
	E3. Ratio of interaction with the surface of square	40	30	20	10	5
F.Landscape	F1. Topography	15+%	15%	10%	8%	5%
	F2. Existing plant material	6	4	2	1	0
	F3. Distribution of urban furniture	5	4	2	1	
	F4. Lighting elements	20	10	5	2	0
G. Identity	G1. Dominant monumental works	20	15	10	5	0
	G2. Usages with historical backgrounds	100	75	50	25	0
	G3. Basic components giving character	20	15	10	5	0

Table 3. Distribution of index values over sample areas (Terzi et al., 2017)(Terzi et al., 2016)

Name	HCI	Diversity	Accessibility	Vitality	Spatial Quality	Potential
Ayvansaray Gate	70	42	33	31	47	44
Eğrikapı	63	57	47	40	36	46
Topkapı	53	47	62	57	64	57
Belgradkapı	47	60	40	43	58	53
Yedikule Gate	37	55	40	43	56	51
Altınkapı	37	55	27	37	40	42
Mevlanakapı	37	53	44	51	42	46
Edirnekapı-Mihrimah Mosque	37	47	62	57	58	53
Silivrikapı	37	38	49	43	45	44
Third Military Gate	37	38	31	34	44	39
Fourth Military Gate	33	35	31	26	45	38
Sulukule Gate	10	27	38	34	55	38

In the scope of this study, 12 different urban squares located at the Historical Peninsula preserving the historical background of

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Istanbul are examined according to certain indexes that reveal the spatial, social and physical characteristics of urban squares. As a result of this evaluation, the outstanding and inadequate aspects of the urban squares were determined based on the indicis (Figure 3).

In HCI index, it is observed that the average value of the urban squares included in the study is 41.7. The Ayvansaray Gate has the highest value, which is 70, among all these urban squares while Sulukule Gate has the lowest. The fact that only 3 of the urban squares examined are above the average gives important references on the historical characters of the urban squares and it should be taken into consideration in the strategies to be developed for these areas. At this point, it is important to develop strategies for the protection and development of the historical environment for these urban squares.

Diversity index of that urban squares have values relatively close to each other and the average value of the urban squares examined for this index is 46.1. When the locations of the urban squares are examined, it is significant that the urban squares with values above the average are not gathered in a specific area but spread along the walls. This also indicates that the district where the urban squares are located has a homogenous character in terms of urban usages. As in the HCI index, the Sulukule Gate has the lowest value under this index while Belgradkapı has the highest which is 60. Moreover, approximately 60% of the urban squares - 7 urban squares- examined in this study are above the average in this index and have the highest percentage among all indexes.

The accessibility index, which examines the level of accessibility of the urban squares in different extends, is another important index in the analysis of urban squares. While the average value of the urban squares included in the study is 42 in accessibility analysis, Topkapı and Edirnekapı have the highest score with 62 among these urban squares. When the indicators included in the index are examined, it is quite clear that the urban squares which have higher score than average value have easy access to urban usages and have a very lively and vivid urban life. In the seven urban squares below the average, on the other hand, making improvements according to the indicators of the accessibility index are very important in terms of developing the dynamics of use of these urban squares in a future-oriented context.

The vitality index, which has the lowest average value of 41.3 among all indexes, demonstrates the extent to which pedestrian

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urban squares can be experienced by the pedestrians. In this context, Topkapı and Edirnekapı again have the highest score in this index as in the accessibility index. In addition, Belgradkapı, Yedikule Gate, Altınkapı, Mevlanakapı, Edirnekapı-Mihrimah Mosque and Silivrikapı stand out with their above average scores. The examination of the urban squares in line with the evaluation criteria of the vitality index, which directly demonstrates the dynamics of pedestrian use, the elimination of the physical deficiencies within this scope and taking the planning-design decisions in this context are very important both for the residents of the urban square as well as for the socio-spatial development of the area.

The spatial quality index, on the other hand, has the highest average score with 49.2 among all indexes. In this index, it is seen that 60% of the urban squares with a score above the average value are located in the northern part of the area. Topkapı has the highest score also in this index with 64, while Eğrikapı has the lowest score which is 36. This index, which provides the chance to examine the physical characteristics of the urban squares in depth, is also very important in terms of developing new strategies for urban squares. Thus, while creating future scenarios for urban squares, the results of spatial quality index should be used effectively in every stages and considered as a guide in the decision-making processes.

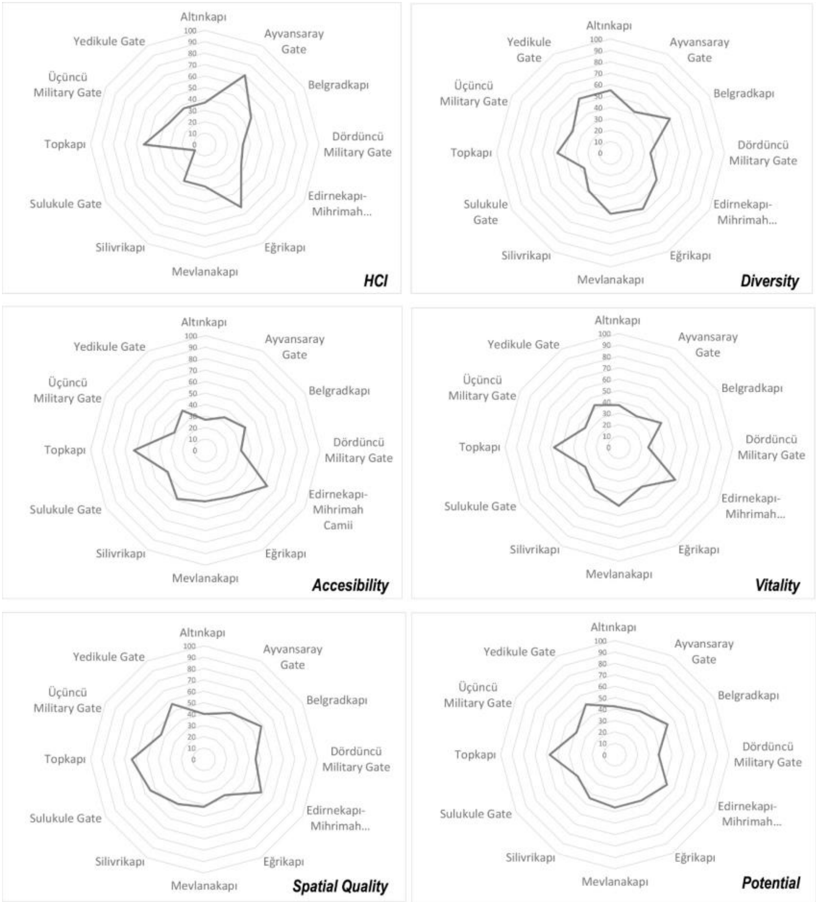

Figure 3. Index values of the Gates of the City Wall

Considering the indicators of the assessment indexes herein and their effects on the urban squares, it is concluded that there are indexes yet to be developed. In this regard, it is required to decide primary intervention scenarios based on the performance scores of 12 urban squares examined in terms of different scales for planning and design. For determination of the interventions which will differentiate according to the index to be developed and shift from urban scale to urban square scale, the indexes should firstly be examined thoroughly. At this point, the accessibility index stands as the one including different components in both urban scale and urban square scale, and directly affecting the dynamics of use of the urban square. Including assessment criteria which reveal urban relation of the area such as distance to public transport stations in addition to the indicators directly analyzing the situation in urban square scale such as pedestrian counting and the number of urban square entrances, the accessibility index has the second lowest score which is 42. Therefore, accessibility index is the one to require first action in order to render the urban squares under the study more accessible, enable them to be experienced more and constitute a reference for the field-related design studies. On the other hand, HCI index, spatial quality index, vitality index and diversity index mostly function on urban square scale and

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demonstrate physical, social, historical and cultural character of the urban square. Having a large coverage ranging from urban furniture in the urban squares to landscape, pedestrian movements, density and types of urban usages, these indexes both contribute to use and development of existing potential of the urban square and promote establishment and improvement of the failing aspects of the urban squares. Vitality index which has the lowest average score among the indexes above needs to be developed through the studies in parallel with accessibility. Moreover, even though spatial quality index has the highest value with the score of 49.2, it remains below the average in the general assessment criteria (out of 100). Therefore, it is essential to define a comprehensive process for the relevant urban squares and describe a systematic and operational framework divided into short, medium and long-term stages. In this context, it is required to develop this process over the scores of the indexes and the scales affected by the indexes. The fact that this method can analyze very broadly the hybrid characters of the urban squares and thus enable determination of the current problems through detailed analysis paves the way for effective use of this method. Involvement of the institutions in charge of the detected problems in the staging process above and thus creation of a coherent and effective process would contribute to transformation of the method into a strategic planning tool. Through the operational base it presents, this method provides a coordinated working environment between different institutions, generates concrete inputs for planning and design process and also has the potential to form the basic reference point of the future strategies for development of urban squares.

CONCLUSION

Istanbul, which has hosted many civilizations in the past, has very valuable structures and squares surrounded by these buildings in terms of architecture and art history. When it is evaluated in terms of urban image, functionality and socio-cultural characteristics, an extremely rigorous, sensitive and holistic approach should be developed in all kinds of improvement, design and development works for these squares. The fact that these unique cultural heritage values owned by Istanbul can be brought to the city with appropriate application tools (design, restoration, rehabilitation, revitalization, management, organization, etc.) and meticulously carried out, is extremely important and necessary in order to maximize the potential value.

The proposed quantitative assessment method provides a measure of the urban square in terms of the historical-cultural heritage richness and identity, diversity, accessibility, vitality and spatial quality. In addition, it evaluates all squares as a whole and reveals the potential of public open space. With this method, the strengths and weaknesses of each urban square can be revealed in the context of the above themes. Thus, it is possible to determine what kind of planning and design strategies are needed to maximize the potential of a urban square.

It is expected that the proposed method will contribute to planning and design practices and academic studies as:

- Proposing a decision support system to city managers,
- Providing an opportunity to use as a guide for the most appropriate and efficient solution alternatives within the framework of limited budget, time, labor and equipment factors during the implementation phase (city square design, rehabilitation etc.), and
- Demonstrating a way of combination of many qualitative and quantitative indicators (35 indicators) that are effective in the design of an urban square.

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Resume

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Research Article

Determination of Urban Sprawl Effects on Farmlands Value Using GIS

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Özer Karakayacı**

Abstract

This paper presents to determine urban sprawl boundaries and the factors of affecting farmland value in urban sprawl. Urban sprawl index is calculated to identify its boundaries and Analytic Hierarchic Process Method is used for determined to weight for the factors. By using these weights in the Geographic Information System (GIS) technology, the value map is created. We illustrate that the farmlands in urban sprawls lost their properties and transformed into urban lands. The analyses revealed that farm criteria have no effect on the lands in urban sprawl. Both urban and rural solutions should be improved in order to prevent the abuse of fertile farmlands that occurred as a result of urban sprawl.

Keywords: *Farmland, urban sprawl, AHP, GIS*

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INTRODUCTION

In all the sectors that form the basis of economy, the most important capital required to carry out the activities is land, but its way of usage, quality and description differ according to sectors. The land which is also an important means of investment is described as farmland in rural areas and named as plot by taking another dimension in urban areas. On the other hand, with the effect of population increase, technological developments, change in customer demands and change in supply accordingly, socio-economic factors, development policies and many other factors; a hinterland has emerged which has characteristics different from the term farmland and plot between urban and rural area and it was defined as urban sprawl.

Showing differences of the concrete variables that determine to the hinterland in the context of the physical conditions of the region and the space usage habits leads tospecific difficulties in definition of urban sprawl (Angel, Parent, & Civco, 2007). Although there are specific differences in the definition of term (Bhatta, 2010), there is an agreement that it displays an unplanned and disorganized growth characteristics and resources are used inefficiently (Bhatta, 2010; Hasse & Lathrop, 2003; Pucher, Peng, Mittal, Zhu, & Korattyswaroopam, 2007). Although there are various studies on urban sprawl, most of these studies assess urban sprawl in the sense of urban area. Moreover, there are different views on whether urban sprawl is the reason or result of land utilization, whether it is the development process of land or a model of land utilization (Galster et al., 2001). These debates have led to the need of study about urban sprawl especially in the last thirty years.

The lands of urban sprawl which are defined as lands that have lost their rural characteristics and yet cannot be defined as urban include specific uncertainties results in various problems such as unplanned urban growth and use of non-agricultural purpose. This problematic is admitted as the main reason for the uncertainty of the real estate valuation in the urban sprawl.

Methods of assessment differ according to the characteristics of premises (Ventalo & Williams, 2001), ambiguities in the term of urban sprawl are effective in assessment activities. As a result of this, value differences occur in the process of transformation of farmland in urban sprawls which are under the pressure of urban growth into lands by losing their agricultural characteristic. The reason of this difference is that every assessment has different qualities and is influenced by different factors. In this context, there are important ambiguities about which factors affect the valuation of the land and which method should be used to valuate it that has lost their agricultural characteristics on urban sprawls and has not gained the characteristics of urban land.

The main objective of this study is to provide the solutions to this uncertainty about the valuation and the concept of urban sprawl. In this context, it was aimed to determine the boundaries of the

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urban sprawl in the study area, to identify the factors affecting the value of urban sprawl and to appraise the value of urban sprawl by using these factors.

LAND USE CHANGE AND URBAN SPRAWL

Practices of public policies which support industrial and business development close to highway depending on dwelling policies revealed sprawl which is a new phenomenon of urbanization (Polidoro, de Lollo, & Barros, 2011). Urbanized areas which have sprawled towards outskirts rapidly with the aim of dwelling, industry and trade in USA towards the end of 1950's resulted in occupation of forests. This uncontrolled urbanization model was called urban sprawl (Bhatta, 2010). These areas can be deprived of infrastructure services, basic facilities such as health, education (Sudhira & Ramachandra, 2007). After 1960's urban growth and urban sprawl are regarded as an important problem in many cities throughout the world and especially in metropolitan cities (Mills, 2003; Zhao, 2011).

Increase of demand for settlement area with the increase of population density in city center requires expansion beyond city boundaries in the sense of settlement (Cavailhès & Wavresky, 2003). Expansion of urban areas caused decrease of first-class farmlands around various big cities (Livanis, Moss, Breneman, & Nehring, 2006). Increasing the demand of farmlands for urban use has caused over time increasing the value of farmlands especially in areas of rapid urban growth (Coisnon, Oueslati, & Salanié, 2014a; Livanis et al., 2006).

As the non-agricultural use of farmlands increase, it is observed that producers accept conversion of farmland on the grounds that opportunity cost is higher and they give up agricultural production (Adrian & Cannon, 1992). Rent obtained in urban area being higher and risk being less than agricultural income is regarded as one of the reasons of expansion of cities towards farmland (Doğru, 2002). In spite of this, it is legally compulsory to protect farmland and use according to natural characteristics according to Law No. 5403 on Soil Preservation and Land Utilization in Turkey. However in Turkey, non-agricultural use of farmland through conversion of farmland into plots by making it zoned for housing within the scope of urban development is regarded as one of the most important problems. Within this scope, approaches about assessment of urban sprawl which are regarded as a process before misuse of farmlands is an issue which requires discussion in the sense of controlled development of this process.

(Oueslati, Alvanides, & Garrod, 2015) emphasized the importance of agricultural productivity along the expansion boundaries of urban areas. As a result of analyses, coefficient of agricultural rent was found to be quite high contrary to previous studies. This case can be interpreted as that agricultural productivity is a real hindrance for urban sprawl in Europe. It is stated that agriculture is quite intensive on the city boundaries of Europe and there is high yield-profit relation. On the contrary to this situation, regardless of the efficiency of agriculture in Turkey, since urban rent is higher than agricultural rent fertile farmlands are opened to misuse such as urban sprawl.

METHODOLOGY

Study Area

This study was carried out in Konya province located in the Middle Anatolian Region of Turkey. The area of the city is the largest city of Turkey is 38.250 km^2. Rural area constitutes an important part of the provincial area. The population of the province is 2.079.225 with an annual 13% growth rate where 76% population lives in urban area (Turkstat, 2014). Urban population in Konya is growing rapidly because of the migration from rural area to urban area.

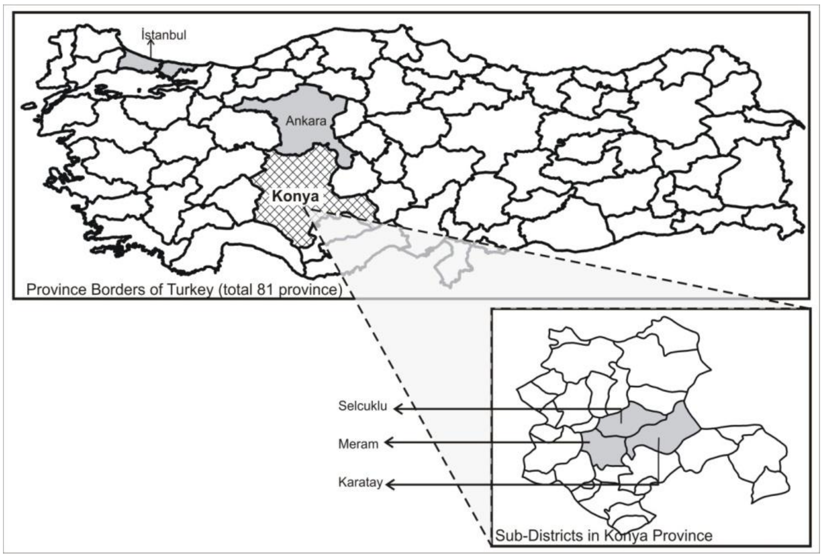

Figure 1. The location of study area within Turkey and Konya province

Konya consists of three sub-districts: Selcuklu, Meram and Karatay. These sub-districts divided into 264 quarters: 76 in Selcuklu, 103 in Meram, 85 quarters in Karatay. These quarters are spatial scale/units for this study. The impact of urbanization pressure on the farmland in the spatial units is one of the most important causes of urban sprawl.In Figure 2, the evaluations covering 9 different regions within Konya urban land not only demonstrate the pressure of urbanization on farmlands but also provide hints about the spatial, social and economic structure of the research region.

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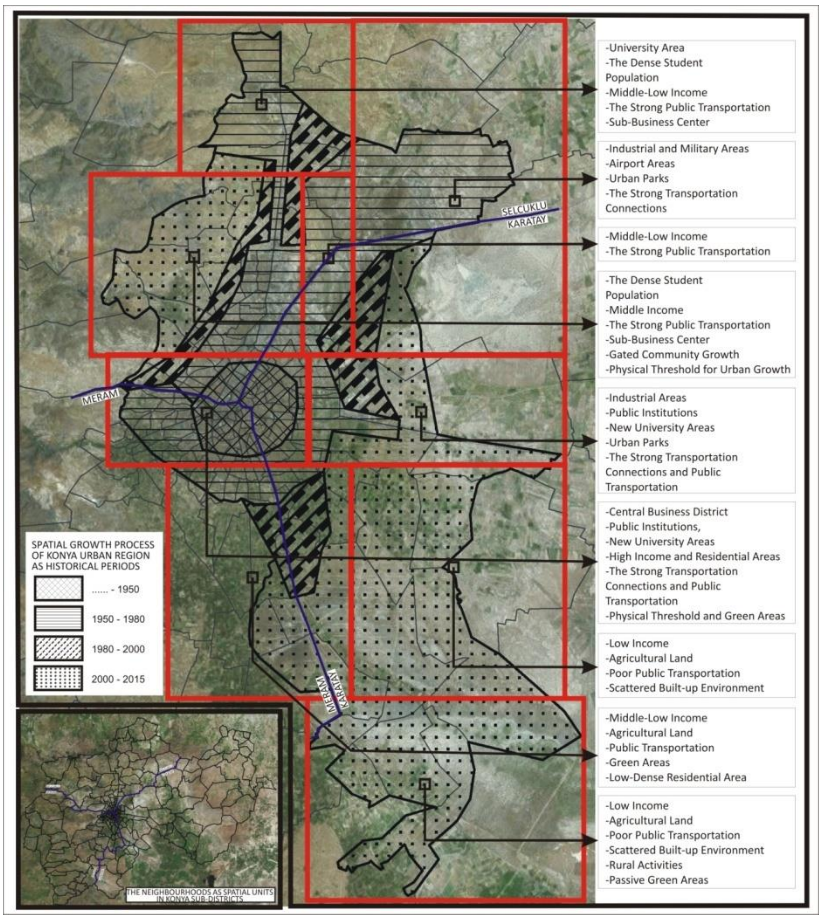

Figure 2. Spatial growth process of Konya Urban Region and its socio-spatial characteristics

Hypotheses

This research has been built upon three key hypotheses: identifying sprawl areas in urban lands, factors effective on the land/area value in sprawl areas and the impacts of such factors on land/area value.

Within this framework the primary problem is detecting sprawl areas to utilize as research area. In studies aimed to detect sprawl areas, there is a tendency to identify sprawl areas via using weights obtained through employing various mathematical and statistical methods for measuring sprawls (Reid Ewing, Pendall, & Chen, 2002; Hasse & Lathrop, 2003; Terzi, 2010). Nonetheless the key problem here is not detecting sprawl areas via statistical and mathematical methods, but rather identifying the components showing the sprawl. Within this framework, in relevant literature there are vital discussions related to the types of components towards detecting sprawl areas. These discussions underline that sprawl areas cannot only be defined with respect to density criteria but accessibility, proximity, ambiguity of economic activities, lack of a definite urban/rural character and similar uncertainties in the types of land use were the basic elements (P. Torrens, 2008; Wu, 2006). Within this framework the foremost priority of current research is, in line with such discussions, testing the hypothesis towards detecting sprawl areas in Konya urban area.

Hypothesis 1. In addition to being low-density regions, sprawl areas are also characterized as the undefined lands with limited accessibility, away from urban and rural centers and lacking a diversification of land-use types.

There are various studies related to detecting the prices of land/area in sprawl areas; however nominal valuation method puts forth the potentials of land/area with respect to the factors affecting the value. Particularly towards the aim of defining spatial qualities of quarters, the application of GIS method facilitated the practicability of nominal valuation method in spatial scale. For instance, in terms of land use in urban sprawls, (R. Ready & Abdalla, 2003), by employing GIS technology and hedonic price model, measured the impacts of spatial amenities and land use in the assessment of lands used as residential areas. Nominal value maps that shall be created by detecting via GIS analyses the potentials of spatial units are beyond an approach based on mathematical analyses but focused on the characteristic structure of the region. Therefore, the second hypothesis of this research has been identified within this framework.

Hypothesis 2. Although Nominal value explains the factors effective on the land/area values, the characteristic structure of the region is even more determinant in the identification of the weights of these factors.

As demonstrated in relevant literature, the indefinite spatial and functional structure of sprawl areas is the main causes of the factors impacting land/area value. The facts that these areas are exposed to pressures from both rural activities and urban activities, unproductive use of lands (Bhatta, 2010; Pucher et al., 2007), loss of green lands, deterioration in habitats, weakening of accessibility and similar negative urban problems and it also shows that within the scope of economical and spatial needs they may work as reservation lands for rural and urban areas. Therefore the correct identification of the factors impacting the value of sprawl areas in each region may demonstrate by what type of land use sprawl areas are pressured. To put this differently, the factors impacting land/area value in sprawl areas are concurrently the features prioritized in the urban-rural use of sprawl areas. Within this framework, the last hypothesis has been built upon sprawl areas and spatial and functional features of the factors affecting land/area value.

Hypothesis 3. Sprawl areas can not only stand as farm-activity focused regions with relation to the spatial and relational features of the region but they may also be reserve areas for urban

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expansion. Therefore the factors that leave an effect on the land/area value in sprawls are concurrently the factors providing hints on the spatial and relational use of sprawl region.

Variables and Data Collection Procedures

In current research, data collection procedure was implemented on the basis of two key stages. In the first stage, for the aim of defining spatial units that would constitute the scope of research, the variables to identify urban sprawl in Konya urban area were procured. In the second stage data related to the factors affecting land/area value were collected. Collected data were compiled on the scale of quarter, which is recognized as the smallest local administrative units in Turkey.

Variables to determine sprawl areas

In determining variables related to determining sprawl areas, theoretical arguments have been the determinants. Accordingly, in theoretical arguments in the definition of sprawl areas the most frequently employed factor appears to be 'density' (R Ewing & Hamidi; Galster et al., 2001; Hasse & Lathrop, 2003; Jiang, Liu, Yuan, & Zhang, 2007). In relevant studies it has been emphasized that low-density lands demonstrate sprawl properties (Reid Ewing et al., 2002; Galster et al., 2001). Indeed, urban sprawls are low-density formations created in urban peripheries. Likewise in order to measure sprawling (P. Torrens, 2008) evaluated the proximity factor to city center and education units and underlined the gravity of accessibility in terms of sprawl criteria. Additionally, the emergence of sprawl as a result of the market developed toward the use of lands stuck between urban and farm use may also related to people's preference for living in spacious houses, amenities like shopping centers and proximity to similar facilities (Wu, 2006). Within this context life quality is linked to the preference for high locations, the amenities and conveniences provided by the city. (Wu, 2006) in his study emphasized the significance of amenities in urban development models and reported that amenities play critical role in the selection of residential areas. The solidness of buildings' physical structures and number of floors, avoiding solid-fuel use to protect the environment and proximity to recreational lands are just a few of the amenities that play determinant role in the life quality of any city, thus these factors are also likely to play role in the detection of sprawl areas. Regardingly, the existence of suitable lands encompassing several amenities for land/area stock and enabling new structuring can also emerge as an acceptable factor in the definition of sprawl areas. Within this framework in order to measure the effect of urban sprawl on fragile natural resources

(Hasse & Lathrop, 2003) focused on the benefits of structured lands.

Determining the Factors Effective on the Value of Urban Sprawl

Physical factors like soil fertility, shape of land, land use, great soil group, land use capability class, elevation, aspect and crop rotation system have been taken into consideration to distinguish the transformed lands in urban fringes from farmlands because these factors are the criteria directly affecting the value of farmlands (Awasthi, 2009; Bellver & Mellado, 2005; Karakayacı, 2018).

Distance to city center, rural center, highway and public lands were taken into evaluation since they are the kind of factors significantly affecting both farmlands as well land value. (Cavailhès & Wavresky, 2003) reported that the relation between the value of farmlands in city peripheries and the distance to city center bears importance in terms of farm use as well as residential use. The writers also emphasized that the tendency to live in city peripheries for the sake of natural panorama, better life quality and physical surrounding and lower population triggered a rise for the demands toward sprawl areas. Besides, infrastructure amenities, structural density, presence of recreational lands and less commuting time are the top factors distinguishing areas and urban fringes from farmlands. Although the effect of environmental pollution differs for farmlands and areas, it is still a pivotal factor for both.

As frequently mentioned in relevant literature the most visible quality of urban sprawl is low-density population which inevitably leaves an effect on the land value. Demographic structure and income level of population bear critical importance in the demand for urban sprawl lands. In a number of researches conducted in Sofia by (Hirt, 2007; Slaev & Nikiforov, 2013) it has been reported that in urban sprawl the income and education level of the population is higher. In contrast to this finding, in Konya urban sprawl constituting the scope of present study, the population living in sprawl areas has lower income level compared to the population in city center as manifested by compiled data. In order to demonstrate the causes of this divergence, factors such as demographic and cultural structure of the population and household income level have also been assessed.

Since urban sprawl cannot possibly make use of all the amenities of the city life, the presence of service units such as education and health as well the availability of residential zones has been considered as factors affecting the value of land. In addition, one of the reasons why people prefer to live in urban sprawl is that

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they favor to move away from stressful city life and live in a peaceful setting (Churchman, 1999), hence crime factor is another criterion that was considered.

In urban sprawl one of the most effective reasons causing the transformation of the lands from farm use to urban use is that the rent to receive from land use is higher than farm use (Adrian & Cannon, 1992; Doğru, 2002), hence urban and farm income factors are other criteria that were taken into consideration. While tax applies to areas (residential), farmlands are exempt from property tax. Since it is an important factor distinguishing the residential area and farmland, it was also taken into account.

Since in farmlands there are different relations such as sharecropping and tenancy, the status of ownership bears utmost significance in order for the farmland to be sold. Considering that in urban sprawl constituting the scope of present research similar conditions might arise, the factor related to ownership status has been taken into consideration. In addition, since in farmlands it is likely to see pastures, forestry, conservation area etc. legal limits have been considered as another factor. Zoning status is vitally important in detecting urban sprawl and setting forth farmland-residential area distinction. In order for any farmland to receive the status of residential area it requires a completed construction plan which significantly boosts the value of any land. Hence zoning status factor bears great share in the assessment of data provided in current research. In the light of all the assessments listed above, 21 variables were detected to identify sprawl areas in Konya research land and the factors affecting land/area values in urban fringes have been analyzed with respect to five criteria as physical, social, economic, environmental and legal. Since urban sprawl possess neither farmland nor urban land quality, in the detection of such factors, the kind of factors affecting the value of both farmlands and urban lands have been accepted as determinants. In this direction, the variables, the types and qualities of variables and the methods to collect these variables are as demonstrated in Table 1 and 2.

Table 1. The variables using for determining of urban sprawl by quarter

Variables	The type of data	Data	Sources
Population Density	Person per hectare	Quarter population / Quarter size	Database of the Municipality of Konya
Accessibility Time	Minute	Time of arrival averagely to Centre of quarter from centre of urban by public transport	Observation and Assocation of Public Transport
Proximity to Centre of City	kilometer	Distance crow flies to Centre of quarter from centre of urban	Map
Accessibility to Education Area	Dummy	The walking of distance is maximum 500 meter for primary school	Database of the Municipality of Konya
Physical Quality Analysis of Buildings	Number	Building with wreck Building with structural deterioration Building with high of structural quality	Database of the Municipality of Konya
The using status of building	Per cent	The used buildings/total buildings	Database of the Municipality of Konya
Residential housing	Number	Buildings used for accommodation	Database of the Municipality of Konya
Building with natural gas	Per cent	Building with natural gas for energy needs/ total buildings	Database of the Municipality of Konya
Building with solid fuel	Per cent	Building with solid fuel for energy needs/ total buildings	Database of the Municipality of Konya
Analysis for height of buildings	Per cent	Building with low-floor/ total buildings Building with middle-floor/ total buildings Building with high-floor/ total buildings	Database of the Municipality of Konya
Analysis of green areas	Per cent	Size of green and play areas/total size of quarter	Database of the Municipality of Konya
Commercial building	Number	Building used for trading	Database of the Municipality of Konya
Manufacturing building	Number	Building used for industrial activities	Database of the Municipality of Konya
Number of Households	Number	Population in the quarter/total building in the quarter	Database of the Municipality of Konya
Density of construction	Number	Number of legal actual construction within last year	Database of the Municipality of Konya
		Number of non-legal actual construction within last year	Database of the Municipality of Konya
Total building	Number	Building used for various activities in the quarter	Database of the Municipality of Konya

Table 2. The factors affecting value of urban sprawl

Physical Factors	Environmental Factors
Soil Fertility	Proximity to Rural Settlement
Shape of Land	Proximity to City Center
Land Use	Distance from Highway
Great Soil Group	Structure Density
Land Use Capability Class	Distance from Various Public Spaces
Elevation	Recreational Area
Aspect	Infrastructure
Erosion Degree	Commuting Time
Crop Rotation System	Environmental Pollution
Social Factors	**Economic Factors**
Population Density	Agricultural Rent
Demographic Structure of Population	Urban Rent
Residential Space	Tax
Per Capita Education Unit	Household Income Status
Per Capita Health Unit	**Legal Factors**
Crime Rate	Ownership Status
Cultural Community	Reconstruction
	Legal Restrict

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Methods and Analysis of Data

The method process designated to test the hypotheses specified within the scope of research objective and to obtain research outcomes has been actualized in four main stages. Besides this method process offers a more systematic perspective that makes research findings and outcomes more comprehensible and detectable.

Accordingly, the key driving point has been detecting the urban sprawl in research area. In relevant literature the approaches towards detecting sprawl areas are mostly based on two main variables as population or construction density, but this approach fails to provide sufficient data on correct detection of sprawl lands. Driven from this perspective, as demonstrated in Table 1, next to density variable, 21 different variables have been used to detect sprawl areas. To the aim of making different variables more detectable and identify sprawl index, factor analysis has been conducted. According to the values obtained via summing up factor weights received for each single quarter, spatial units are categorized as areas with dense urbanization, urbanization, sprawls and areas bearing rural character. In that way in Konya region sprawl areas on quarter scale were detected. Thus, spatial units necessary for research area were defined and also Hypothesis 1 detected in relation to sprawl areas was tested.

In the second stage; factors affecting urban sprawl were designated. As listed in Table 2, these factors were detected within the main headings as physical factors, environmental factors, social factors, economical factors, legal factors. As mentioned in the literature, since the factors which have effect on the value of real estate do not have the effect at the same rate, weight coefficient should be determined for each factor. Mathematical and statistical methods can be used in order to measure factors' degree of effect on real estate. Weight coefficients are determined for each factor and mathematical or statistical models can be formed in this way. AHP method was used in weight determination stage for factors which affect the value.

To sum up via AHP method the weights of each factor have been detected within rural land, sprawl land and urban land. Since the research is based particularly on sprawl lands, AHP weight indexes specific to sprawl land were accounted. It was seen that 10 factors of which weight indexes are above 4% rendered greater effects on land/area value. Thus, variables of which effect on the value is below 4% were excluded from statistical analysis process. Within this framework, during the processes of nominal value map and statistical analyses, factors such as LUCC, proximity to city center, environmental pollution, household income level, education unit, urban rent, number of houses, zoning status, health unit, and infrastructure were manipulated as variables.

In order to obtain nominal value map detected within the scope of variables identified at the end of AHP method, scoring was conducted on the basis of the qualities of each quarter unit. This was the third stage of method process. In the process of obtaining nominal value map, spatial analysis menu of ArcGIS 9.1 package program was used. Following this stage, weights obtained in AHP analysis and values on nominal value were entered into ArcGIS database and a nominal value map was created on the basis of below-given formulation.

$$\mathrm{NV} = \sum_{1}^{i}(ifactor_s * ifactor_w) \qquad \text{(Formula 1)}$$

n(nv); nominal value index for n quarter, ifactor$_s$; scoring of i variable for n quarter, ifactor$_w$; weight value of i variable for n quarter

Consequently, via nominal valuation method average nominal values for each quarter in research area were detected. In this method, via functionalizing the factors effective on value, obtained coefficients can be exchanged into current value at any time. Thanks to value maps created with these coefficients, the values are safeguarded against any potential regional or national economic changes.

RESULTS AND DISCUSSION

Sprawl Areas in Konya Urban Region

Since the dimensions of urban sprawl differ from place to place, it is not possible to generate generalizable criteria to measure the degree of urban sprawl (Estiri, 2012). It is not easy to set a threshold in order to determine whether there is a sprawl or not certainly. Researchers generally determine this threshold according to their own assumptions (Bhatta, 2012). As stated in methodology section, in the detection of urban sprawl within the scope of current research the objective is to designate sprawl areas specific to 21 variables such as density, accessibility, proximity and land-use density and to test Hypothesis 1.

Urban sprawls are the areas stuck between rural land and urban land and their borders are not neatly specified. Therefore, in Konya city constituting the scope of this research, data were collected specific to 21 variables detected on the basis of quarter scale which is the smallest administrative unit. However, since analyses to conduct via 21 variables would give methodological errors, factor analysis was made to obtain smaller numbers of factors to represent the relations among these variables in the highest possible level and number ofvariables was reduced to 4 factors.

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According to the result of the analysis, total variance percentage of the 4 factors obtained was measured as 63.34%. Four factors were renamed on the basis of the qualities of variables. Hence since factor 1 included physical variables such as density, accessibility and structure quality it was named as density and accessibility factor (F1). Since Factor 2 mostly demonstrated urban amenities and quality it was defined under the heading urban amenities (F2). Socio-economic factors such as commercial and industrial buildings, number of household were defined as Factor 3 (F3) and lastly factor 4 (F4) in which variables related to the speed of structuring were grouped is defined under the general heading structuring mobility.

In theoretical part, driven from the arguments on sprawl areas, instead of rise sprawl in variables such as density-accessibility and urban amenities urbanization tendency; household, industrial structures and increase in structuring speed are, rather than urbanization, demonstrated sprawl tendency, hence in Konya research area, sprawl index in quarter scale has been calculated as below.

$$USI_n = (F3_n + F4_n) - (F1_n + F2_n) \qquad \text{(Formula 2)}$$

USI_n urban sprawl index for n quarter, $F1_n$ factor weight of factor 1 for n quarter, $F2_n$ factor weight of factor 2 for n quarter, $F3_n$ factor weight of factor 3 for n quarter, $F4_n$ factor weight of factor 4 for n quarter.

At the end of conducted calculations index values obtained for each single quarter have been classified. The key reason behind this classification is to present the sprawl occurred as a result of the transfer of development due to rapid urbanization toward urban peripheries and rural lands. At the end of this classification quarter settlements of which index value is between -0.49 and +0.49 were recognized as urban sprawl. As shown in Figure 3, at the end of these evaluations, while in Konya case 39 quarters demonstrated dense urbanization characteristics, 55 quarters demonstrated urbanization characteristics and 42 quarters demonstrated rural land characteristics, 76 quarters were in village status and 52 quarters were seen to have sprawl tendency. In the next stages, sample area of present research contained 52 quarters bearing sprawl characteristics.

Low-density housing is among the primary indicators of sprawl tendency (Reid Ewing & Hamidi, 2014). As also argued by (Churchman, 1999), driven from the hypothesis that high density settlements lead to sprawl, in current research population and housing densities in city center and urban peripheries were taken into account. (Churchman, 1999) claimed that in high-density cities people tend to complain about the crowd and congestion and that sprawl started a result of this tendency to move away from this density. Indeed, as seen in case study Konya, parallel to the population boom witnessed in due course, a corresponding rise in demand for housing led to congestion in city center and consequently urbanization shifted towards city periphery. Likewise, (Hasse & Lathrop, 2003) detected that density shifted from old city centers and rural lands to the new settlements. This deduction validates Hypothesis 1 specified within the scope of current study. That is because socio-economic factors and life styles are a few of the factors behind low-density areas.

In contrast to urban sprawls city centers are the areas in which economic and social activities are at their peak. Noting the fact that for employment and social activities people need to use city center, it is seen that proximity to city center is a vital factor in determining sprawl area, thus accessibility matters vitally in sprawls as also emphasized by (P. M. Torrens & Alberti, 2000). It is also known that since urban sprawls are away from city centers, they accelerate commuting time and costs. The rise in the distance toward city sprawls not only increases transportation costs but it also decreases the use of public transportation and increases the dependency on private vehicles (Song & Zenou, 2006).

Under the factor of constructing mobility the number of constructions built in the last year, number of unlicensed buildings and licensed buildings were counted. Since urban sprawls are the areas in which new constructions are intensely observed these criteria play critical role in the designation of urban sprawl borders. In particular, the frequency of unlicensed structures in the urban sprawls detected upon analysis verifies that the results of this analysis are valid. That is because urban sprawl may be the areas with no or limited infrastructure amenities and zoning plan has not yet been approved by concerned municipalities. Therefore, despite the absence of required licenses for construction the erection of new buildings is the most vital indicator of urban sprawling. Indeed, farmlands subjected to urban sprawling can gain land characteristics only after being considered as a zoning plan and benefit from urbanization amenities. In Greece-based study conducted by (Polyzos, Minetos, & Niavis, 2013) the size of urban sprawl is calculated via rationing the constructing taking place outside the approved city by the ratio of total constructing and this is also supportive of the thesis stated above. If the opposite is valid, since in sprawl areas new construction plans are prepared, it is possible that high-rise and high-quality buildings shall multiply in significant numbers.

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To sum up it has been concluded in this research that urban sprawling speeds up the transformation process occurred in land use. It is seen that in research area transformation from rural land to urban land takes place rapidly. Urban sprawl affects farmlands in terms of both quantity and fertility (Adrian & Cannon, 1992). In a research conducted by (Akseki & Meşhur, 2013) as a consequence of urban sprawl witnessed for the last 50 years in Konya, 12.607 hectare 1st class, 2.393 hectare 2nd class, 55 hectare 3rd class and 2.574 hectare 4th class farmland were opened to constructing. In present study it was detected that 85% of the land designated as urban sprawl were prime fertile lands for farming. Likewise, (Hasse & Lathrop, 2003) asserted that the loss of prime farmlands is, in contrast to non-prime farmlands, more vulnerable against urbanization. In line with his views (Delbecq, 2010) reported that sprawling is, on accounts of its low- density composition, the accelerated form of urban growth while on the other hand it is the destruction of farmlands. Figure 3 reveals that in Konya case urban sprawling expands towards the south. It is recognized that in southern Konya there are extremely fertile farmlands.

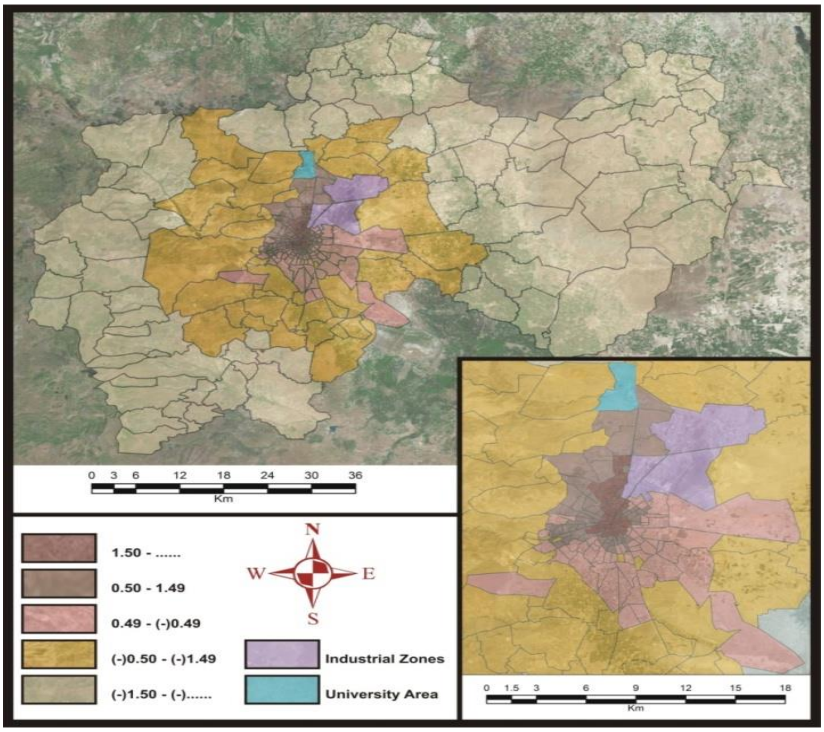

Figure 3. The characteristics of quarters in Konya according to Urban Sprawl Index

There are some reasons accounting for the transformation of these fertile farmlands into urban lands; in addition to the demands of people who felt sick of crowded cities and wanted to live city peripheries, population emigrated from villages to city center also favored to settle in areas closer to rural land can be recognized as the desire of rural population to benefit from the urban amenities while at the same time partially sustaining the land's farming activities. Using fertile farmlands to serve urban transformation stems from the failure in planning policies. (Slaev & Nikiforov, 2013) also emphasized this factor and classified the role and functioning of planning among the factors affecting urban sprawling.

In urban sprawl constituting the scope of present study it is observed that farming activities are still practiced, though limited. As a result of the lower land rates in city peripheries the existence of payable housing means (Burton, 2000; Terzi, 2010) can be the reason why low- income rural population selected to settle in city sprawls. Also, the potential rise in land values as a result of future urban transformation in places nearby city (Cavailhes & Thomas, 2011; Livanis et al., 2006) is another vital factor affecting the urban sprawling on fertile lands. It can even be argued that it is the most important factor in the assessment of urban sprawl phenomenon in terms of farming.

The Weights of the Factors Affecting Farmland/Urban Land Value in Sprawl Areas according to AHP Analysis

Urban sprawls are those between rural and urban land and whose boundaries were not determined exactly. There is no specific method is determination of the value of these areas, farmland and land valuation methods can be used. However, there are specific inconveniences in the use of these methods in the sense of land located in urban sprawl. Therefore, it is required to determine factors which affect the value correctly and detect valuation methods in areas at urban sprawl. For this aim, in the study factors affecting the value were weighted separately with AHP method in terms of farmland, urban sprawls and plot (table 3). Moreover, the structure of urban sprawl may differ according to the conditions of country or region. Therefore, general structure of Konya which is the study field was considered in weighting the factors.

Urban sprawls can be assessed as transition regions between farmland and plot (Thapa & Murayama, 2008). Furthermore, to separate the farmland value within agricultural and urban components may lead to wrong results due to the farmlands close to the city center more sensitive to urban sprawl components (Livanis et al., 2006). Therefore, it is important for the whole three lands to determine weights and compare them in order to detect factors which affect urban sprawls. In actual fact, as a result of the analysis, it is seen that urban sprawls are similar to both farmlands and plots.

According to specified weights, for farmlands, physical factors with a ratio of 35.89%, in city sprawls with a ratio of 36.13% and in areas with a ratio of 45.54% environmental factors are the most significant factors. With a ratio of 25.26% social factors, compared

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to other factors, play even greater role in urban sprawls. The population density in this group has importance due to the characteristics of urban sprawls but since housing area, the presence of educational and health units are the characteristics of being away from city center, these factors also carry value. Since farmlands are also production lands the factors in this group need not to be taken into account, but since in urban land these factors are already available, these factors do not carry as much value as the urban sprawls for the value of lands.

Although in Konya which is the study field, the effects of urbanization is observed depending on urban growth in urban sprawl, it is observed that agricultural production is done though partly because it is under the effect of urban land. Therefore, the structure of building which is like farmland and weight value of factors of land use capability capacity were higher in urban sprawls compared to plots. Another factor which makes land use capability factors important is that since land in I., II. and III class are convenient for agricultural production, it is wrong to misuse them for non-agricultural aims, it would be wrong for these areas to be located in urban sprawl and use them for urbanization aims.

It is observed that factor of distance to city center is important for all three types of estate. Since the lands has the characteristics of real estate, it was emphasized that they are important in the rate of 11,76%. For agricultural areas, urban proximity means proximity to market which was important in the rate of 4.99%. For urban sprawls factor of distance to city center has different meaning according to distance factor, farmland and plots. Since urban sprawls are the areas which is preferred by people who are fed up with the density of city (Churchman, 1999), factor of distance to city center is important.

It is seen that infrastructure factor has greater effect (7.54%) on the value of land located in urban sprawls compared to other real estate. The reason of this is that urban sprawls are in transformation process from rural land to urban land. Since urban sprawls are in the characteristics of rural land, it is required primarily in the process of urbanization though it is devoid of infrastructure opportunities.

To sum up; according to the results of AHP analysis 9 criteria that have over 4% effect on land/area value such as land use capability class, proximity to city centre, infrastructure, environmental pollution, residential space, education unit, health unit, urban rent, household income have been the kind of variables employed in the detection of nominal value index and statistical analyses.

Nominal Value for Farmland/Urban Land in Sprawl Areas

The foremost factor determining the value of any immovable property is its location (Din, Hoesli, & Bender, 2001). According to the complex nature of land use pattern in urban sprawl, spatial parameters should be used in order to make measurement (Noor & Rosni, 2013). The use of GIS in the spatial-parameters based analysis methods has recently become popular and as spatial parameters are also taken into consideration in the researches to detect land/area value it is seen that mostly GIS and hedonic price models are integrated (Livanis et al., 2006; R. C. Ready & Abdalla, 2005). In the study of (Thapa & Murayama, 2008) which was carried out by using integration of GIS and AHP techniques in order to determine suitable areas for agricultural production on city boundaries, they used spatial parameters such as land use, soil, water, road and market.

In the study which was carried out by (Sperandelli, Dupas, & Dias Pons, 2013), it is emphasized that rural land and urban land boundaries cannot be separated clearly, although it is possible to determine that housing is intensive and determine city boundaries with road network and buildings when observed with aerial image. In order to determine these boundaries, the land was divided into three as urban land blank land, green land and occupied land and change of these lands according to years were analyzed with the help of GIS analysis. In the study it was concluded that blank land has decreased considerably and one of the reasons of this is urban sprawl.

The analysis of the values of farmlands closer to city center is more sensitive to urban sprawl components. Due to this effect separation of farmland value within farm and urban components may lead to obtaining misleading results (Livanis et al., 2006). Therefore in the production of value maps, in the previous section among the factors of which coefficient was above 0.04 and obtained via AHP method to designate the factors affecting the value of lands in urban sprawl, total 8 factors (proximity to city center, infrastructure amenities, environmental pollution, housing number, demand for educational and health units, urban rent and household income status) were utilized.

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Table 3. The scoring variables affecting value for nominal value map

Variable		Score			Score
LUCC	I-IV. classlands	10	Education unit	No need	10
	V-VI. classlands	5		Medium	5
	VII-VIII. classlands	1		Need	1
Proximity to city center	1 - 2 km	10	Urban rent	+ - 131	10
	2.1 - 4 km	7		130 - 101	7
	4.1 - 6 km	5		100 - 71	5
	6.1 - 8 km	3		70 - 36	3
	8 - + km	1		35 - 0	1
Environmental pollution	0 - 3 number/ha	10	The number of houses	+ - 32 number /ha	10
	3.1 - 6 number /ha	7		31 - 24 number /ha	7
	6.1 – 9 number /ha	5		23 - 16 number /ha	5
	9.1 – 12 number /ha	3		15 - 7 number /ha	3
	12.1 - + number /ha	1		7 - 0 number /ha	1
Household income level	+ - 616$	10	Zoningstatus	Available	10
	615 - 541$	7		Not available	1
	540 - 461$	5	Health unit	Available	10
	460 - 386$	3		Not available	1
	385 - - $	1	Infrastructure	Available	10
				Not available	1

Also, it has been focused on farmlands which lost their farming properties in urban sprawl and faced out-of-purpose use, in addition to these 8 factors, land use capability class factor was also taken into account. For each factor, the scoring indicated in table 3 and the weights in table 4 procured as a result of AHP analysis were multiplied to obtain a nominal value which was calculated for any spatial unit/quarter in sprawl areas.

Table 4. The weight for urban land, farmland and urban sprawl by AHP

	FACTORS	Farmland	Urban Sprawl	Urban Land
Physical Factors	Soil Fertility (SF)	0.0833	0.0047	0.0043
	Shape of the Land (SL)	0.0338	0.0277	0.0166
	Land Use (LU)	0.0653	0.0392	0.0449
	Great Soil Group (GSG)	0.0174	0.0065	0.0052
	Land Use Capability Class (LUCC)	**0.0456**	0.0241	0.0098
	Elevation (E)	0.0142	0.0057	0.0149
	Aspect (A)	0.0282	0.0112	0.0347
	Erosion Degree (ED)	0.0205	0.0115	0.0063
	Crop Rotation System (CRS)	0.0506	0.0052	0.0058
Environmental factors	Proximity to Rural Settlement (PRS)	0.0527	0.0095	0.0154
	Proximity to City (PC)	0.0499	**0.0479**	0.1176
	Distance from Highway (DH)	0.0501	0.0186	0.0937
	Parcel Accessibility (PA)	0.0289	0.0390	0.0241
	Density Structure (DS)	0.0144	0.0243	0.0199
	Distance from Various Public Spaces (DPS)	0.0094	0.0366	0.0393
	Recreational Area (RA)	0.0072	0.0359	0.0389
	Infrastructure (I)	0.0275	**0.0750**	0.0423
	Commuting Time (CT)	0.0141	0.0291	0.0615
	Environ. Pollution (EP)	0.0625	**0.0454**	0.0181
Social factors	Population Density (PD)	0.0115	0.0266	0.0158
	Demographic Structure of Population (DSP)	0.0113	0.0213	0.0182
	Residential Space (RS)	0.0150	**0.0489**	0.0295
	Per Capita Education Unit (PE)	0.0066	**0.0468**	0.0241
	Per Capita Health Unit (PH)	0.0083	**0.0468**	0.0240
	Crime Rate (CR)	0.0053	0.0392	0.0399
	Cultural Community (CC)	0.0057	0.0230	0.0228
Economic factors	Agricultural Rent (AR)	0.0832	0.0056	0.0065
	Urban Rent (UR)	0.0088	**0.0659**	0.0893
	Tax (T)	0.0062	0.0174	0.0196
	Household Income Status (HIS)	0.0100	**0.0429**	0.0199
Legal factors	Ownership Status (OS)	0.0536	0.0233	0.0145
	Reconstruction (R)	0.0854	**0.0826**	0.0291
	Legal Restrict (Protected area, forest, pasture etc.) (LR)	0.0135	0.0190	0.0337

It is seen that the regions with the highest nominal value index (6th Region) are the quarters closest to city center. In areas approximate to city center, land value is higher and housing density is greater. These areas are more popular due to the low costs of commuting (Coisnon, Oueslati, & Salanié, 2014b) and closeness of city center to the amenities. In quarters with highest index value urban rent is also higher, education, health and similar social amenities are closer and housing density is stronger. The fact that these areas are open to construction or in other terms urban zoning is also effective in receiving higher index values. The greater number of amenities accelerates the risk of transforming the lands from farm use to urban use (Bastian, McLeod, Germino, Reiners, & Blasko, 2002). Within this context opening these 1st class farmlands for urban use indicates an out-of-purpose use and clearly reveals the gaps in land use policies. As also reported in the study of (Du, Shi, & Van Rompaey, 2013) this is indicative of the fact that due to the ineffective land use policies urban sprawling has gone out of control.

In value map some quarters located in the 5th region, despite their proximity to city center, bear nominal value indexes lower than the 6th region index, which might be related to the absence of

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health units and relative lowness of housing frequency and urban rent. In the 6th region where nominal value index is the highest, small industries exist which boosts not only the urban rent in this region but also the density of housing. People employed in industrial sector, due to high costs of commuting; prefer to settle in locations close to industrial quarter, which in effect increases the density. In relevant literature it has been noted that the development of industry and commerce in regions closer to highways played role in the development of new settlements and formation of urban sprawl phenomenon (Patacchini, Zenou, Henderson, & Epple, 2009; Polidoro et al., 2011). It is also stated that industrial and correspondingly housing sector shifted towards city outskirts to select low-value farmlands which in effect transformed farmlands into urban lands and created urban sprawling (Du et al., 2013; Malaque III & Yokohari, 2007), as also been verified in current study.

In quarters specified as 4th Region in Value Map nominal value index is comparatively lower than the 5th and 6th regions. The reasons are, as shown in the analyses, longer distance to city center and the lower income level of household. Parallel to these analyses, it has been verified that proximity to city factor is quite an important factor in the valuation of urban sprawl. People with lower household income prefer lower-cost houses which are mostly scattered far away from city center. In addition, the areas in which 3rd and 4th regions are located are within borders of rural land and there exists a population still engaged in farming[1]. As acknowledged, welfare level of rural people in Turkey is low. The fact that in the 3rd and 4th regions some quarters are still closed for construction is also effective in receiving low nominal value index. It is even claimed that due to these reasons there are still some lands bearing farmland properties, as shown in figure 4.

[1]InFigure4, as the base, the satellite images of the region are shown and farmlands in the specific regions are shown in darker colours.

Quarters specified as 1st and 2nd regions are away from city center, low housing density, limited educational and health units and not-zoned for construction. Consequently, urban rent is low and indexes are similarly quite lower. Also since they possess 6th and 7th class farmlands they are in practice the most applicable lands for non-agricultural use. The reason why these quarters stand out as urban sprawl in the analyses is that there is some housing density, though low. The reason why these quarters are selected as settlements is their position nearby intercity highway. It can also be argued that recreation land in the 2nd region and Konya Metropolitan Facilities in the 1st region are also some of the factors that played role in the opening of this area for settlement purposes.

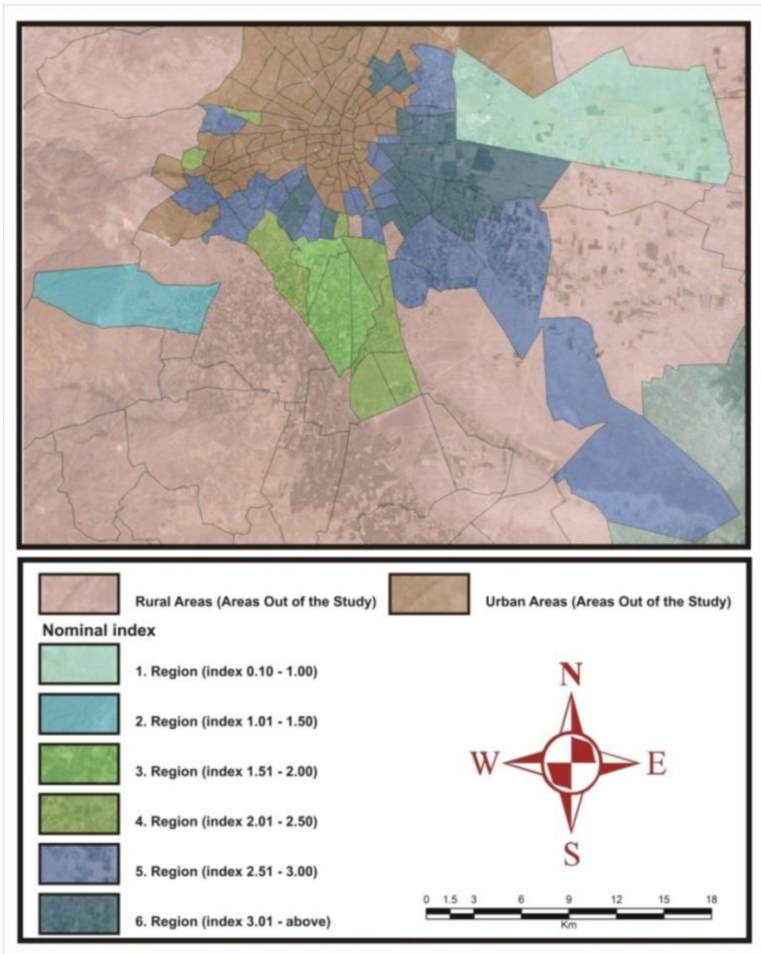

Figure 4. Nominal value map for the study area

It is thus concluded that in the valuation of farmlands in urban sprawl, not agricultural criteria but urban criteria played more critical role. The reason is that farmlands in urban sprawls have lost their agricultural identity and turned into areas for non-agricultural purposes. The most important factors affecting the value of lands in urban sprawls are proximity to the city center, presence of social amenities and urban rent and these factors have been verified via value map obtained through nominal value calculations. This deduction also validates Hypothesis 2.

CONCLUSIONS

Urban sprawls are transition zones with indefinite borders between urban and rural areas. In our study the borders of urban sprawl area in Konya city have been detected. For that purpose, the index that was developed via using urban sprawl-triggering factors was utilized. At the end of these analyses, within the scope of factors affecting urban sprawl, in addition to density and accessibility factors widely encountered in relevant literature, additional factors such as zoning status, constructing mobility and amenity factors also proved to be remarkably effective. Constructing mobility have emerged as a consequence of opening prime farmlands in study area to construction for urban use

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enabled urban growth while simultaneously triggered losing fertile farmlands.

Economic theory asserts that via Value= Rent/capitalization rate formula it is feasible to calculate the value of farmlands. Nonetheless as for the farmlands in urban sprawl, there exists no relation between the farm rent and market value because farmlands in urban sprawl transform into alternative uses with higher profits and lose their properties. Within that context, it was concluded in our study that urban sprawling quickened the transformation process in land use and urban sprawls are scattered forms of farmlands. In a different saying, it was detected that in research area farmlands in urban sprawls lost their properties and transformed into urban lands. Hence in the detection of the value of lands in these areas better results would be taken if evaluation was conducted on the factors affecting the value. It is also concluded that if the lands within urban sprawls were valued without considering the factors such as income and market value which are all traditional methods affecting the value, objective results would not be received hence there emerges the need to actualize relevant legal regulations.

The analyses also revealed that farm criteria have no effect on the lands in urban sprawl but rather urban criteria are more effective. It was also detected that the most effective factors on the value of lands in urban sprawls are proximity to the city center, urban rent and existence of social amenities. The popularity of these places for urban sprawl is because city center fails to meet the increasing housing need of risen population and lower price of farmlands. The reason why urban sprawl, a result of urban growth, violates fertile farmlands is related to implemented policies. To solve this problem; while on one hand specific policies are needed to fix rural population in their location, rural housing projects, integrated-farm development projects and farm development on the other hand land market-focused policies and reforms should be devised to ensure effective urban planning and compact development. It means that both urban and rural solutions should be improved in order to prevent the abuse of fertile farmlands that occurred as a result of urban sprawl.

In present research GIS technology has been utilized in the detection of urban sprawl borders as well as in the formation of the value maps of the lands in these areas. Adding a visual dimension to spatial factors affecting land value GIS technology provides geographical reference and critical data to infer the complexity of urban sprawl. This technology with no indeterminations and enabling quick generation of data has the qualities that would assist policy implementers.

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Research Article

Policy Recommendations for the Planning of Multi-Level Redevelopment and Social Housing Practices

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Abstract

Considering the urgent need for intervention in areas affected by problems such as *gecekondu* settlement and earthquake risk, redevelopment is inevitable in Istanbul. Such interventions, however, have proven problematic in meeting the local community's needs. There is a gap between the Istanbul experience and Western—in particular Western European—redevelopment practices, after which the Turkish experience has been modelled. The study aims to fill this gap through a review of these practices, a close examination of the hands-on redevelopment experience, and the lessons derived from two pioneering redevelopment projects in Istanbul: the *gecekondu* renewal of Ayazma-Tepeüstü and the earthquake-based regeneration in Sümer. 26 in-depth interviews were carried out with actors who influenced redevelopment decisions and those who were influenced by them. Data triangulation was employed to compare the two cases and reveal conflicting opinions and claims. Based on insights from informed practitioners (i.e. central government and metropolitan-level housing providers, local municipalities, and NGOs) and residents, the article analyzes the physical, financial, and community aspects of local redevelopment

Keywords: *Urban redevelopment, social housing, policy development, ıstanbul*

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projects. It then derives policy sets for the planning of multi-level redevelopment and social housing practices as suggested by the project practitioners and community. This study argues that whether focused on renewal, regeneration, transformation, slum removal, or earthquake preparedness, redevelopment activities should pursue planning policies at both the general and local levels when designing a project and take into consideration the affected community's inclusion and wellbeing in corresponding policies, including those of social housing.

INTRODUCTION: CONCEPTUAL APPROACHES TO REDEVELOPMENT

Urban planning models to better existing urban areas have had many different labels: renewal, redevelopment, regeneration, recovery, revitalization, transformation, gentrification, and restructuring. In the United States (US), the term *redevelopment*—or in some cases, *renewal*—is currently more dominant, while in Western Europe *regeneration* is commonly the preferred term. In Turkey, the words *dönüşüm*, translated as transformation or regeneration, and *yenileme*, which more closely corresponds to renewal and less to redevelopment, are used more or less interchangeably. This is not only the case in Turkey; as happens for many concepts derived from multiple disciplines and sub-disciplines, there is a lack of uniform definitions or strict boundaries for redevelopment, despite considerable attempts to establish them (Longa, 2011; Sutton, 2008; Roberts & Sykes, 2000).

Sutton (2008) emphasizes helpful distinctions in the motives of these initiatives: whether they are people- or place-centered, and whether they are used as means or ends. She suggests that employing people as a means in pursuit of a specific goal implies the alteration of behavioral patterns, while using place as a means refers to physically changing the built environment. From an outcome-focused perspective, treating people as the ends indicates an emphasis on improved livelihoods and quality of life; this is *development* in the broad sense. Treating place as an end is effectively a subset of *growth* in the economic sense of increasing property values and returns on investment (Shihata, 1997). In this paper, the general term *redevelopment* is used to address the people-centered concerns embedded in regeneration and renewal practices.

This study argues that no matter they are called, redevelopment activities should pursue planning policies at both the general and local levels when designing a project and take into consideration the affected community's inclusion and wellbeing in corresponding policies, including those of social housing. The

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study makes this argument through an examination of two pioneering Turkish cases. In the following section, the paper looks at the Western traditions of redevelopment with a particular focus on Western Europe, which Turkish redevelopment history predominantly follows. The third section examines the context in Turkey and Istanbul, taking into account both past and future redevelopment agendas. The empirical research, which is introduced in the fourth section and analyzed in the fifth section, is focused on two redevelopment cases in Istanbul: Ayazma-Tepeüstü, located within the former borders of the Küçükçekmece district, and Sümer in the Zeytinburnu district. The pioneering nature of these cases originates from the fact that Ayazma-Tepeüstü was the first large-scale gecekondu redevelopment project undertaken in Istanbul by TOKİ, and the Sümer Neighborhood case was the first earthquake-focused urban redevelopment project in Istanbul. The aim of the empirical research is to derive policy sets for the planning of multi-level redevelopment and social housing practices, as suggested by the project practitioners and community. These policy sets are delivered in the sixth section in three sub-sections: general redevelopment, local redevelopment, and social housing planning. Finally, the conclusion section highlights that, by taking into account such policies, it will be possible to strive for an integration of the physical, financial, and inclusionary aspects of a project for a more democratic and sustainable redevelopment scheme.

REDEVELOPMENT TRADITIONS IN THE WESTERN WORLD

The initiation of urban renewal in the US relies on a rather vague term: the appearance of “blight” in an area (Sutton, 2008; Gordon, 2003). As a result of this ambiguity, a number of interpretations of this term have been adopted by different municipal entities. For example, the New York State General Municipal Redevelopment Law defines a “blighted area” as “an area within a municipality in which one or more of the following conditions exist: (i) a predominance of buildings and structures which are deteriorated or unfit or unsafe for use or occupancy; or (ii) a predominance of economically unproductive lands, buildings or structures, the redevelopment of which is needed to prevent further deterioration which would jeopardize the economic wellbeing of the people” (§970-c).

The European counterpart of American renewal, or redevelopment, is *urban regeneration*, as mentioned above. Urban regeneration has widely been accepted by Western European planners as the transformation of a place (residential, commercial, or open space) that has displayed the symptoms of physical, social and/or economic "decline" (Evans, 2005). According to the Sydney, Australia-based International Federation of Arts Councils and Culture Agencies, regeneration is a response to decline or *de*generation and can be described as the renewal, revival, revitalization or transformation of a place or community (IFACCA, 2006). Robert and Sykes (2000) elaborate on the practice further, arguing that it comprises economic issues (job prospects, employment to combat social deprivation), physical improvements, environmental preservation or restoration, and social issues (neighborhood strategies, community issues, education and training).

Urban redevelopment has a longstanding tradition in Europe. In the immediate period after World War II, the repair of wartime damage and reconstruction of the fabric of towns and cities, which in many had been neglected for years, initially took priority (Roberts, 2000). This process of reconstruction was seen as a task of national—even international—importance across the continent. Consequently, the emphasis in the 1940s and 1950s centered on reconstruction, replacement, and the eradication of the physical problems of war-torn cities. As Couch (1990) states, the government-led priorities of slum clearance and reconstruction, enthusiastically supported by local authorities and the private sector alike, led to the embrace of high-rise housing and industrialized building techniques. However, by the mid-1960s growing dissatisfaction with slum clearance and the resultant decanting of populations to peripheral estates, together with a more participatory and decentralized approach to government, led to a series of adjustments to policy informed by the growing influence of private investment and a greater balance between the public and private sectors (Roberts, 2000). In the urban policy field this change in priorities resulted in an increased emphasis on improvement and renewal. This 'discovery' of the city, together with the first uncertain steps towards the generation of urban policy, led to a major expansion of urban initiatives during the 1970s (Turok, 1987). The result of this increase in initiatives was a series of attempts to improve coordination between the previously separate economic, social, and physical notions of policy.

Many of the urban policy initiatives of the 1970s, which involved peripheral renewal with a local spatial focus triggered by private investments, initially continued into the 1980s, although substantial modifications and additions were subsequently introduced (Turok, 1987). During the 1980s there was a move away from the idea that the central state should or could provide all of the resources necessary to support policy interventions. This

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new policy stance in Europe was matched by a greater emphasis on the role of partnerships. Roberts (2000) states that the more commercial style of urban redevelopment evident in the 1980s reflected yet another set of changes in the nature and structure of political philosophy and control. The redevelopment of flagship projects through private investment reduced the role of the public sector more than ever before, to merely that of a facilitator that provided selective public funds as well as very selective state support in a social context that mainly emphasized community self-help.

Further adjustments to the form and execution of urban policy occurred in the 1990s, with a return to a more consensus-driven style of politics and the recognition of a series of new problems and challenges (Vickery, 2007). National policy statements on 'design' in urban regeneration were stronger, placing design matters at the center of urban and economic planning (DOE, 1997; DETR, 2000). The prospect of integrating design, cultural activities, and urban regeneration gave rise to an emphasis on heritage, preservation, and the role of community. This trend continued into the 2000s, with an added emphasis on sustainability (Leary & McCarthy, 2013).

These economic, physical, and social ambitions, with their attendant weaknesses, can also be observed in the Turkish redevelopment agenda. In Turkey, the general components of redevelopment are apparent in project publicity reports as rationales, and as observed in the empirical research of this study, accompanied by local justifications such as earthquake threat, illegal settlements, and excessive population and building densities, all of which result in safety concerns (Gül & Dulupçu, 2010; Ezme, 2017). However, even though current projects are defined as a form of *urban redevelopment*, due to the lack of coordination of redevelopment components and their ignorance concerning present social structures and potential future social conflicts, the concept of redevelopment in Turkey deviates to an extent from today's Western notions and experiences (Güzey, 2013; Kuyucu, 2018).

TOWARDS LOCALITY: AGENDA SHIFTS IN TURKEY AND ISTANBUL

Municipalities in Turkey have for more than 150 years been organizers of urban development in the modern sense (Ersoy, 2001). Today, the Turkish territorial hierarchy for urban planning, from large to small scale, is *ülke* (country), *il* (province), *ilçe* (district), and *mahalle* (neighborhood). Although the current

Turkish Zoning Law (No. 3194) specifies different types of development plans at different levels and scales, the most widely used at the city level are "physical development plans" and "implementation plans," which are used in the planning and execution of redevelopment projects.

The roots of urban redevelopment activities in Turkey are found in the *gecekondu* (squatter) settlements that emerged in major Turkish cities in the early 1950s (Tas & Lightfoot, 2005). As in post-war Europe, policies of economic growth and industrialization motivated the rapid growth of urban centers and the development of *gecekondu* in large cities in Turkey. By the 1970s, municipal governments regarded *gecekondu* areas as the source of all negative externalities in large cities, and municipal agencies regarded their demolition and subsequent public housing applications as the only solution (Güzey, 2013). This policy of demolition resulted in the eviction of *gecekondu* populations in central urban areas. Although not mentioned in plans, the replacement of a lower-income population with a higher-income group—in other words, gentrification—was an expected and deliberate underlying purpose of redevelopment (Uzun, 2003; Güzey, 2009). Hence redevelopment plans, shaped by physical redevelopment projects prior to the 1970s, aimed at improving highly dense and irregular housing areas, and redevelopment was treated as a means of increasing housing stock.

The year 1980 was a turning point for Turkey in many respects. After a military coup on September 12, the central government implemented neoliberal economic policies and structural adjustments to integrate Turkey into international markets and embrace the dynamics of the free market economy (Kazgan, 1997; Özdemir, 2011). In the 1980s, two important developments in the urban space attracted attention: an increase in the construction of both authorized residential areas and *gecekondu*, and the decentralization of residential areas. Urban redevelopment within this period took place in inner city residential and industrial areas, central business districts, and coastal areas (Egercioğlu & Özdemir, 2007).

Since coming to power in November 2002, the Islamic and conservative Justice and Development Party (*Adalet ve Kalkınma Partisi* — AKP) has encouraged the consolidation of neoliberal spatial policies. Bakçay-Çolak (2012) iterates that the resulting new model of urban management has transformed the city's main functions for the purpose of generating urban income and distributing this income arbitrarily to give birth to a new,

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conservative bourgeoisie, particularly in Istanbul. The Housing Development Administration of Turkey (*Toplu Konut İdaresi*—TOKİ) emerged as another factor central to the urban restructuring process in this period (www.toki.gov.tr). Established in 1984 under the Prime Ministry to help ameliorate the housing problems of middle and lower-middle income groups, TOKİ became an active investor in mass housing, equipped with special powers and financial resources to accomplish vast urban transformation projects through joint ventures with private developers and local municipalities (Türk & Korthals Altes, 2014; Aksoy, 2012). This model is reflected at the municipal level in a subsidiary of the Istanbul Metropolitan Municipality (IMM), the Istanbul Housing Development Organization Co. (*İstanbul Konut İmar Plan Sanayi ve Ticaret A.Ş.*— KİPTAŞ).

Despite considerable attempts to balance out the impacts mentioned above through community inclusion and participation related to urban redevelopment practices in Turkey (Varol, Ercoşkun & Gürer, 2011; Karaman, 2014), overall, the new legal framework and the neoliberalization process have had a number of consequences in major cities in Turkey, particularly in Istanbul. Bartu-Candan and Kolluoğlu's (2008) assessment provides a summary of these consequences:

- A new neoliberal language that involves abundant usage of the terms vision, mission, transparency, efficiency, accountability, and public participation;
- A dramatic shift in the type of private investments, marked by a spectacular increase in the number of hotels, shopping malls, and office buildings since the 1980s;
- A change in the actors of the real estate market, e.g. the emergence of real estate investment trusts and TOKİ, introduced by legislative interventions of the central government; and
- The emergence of the discourse of natural disasters following the 1999 Marmara earthquakes, which emphasizes strengthening housing stock for an anticipated high-magnitude earthquake in Istanbul.

In Istanbul, an additional significant motive for the transformation of the city was its repositioning as a 'global' city, in competition with with the leading metropolitan cities of the world (Aksoy, 2012; Uzun, 2003). In the case of housing provision, the abovementioned consequences and motives are reflected in urban redevelopment projects either as mega-projects designed by world-renowned architects (e.g. the Kartal project by Zaha Hadid and the Küçükçekmece project by Ken Yeang) or as *gecekondu* transformation projects. Accordingly, applications in Turkey have been directed mostly at residential contexts, especially *gecekondu*, and used as tools in the re-acquisition of rent in cities' most appealing locations (central areas, development sites, and the like) and in the creation of high-income and high-status housing (Güzey, 2009).

As a final analysis of the urban redevelopment processes in Turkey, it is necessary to mention a more recent development in the legislative arena. Due to the central government's increasing ambitions regarding redevelopment and its need to further control project initiation, the Turkish Parliament passed the first law to directly address urban development on May 16, 2012: law no. 6306 on the "Redevelopment of Areas under Disaster Risk," more commonly called "the Urban Redevelopment Law." It aims at "determining procedures and principles regarding the rehabilitation and renewal of lands under disaster risk or plots with buildings under disaster risks in order to provide healthy and safe living environments" (Official Journal, 31 May 2012). Since its initiation, a number of amendments have been made to the law to ameliorate the ill consequences it has had on redevelopment practices (Balaban, 2019). Due to the ongoing restructuring of this law and the overall time frame of this study, which was conducted from 2014-16,, the case projects examined in this paper were undertaken under previous laws. Nevertheless, implications derived from the empirical research can inform possible consequences of the Urban Redevelopment Law.

NOTES ON EMPIRICAL METHODOLOGY

The empirical study examines published and unpublished material in addition to collecting and analyzing primary data through qualitative methods. Primary data collection was conducted through in-depth interviews in one-on-one sessions with a total of 26 informed subjects from two case projects. These interviews aimed at revealing project decisions and the rationales behind them, and at determining policy proposals based on the redevelopment practice of these projects, as perceived by the actor groups. The subjects thus comprised local municipalities at district level (The Municipality of Küçükçekmece, Istanbul—the *MKI*—and the Municipality of Zeytinburnu, Istanbul—the *MZI*), governmental development institutions (TOKİ and KİPTAŞ), NGOs (the Urbanism Movement of Society, Istanbul—*İmece*—and the Migrants' Association for Social Cooperation—*Göç-Der* in the Ayazma-Tepeüstü case—and the Association of the Istanbul Zeytinburnu Curtain Manufacturers Market—*İSPER* in the Sümer case), and the community representatives of different user types

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(owner or tenant, status groups, and ethnicities, where applicable). In addition to interviews via a snowball sampling method that covered all actors willing to participate (Noy, 2008), the qualitative research involved participant observation with an ethnographic approach (O'Reilly, 2012). In order to ensure the confidentiality of the subjects, any descriptive information has been omitted except for contextually vital institutional names and positions. Triangulation of coded data (Lewis & Ritchie, 2003) allowed comparison within and between different categories of actors of each project (triangulation of sources) as well as comparison of the two projects (environmental triangulation).

COMPARATIVE REVIEW OF CASES: AYAZMA-TEPEÜSTÜ AND SÜMER

Küçükçekmece and Zeytinburnu were among the districts in Istanbul for which there was a need for large-scale rehabilitation and revitalization of *gecekondu* sites and increased preparedness for an expected major Istanbul earthquake (Erdik & Durukal, 2008). Both cases are the primary examples of their kind in Istanbul and Turkey. The Ayazma-Tepeüstü case (2004-2012) was the first large-scale *gecekondu* redevelopment project undertaken with TOKİ, while the Sümer case (first phase in 2008-2013) presented the first earthquake focused *in situ* urban redevelopment project to be realized in a high-density settlement.

Site selection and characteristics

Ayazma and Tepeüstü were determined through field and community surveys conducted by the MKI in 2004 to be two of the four most problematic *gecekondu* neighborhoods of Küçükçekmece (Ramazanoğulları Turgut & Çaçtaş Ceylan, 2012). As reported by the MKI and TOKİ interviewees, their selection over other neighborhoods was mainly due to their location, land ownership pattern, lack of urban facilities, pedestrian access problems, and poor public health conditions around the river bed, which also posed a flood threat. The problems of the Sümer neighborhood were rooted in larger scale issues that affected the whole Zeytinburnu district. As an MZI official elaborated, Zeytinburnu's earthquake risks are significant due to its problematic high-density building stock, which was constructed without consideration for the area's hazardous geology and poor urban conditions, which include unplanned development, inadequate social facilities, a lack of open spaces, narrow roads, and urban poverty. In both cases, locational advantages were mentioned multiple times by almost all interviewees (Figures 1 and 2). Ayazma and Tepeüstü are valuable neighborhoods, easily visible from surrounding major developments, adjacent to main highway arteries and junctions that connect the sites to the Atatürk International Airport and the nearby Atatürk Olympic Stadium, which was envisioned as a major focus of mega-event planning in Istanbul, an aspect of the ambitious "world city" vision of the government for Istanbul. The Sümer neighborhood is also close to a main highway and the Ataturk Airport and is easily accessible from important transport routes such as the Marmaray tunnel, the Kabataş-Zeytinburnu light rail, and the Kazlıçeşme International Seaport.

Figure 1. Ayazma, Tepeüstü, Bezirganbahçe, and other important land uses within the former Küçükçekmece district border (Produced by author)

Figure 2. The Sümer Neighborhood within the Zeytinburnu district borders (Produced by author)

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Issues of land and unit ownership were especially problematic in both cases because of their heavy *gecekondu* presence. MZI and TOKİ officials reported that while land ownership in the Sümer neighborhood was roughly 90% private, around 40% of Ayazma and 80% of Tepeüstü were developed on State Treasury land. Almost all pre-existing Ayazma and Tepeüstü units and 35% of Sümer units were illegally built, which prompted the government to call some of their residents "illegal occupiers," particularly in the Ayazma-Tepeüstü case.

Ayazma was a hub of socio-economic disadvantages: the community was plagued by very low education and income levels and high unemployment, both of which contributed to poor living conditions in both Ayazma and Tepeüstü (Ramazanoğulları Turgut & Çaçtaş Ceylan, 2012). Sümer residents had comparatively higher education levels than residents of Ayazma-Tepeüstü (around 85% were primary school graduates, according to one resident) and higher paying jobs on average, either through blue-collar work or small businesses they operated in Zeytinburnu. The community surveys conducted by the local municipalities in both cases determined that the communities were unable to partake in redevelopment activity at their own expense due to their low income levels. On a final note, as MKI and community representatives stated, while the population of Tepeüstü was mostly heterogeneous, the majority of the Ayazma population were Kurds who had emigrated from eastern Turkey. Both MKI and NGO representatives mentioned the history of political tensions between this group and the AKP government because of the latter's conservative and nationalist stance; in fact, this tension was a significant source of the community conflicts in the Ayazma-Tepeüstü case (also see Uzunçarşılı Baysal, 2013).

Project formulation: Physical and financial aspects

The earlier project alternatives for Ayazma-Tepeüstü and Sümer had different stances on community needs and displacement than the projects' eventual outcomes. The MKI's first zoning plan and design study foresaw on-site public housing for existing Ayazma residents and a public convention center in Tepeüstü; however, these measures were replaced by TOKI's plans, which displaced the residents and offered an uplift of the area as elaborated below. In Sümer's case, following three declined project alternatives proposing a shopping mall and luxury high-rise condos on site, the KİPTAŞ-MZI project partnership had to generate an *in situ* solution due to public reaction against displacement.

In the fourth project alternative, which was eventually implemented in Sümer, project executives decided to use a nearby

1.4 ha state-owned soccer field to construct *Sahilpark*, a security-controlled gated housing site with street-facing stores, transfer the 3,600 residents from 1,038 units and 212 retail stores to the new units, and build the second phase on the 4.9 ha lot they vacated (Figure 3). The project also called for the concurrent development of a nearby 10.6 ha private lot to build a new sports facility and luxury housing project, *The Istanbul*, to generate income for the development of *Sahilpark*. The *Sahilpark* housing site was also an uplift: it offered a 25 sqm parking space to each unit in an underground parking structure, a leisure area by an ornamental pool, a playground, and an exercise station.

Figure 3. Components of the Sümer urban redevelopment project area (Produced by author)

The flat-for-land method was used once the rightful owners agreed to partake in the project. KİPTAŞ staff conducted a gross unit measurement study for each existing unit, which reportedly caused friction among residents due to the intangible qualities of their homes. In determining the allocation of new units, KİPTAŞ decided on a 25% deduction of the existing unit area in order to compensate the project costs. MZI and KİPTAŞ officials considered this rate a major incentive to the community in a metropolis like Istanbul, where, they claimed, the average rate was 50%. After application of the deduction, a *Sahilpark* unit that corresponded to the deserved value was offered. In order to compensate any size differences, and in accordance with the fair property value analysis they undertook, KİPTAŞ and the MZI set the equalization price for unit area at TRY 2,500 per sqm for *Sahilpark* units, with the existing units valued from TRY 700 to 1,000 per sqm. An İSPER representative explained that a similar set of deals was formulated for the store owners of the project area, but a business taxation problem arising from a lack of proper legal remedies

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hindered them from signing project agreements over the course of the first phase of the project.

The anonymity of some interviews helped reveal a hidden financial agenda in the Sümer case. It was claimed that the private lot's owner, the Koç Group, was the actor that profited most from the project: its former afforestation property was now zoned for housing and designated for the eventual development of *The Istanbul*, 40% of which was allocated to the group. One official also predicted the construction of approximately 3,500 units to replace the 1,250 existing units of Sümer by the end of the second phase, and argued that some portion of the remaining units would be delivered to KİPTAŞ as profit based on a 40% flat-for-land method.

In the Ayazma-Tepeüstü case, the TOKİ and MKI officials reported that the redevelopment project sites in Ayazma and Tepeüstü were 20 ha and 13 ha, respectively, housing a total of approximately 8,800 residents in 2,070 units in 700 buildings, collectively. These officials co-decided to construct a public housing site where the *gecekondu* residents would be transferred in a less accessible Bezirganbahçe location that originally belonged to the State Treasury to make room for development that could take advantage of the favorable location and high value of the original land. Later, in order to address the demand of some Ayazma homeowners who wanted to stay in their neighborhood, TOKİ built a few housing blocks in Çakmak, which was closer to Ayazma. The rightful owners were asked to choose to what area they wanted to be transferred (Figure 4).

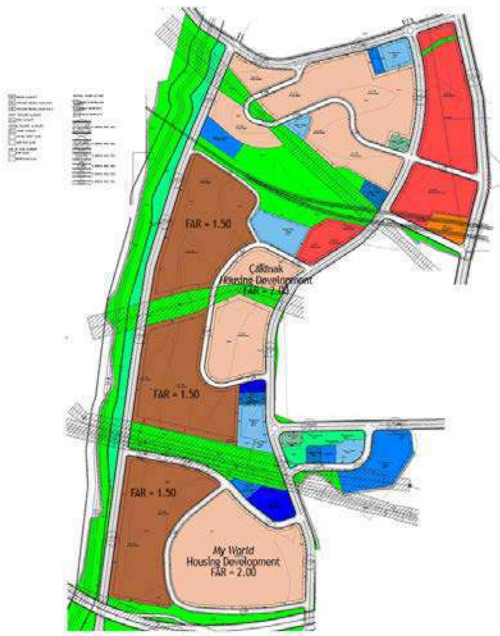

Figure 4. TOKİ's 1:1000 plan for the extended Ayazma site dated 2008 (Adapted from the image by TOKİ Istanbul Redevelopment Office archive, April 2014)

TOKİ later sold the former Ayazma and Tepeüstü lots at auction through its Property and Housing Real Estate Investment Company. The Ağaoğlu Group purchased the Ayazma site to build the luxury housing project *My World*, while the Torunlar Group purchased Tepeüstü as land zoned for retail and tourism with an increased building density and built a high-end mixed-use complex, the *Mall of Istanbul*, with offices, luxury condominiums, and a shopping mall. TOKİ partnered in both developments. In all development projects, actual construction was outsourced to private firms that used their own workforce and inspected by the employer institutions, which proved to be insufficient to maintain construction quality and safety, as admitted by the TOKİ executives interviewed.

The financial terms offered to Ayazma-Tepeüstü residents were relatively simple compared to those offered to Sümer residents. The rightful owners of Tepeüstü, all of whom owned *gecekondu* on state property, received one Bezirganbahçe unit in exchange for every unit they owned. As financier of the public housing project and a non-profit developer, TOKİ determined the dwelling unit price in Bezirganbahçe to be TRY 51,000 based on land, construction, and project costs. It appraised each *gecekondu* unit on state-owned land in Ayazma at a flat price of TRY 10,000 regardless of its size, condition, or location, an amount that was considered a down payment toward the Bezirganbahçe units. The remaining balance was termed for 15 years of fixed interest-free installments. Upon the objections of the Ayazma residents due to financial hardship, then-Prime Minister Erdoğan used his right of initiative in favor of the community and announced a 10% discount. If residents agreed to pay the unit price in advance, they were offered an additional 20% discount. Nevertheless, although its officials did not make financial details explicit, residents and NGOs claimed that TOKİ gained substantial profit from the public-private partnership projects realized in Ayazma and Tepeüstü.

As is apparent above, in both case projects, the rightful owners were offered a seemingly limited flexibility regarding the units they could choose to receive. However, with little to no room for negotiation, if they did not agree with the project terms, they were forcibly excluded from the project through legal means, which favored the government. There were numerous claims of apathy, bullying, despotism, unfair allegations, and neglect, which caused multiple conflicts between the government and the community in the Ayazma-Tepeüstü and Sümer projects.

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Community Inclusion: Government and Resident Perspectives

In both cases, the majority of the interviewees from the government institutions and all of the interviewed rightful owners stated that the community was not adequately involved in the project's direct decision-making, while all interviewees reported that the level of formal public participation was "information giving" at the most. According to a TOKİ manager, community surveys were a means of formal participation, while interviewees from *İmece* and *Göç-Der* argued that the surveys were by design one-way instruments tailored to gather information about residents rather than enable a two-way discussion that might facilitate collective decision-making. As for Sümer, the MZI vice mayor pointed to the simultaneity of the decision-making process and the collection of the community's opinion in the early stages of the project: the decision-makers made a decision, then communicated it with the rightful owners via presentations and models. He stated that the project partnership used this method to obtain the community's verbal consent for the ultimate decision to implement the redevelopment project.

An MZI planning officer pointed to the general lack of legal regulation concerning formal participation methods in urban planning in Turkey, an absence which resulted in neither the MZI nor KİPTAŞ applying any further methods, such as co-discussing and co-deciding on design alternatives or receiving the rightful owners' written consent. While this officer agreed on the inadequacy of Turkish legislation, an *İmece* representative offered a different approach to the participation mechanism. She believed that revolving participation meetings and public persuasion processes were unnecessary if the community clearly did not want to realize a project or wished to remain in their area: in the Ayazma-Tepeüstü case, for instance, the community's desires and needs were so explicit that there was "no need of such democratic charades."

The government's positive attempt to elevate the education level and general quality of life of the local community was spearheaded in the Ayazma-Tepeüstü case when the project consultant, also a planning professor, founded a social empowerment project, *Bizim Halka*, and established a project office that employed sociology, psychology, and preschool education professionals to ease the residents' adaptation to mass housing life in Bezirganbahçe (Ramazanoğulları Turgut & Çaçtaş Ceylan, 2012). However, interviewed residents argued that the program was terminated because of a number of challenges involving project operations, effectiveness, and lack of community trust. In the Sümer case, such an empowerment program was not considered, possibly because the new lifestyle in *Sahilpark* was more welcomed by the residents who were able to stay in their neighborhood and whose socio-economic status was on average higher than that of Ayazma residents.

The most significant and resonant community resistance of the two redevelopment projects was that of the tenants of Ayazma (Bartu-Candan & Kolluoğlu, 2008; Aksoy, 2012; Uzunçarşılı Baysal, 2013; "Ecumenopolis", 2012). In interviews, officials from TOKİ and the MKI defined the protestors as "marginal groups," alluding to their partial Kurdish identity. The MKI vice mayor believed that the fact that the residents did not sufficiently know how to seek their rights diminished their potential influence over decisions. In Sümer, an officer and an anonymous interviewee of the MZI asserted that for the most part, household visits and informal resident meetings were conducted one-on-one to prevent any group "synergy" or opposition. As claimed by multiple interviewees, with this and other project marketing and persuasion strategies, the MZI-KİPTAŞ partnership was largely successful in its attempts to divide the community.

INFORMED POLICY SETS FOR REDEVELOPMENT AND SOCIAL HOUSING PROGRAMS

In both cases, interviewed officials suggested a connection between the novelty of the projects and explained how they derived lessons for further redevelopment activities in Istanbul. The practice-oriented lessons in this section offered by the redevelopment practitioners are translated into three sets of policies for redevelopment at the general level, at the local level, and relating to social housing, with insights for more democratic and sustainable outcomes (Table 1).

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Table 1. Practice-oriented policies suggested by the informed practitioners

Planning type	Informed policies
General redevelopment	· Steering the national economy to address housing problems · Planning at the national, regional and metropolitan levels · Holistic approach: all departments, all sectors, all needs · Long-term and longitudinal planning · Partnership with the community · Development of programs for the social and economic well-being of residents · Prioritization of *in situ* social housing over gentrification · Abandonment of the "sign or leave" attitude
Local redevelopment	· Longer-term and election-free planning · Consideration of idiosyncratic conditions · Pre-project determination of local needs and interests · Generation of multiple community-friendly scenarios · Encouragement of area-based redevelopment · Building density control and amenities · Value-based assessment of existing units · Affordability
Social housing	· Depot housing concept · Modest and secure living spaces for higher quality of life · Adequate and maintained community amenities and infrastructure · Production of jobs and employment · Construction quality management · Moderately high buildings at lower building density · Various unit types to combat "choicelessness" · Rental and sale options and affordability

General Redevelopment Planning

Steering the national economy toward addressing housing problems. A high-rank TOKİ executive proposed that the national economy should be steered toward the production of more feasible housing options for citizens, while financially empowering the state to realize public housing projects and build earthquake-resilient urban areas. A crucial note offered by an activist suggested that the state's earthquake relief taxes collected from the citizens since the early 2000s should be spent on their intended purpose of disaster mitigation instead of on unrelated purposes such as highway construction. Likewise, a portion of gentrification revenues could be transferred to public housing projects to increase their building quality and the quality of life they provide.

Planning at the national, regional and metropolitan levels. Government officials from both case studies believed that their projects lacked a holistic approach to redevelopment, which integrated all past, current, and future redevelopment activities in Istanbul. Redevelopment planning should be carried out at national, regional, and metropolitan scales, with local redevelopment projects generated accordingly. Large-scale planning should project population movement, transportation infrastructure, project phasing, and financial alternatives to inform local practices.

Holistic approach: all departments, all sectors, all needs. In addition to master redevelopment planning, the executives of TOKİ suggested undertaking a more multi-disciplinary approach, with the inclusion of historians, sociologists, psychologists, economists, tourism professionals, and investors along with planners, architects, and cartographers to ensure more sustainable and viable outcomes from redevelopment practices. Another TOKİ officer emphasized the government's role in such collaboration and argued that central and local governments should adopt a more active role in guiding and monitoring the collaboration of various parties, in particular regarding compliance with the law. He added that leading central government institutions, such as the Ministry of the Environment and Urbanism and the legislators of Urban Redevelopment Law No. 6306, should be involved in redevelopment discussions. After all, the burden of solving redevelopment problems did not lay with the citizens; it was the responsibility of government officials at all levels to seek out workable housing strategies to promote their citizens' happiness.

Long-term and longitudinal planning. In reference to following up local residents' lives after displacement, an MKI planning executive likened her institution's treatment of the Ayazma-Tepeüstü redevelopment to child abandonment, although she believed that it was not the planning department's but academia's job to conduct follow-up social programs or data collection studies. As a scholar, the municipality's redevelopment consultant also emphasized the necessity of longitudinal studies and offered various research topics based on her experience and observations at Bezirganbahçe: the increase in crime rates and the profile of organized crime, residents' social interactions and sense of security, and changes in former Ayazma women's lifestyles. Former Ayazma residents now living in Bezirganbahçe seconded these concerns.

Partnership with the community. Because of the dominant focus on the collaboration of formal actors, few subjects brought up the need for the active involvement of the local community in project decision-making. In line with general participation practices in Istanbul and Turkey, the government informed the public of the details of the implemented redevelopment process only after having consulted all higher government entities and received their approval. A government official admitted that the formal redevelopment actors, including TOKİ, carried out planning decisions on a two-dimensional platform (physical and financial planning) and dismissed the third social dimension. If TOKİ and the local municipality had included this third dimension, he

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argued, the problems of social and financial adaptation to a new high-rise lifestyle could easily have been foreseen.

Development of programs for the social and economic well-being of residents. A municipality advisor argued that housing provision was not enough to sustain public happiness; public housing policies had to work hand in hand with other social programs to combat large-scale unemployment and education problems in these low-income populations. One simply could not achieve this at the municipal level without a deep change in the understanding of governance on a national scale. He suggested that the government should initiate programs for the socio-economic well-being of residents that go hand-in-hand with those promoting awareness in order to effectively involve communities in decision-making.

Prioritization of* in situ *social housing over gentrification. NGO activists asserted that this prioritization is essential in acknowledging low-income illegal settlements and their communities' desires. Redevelopment projects should aim to solve long-established housing problems in metropolitan cities such as Istanbul while keeping the willing population on site. An advocacy planner objected to the need for displacement, arguing that it should not be an automatic policy for redevelopment but an agenda only if local residents are not willing to live in their neighborhood or if the geological condition of land does not allow for any kind of development, suggesting that where the occupied land already belongs to the state, the government can adopt *in situ* public housing policies to legally accommodate local residents and other communities in need. Such *in situ* formulations would free the government from the burden of expropriation and allow it to retain ownership of centrally located state lands.

Abandonment of the "sign or leave" attitude. According to some government officials, a powerful central government was necessary to assure the successful realization of redevelopment projects in Turkey. Behind this assumption is the opinion, one official argued, that unlike in Europe, where redevelopment is understood as painting and planting around an industrial plant, redevelopment in Turkey—as in all developing countries—is defined as the total removal of building(s) or function(s) and that the central government should thus have significant economic and legal power to initiate, plan, and execute projects. A KİPTAŞ executive further argued that using forceful tactics was an inevitability in societies like Turkey; the government had to "hold the stick" in order to persuade its people and accomplish its projects where citizens refused to compromise. Others had a more community-friendly stance. They believed that redevelopment was a necessary and inevitable physical intervention measure to solve the rooted housing problems of Istanbul, but that municipalities had to offer the residents more agreement options than a mere “sign or leave.”

Local redevelopment planning

Longer-term and election-free planning. Local government executives stressed the importance of changing the timespan of redevelopment projects, arguing that projects should be allowed at least 10 years (instead of 5 years, which is the interval between local government elections), freeing public actors of election concerns in order to allow for a more thorough project formulation and implementation.

Consideration of idiosyncratic conditions. Multiple interviewees emphasized the uniqueness of each redevelopment project in its physical, economic, and social conditions, differences that any collaboration should consider carefully when tailoring project formulations while also adopting broader redevelopment guidelines and policies. As the NGO representatives suggested, employing survey methods to assess residents’ sincere opinions and demands is also necessary for determining the distinctive conditions of the community.

Pre-project determination of local needs and interests. When considering communities’ needs and interests, some subjects from both government and non-government institutions envisioned a set of tools to collect residents’ sincere opinions and demands before the project formulation phase, so that formal institutions could make more public-friendly decisions. A parallel suggestion was that zoning and local redevelopment plans should call for community consent and participation before project initiation.

Generation of multiple community-friendly scenarios. In both cases, the community rejected the project options the formal actors suggested because they were not realistic or community-friendly enough and oriented more toward profit for the government and private stakeholders. An MKI officer suggested that redevelopment project partnerships should instead focus on developing alternative scenarios with local communities and other stakeholder groups: plans should be generated to allow some residents to stay on site, some to be compensated for the property they are willing to vacate, and some to be offered public housing elsewhere.

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Encouragement of area-based redevelopment. The local municipality officials argued that planning guidelines should promote block-based rather than lot-based redevelopment, as redevelopment in larger lots tends to yield greater benefits for the community (i.e. by allowing for more orderly building clusters and the elimination of parking problems). For instance, in the Zeytinburnu case, the MZI had recently attached a note to the 1:5000 zoning plan for Zeytinburnu to the effect that the residents of a building block were at that time encouraged to gather and agree on redevelopment via a 15% increase in construction area in areas of at least 1000 sqm. The 1:1000 implementation plans were being prepared in line with this 1:5000 plan report.

Building density control and amenities. In both cases, as in almost all cases in Istanbul, building density was increased considerably via redevelopment. A KİPTAŞ executive admitted that the idea of redevelopment through density increase was developed by the government prior to and independent of the disaster risks. Although he believed that securing the lives of the Zeytinburnu residents was the project's foremost objective, the means by which the redevelopment was carried out, e.g. the zoning change on Koç land and the increase in population density and resulting traffic congestion, were not exactly compatible with this end. A TOKİ executive seconded this criticism and added that if TOKİ were to plan the Ayazma-Tepeüstü redevelopment project over again, it would look for ways to lower density further than what has been realized in the original neighborhoods and better organize urban facilities to provide a more balanced and sufficient social infrastructure. These officials believed that as an alternative to deducting from existing unit area and increasing density to compensate for project costs, a financial formulation that embraces a one-for-one principle with increased unit prices while keeping residents on site and maintaining the same density may be encouraged. Such an approach would not require low project costs and construction quality and would allow for the design of parking spaces and recreational amenities, perhaps with higher standards.

Value-based assessment of existing units. One problem in the Ayazma-Tepeüstü case involved the assessment of the units of local residents that ignored intangible qualities (i.e. floor, view, orientation, building quality, etc.). A KİPTAŞ official observed that, as opposed to taking into account merely the size of a unit, a value-based method was more precise in assessing a unit's intangible qualities and could yield faster and fairer results by preventing conflicts.

Affordability. There were conflicting implications regarding different affordability segments within the community. In the Sümer case, a major finding of the initial community survey indicated a low-income profile. However, the MZI vice mayor claimed that residents claimed a higher ability to pay when they saw the value increase in the new development, *Sahilpark*. Those who could afford new *Sahilpark* units demanded more or larger units from the government, so a KİPTAŞ executive suggested that instead of a 25% deduction rate per unit, the financial formulation for future redevelopment projects should be made on a one-for-one principle with increased unit prices while at the same time keeping residents on site and retaining the area's original building density. He referred to such a process as "producing quality work despite the citizens," as he believed that it was impossible to satisfy all residents anyway.

Social Housing Planning

Depot housing concept. The Ayazma-Tepeüstü project's municipality consultant suggested that public housing be built in suitable locations (often in peripheral areas) and made available to local communities for long-term housing in times of redevelopment. In accordance with central or metropolitan-level policies, the government can make pre-built public housing sites available to homeowners or tenants to prevent them from having to move to other illegal or disaster-prone areas.

Modest and secure living spaces for higher quality of life. In general, residents called for social housing projects to fulfill two major community-friendly criteria: affordability and livability. Community advocates argued that while public housing projects need not be luxurious like *My World* in Ayazma, they should offer high quality of life, meaning that the safety of the community should be prioritized at a cost that is within the reach of residents, and that the government's overall priority should be to ensure the betterment and security of the lives of those now living in public housing.

Adequate and maintained community amenities and infrastructure. Residents also demanded that social housing projects should offer better-organized and sufficient public amenities such as playgrounds, social facilities, schools, and health clinics. A local municipality official recalled her immense efforts to appeal to the Istanbul Metropolitan Municipality for outdoor cleaning at the Bezirganbahçe public housing site; however, as a mere local municipality officer, her voice was not heard. The upkeep of the housing site was abandoned shortly after the project's completion, as this officer and the residents claimed

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that the private site management company employed by TOKİ did an inadequate job. In particular, if development must be carried out at the less valuable periphery of the city to reduce land costs, she argued that the government might offer decent services in more distant areas (i.e. improved transportation connections, better community amenities, and higher construction quality).

Production of jobs and employment. A local activist asserted regarding the Ayazma-Tepeüstü case that the health and employment problems of low-income communities surpassed their housing problems; she therefore called for government programs that foster nearby employment opportunities to ensure citizens' socio-economic wellbeing and allow them to work in jobs that would normally exclude them from government assistance. On the other hand, a TOKİ official suggested that 95% of the residents wanted to stay in their neighborhood in urban redevelopment schemes and that everyone demanded at least a one-for-one formulation, if not more. In order to come to a compromise with the residents, he argued, the government should offer livable and appealing low-cost public housing projects with employment opportunities on less valuable land outside the city centers, providing larger units and jobs to ensure the citizens' socio-economic wellbeing.

Construction quality management. TOKİ officials acknowledged the inadequate workmanship at Bezirganbahçe but placed blame squarely on the contractors, even though TOKİ undertook quality management and inspection of construction activities. They argued that when looking for ways to reduce unit costs, the government should take measures (e.g. personnel training) that will increase the effectiveness of inspections of the contractors' work to prevent them from reducing construction costs at the expense of quality.

Moderately high buildings at lower building density. A former local municipality executive criticized TOKİ for the excessive increase in building density in both Ayazma and Tepeüstü. The population had to move from their (1-2 story) low-rise homes to 10-to-15-story buildings. A TOKİ executive admitted that TOKİ "confined the people to high-rises" for the sake of cost-effective construction. The forced change in the lifestyle of former Ayazma residents caused severe reported adaptation problems (e.g. lack of yards, children falling from balconies). Thus, lower building density and moderate building height should be top priorities in social housing projects.

Various unit types to combat "choicelessness." TOKİ used only one unit type for all family sizes and lifestyles to ensure low construction costs. This approach allowed social housing units to be offered to residents at a low price, although sites like Bezirganbahçe resulted in the abovementioned social and physical costs. All TOKİ officials interviewed argued that the urgent need for low-cost public housing developments was almost over, as the majority of low-income people were provided with public housing in Turkey and the market had reached a balance. It was now time to generate more unit types in lower-height buildings to increase the quality of life of their inhabitants.

Rental and sale options and affordability. Because it was difficult for the low-income residents of both cases to afford new unit loans, the community activists argued that the government should seek financial formulations in which public housing units could be for either rent or sale or could be given at no cost to the residents but without transfer of ownership.

CONCLUSION: ROOM FOR FURTHER (RE)DEVELOPMENT

The arguments and suggestions offered by the informed practitioners of the case projects are parallel to those offered in the Western literature. Overall, they call for a comprehensive and urgent transformation of redevelopment policies, as the current applications fail to fulfill the community's needs while deeply affecting their lives. The findings also suggest that the legacy of redevelopment depends on a successful social housing program, in the absence of which the redevelopment efforts may bring severely ill consequences. As European practitioners and policy-makers realized in the 1960s and 1970s, coordination between the previously distinct economic, social, and physical notions of policy should be improved in Istanbul and in Turkey. Otherwise, growing dissatisfaction with place-centered redevelopment decisions, *gecekondu* clearance, and the resultant displacement of populations to peripheral and undesirable estates observed in post-World War II Europe will prevail. What distinguishes applications in Turkey from the models in developed countries is the tendency to regard urban redevelopment as a form of project-based housing supply rather than as a holistic restructuring process that should be evaluated at a larger scale. A set of keys offered in the literature can be summarized in Robert and Sykes' (2000) list of the components of urban redevelopment programs: the identification of problems, constraints, opportunities, resource requirements, and overall strategy accompanied by a detailed schedule of implementation and action in the framework of partnership and sustainability. A set of keys specific to the

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Istanbul experience discussed in this study can shed light on current attempts at the reformulation of the redevelopment scheme in Turkey and elsewhere.

There are a number of specific potential applications inspired by the case projects of this study. Some interesting topics that merit further exploration include the ways in which the urban identity of Istanbul perceived by the government and how its inhabitants have affected the form, appearance, and aspirations of redevelopment projects; the changing concept of the *mahalle* in today's Istanbul as a major factor in defining area-based redevelopment sites; the role of the press as an important participant in redevelopment debates; social influences beyond the oblique associations inherent in references to the Kurds; the impact of the 5-year local election cycle on redevelopment projects; and the ultimate housing outcomes of redevelopment projects for different kinds of *gecekondu* households (i.e. owners, tenants, households with small homes, others with larger homes). The sustainability of quality of life is as important as its establishment; therefore, academics should be encouraged to conduct longitudinal post-occupancy research about residents affected by redevelopment. The study of practice in the face of the complex relations of power, political loyalties, and ethnic, religious and territorial identities (and more) should extend to the micro-political details of planning practices. Further conceptualization and generalization of case findings may help academics see some of what can be learned from practice and help them to gear their instruction to the realities of practice.

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Resume

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Seismic Design Considerations for Architectural Design Aspects

Serra Zerrin Korkmaz*

Abstract

Architectural design decisions play an important role in the earthquake behavior of buildings. However, architects are very unfamiliar with earthquake response concept. Earthquake resistant design (ERD) initiates generally during the architectural design stage to adhere to these principles. This study was focused on plan geometries, architectural design and structural system configurations for structural earthquake responses. A general-purpose finite element program was used to evaluate several irregularities and their corresponding earthquake responses. In the first phase of the study, the projections in plan view and projection ratios were compared from a torsional response perspective. In the second phase, nonparallel axes are investigated. In the last phase, the effects of shear wall arrangement on torsional irregularity response were analysed by considering 4 different configurations in a school building failure during the recent earthquake (2011) in the city, Van located in the east of Turkey. The number of storys was chosen as a parameter for the latter phase. The mode superposition method was preferred for the linear dynamic analyses. According to the results of the study, the torsional rotation was found to be proportional

Keywords: *Earthquake, irregularity, architectural design, earthquake code, torsion*

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to the projection ratio in plan. For non-orthogonal cases, structure with an inclined axis more than 30°, torsional irregularity factor exceeded the code-defined limit. Beneficial observations and conclusions were drawn for both architects and structural engineers' perspective.

INTRODUCTION

Chapter 3.6 of the recently published Turkish Building Earthquake Code TBEC (2018) addresses and describes the "Definition of Irregular Buildings". In this heading, the structures are classified as either regular or irregular (Korkmaz & Korkmaz, 2013).

Geometric arrangements in plan and elevation view for various types of buildings are identified as irregularities. In TBEC 2018, architects are advised to design regular, symmetric structures (Tezcan & Alhan, 2001). TBEC 2018 states that; "Regarding the definition of irregular buildings whose design and construction should be avoided because of their unfavorable seismic behavior". This is due to fact that structural irregularities affect the seismic performance of buildings (Inel, Ozmen, & Bilgin, 2008). The code's main advice is to avoid these irregularities during the preliminary architectural design stage. It is known that irregularities in a structural system are influential in reducing the seismic performance of buildings (Mendi, 2005). Irregular configurations, either in plan or in elevation, was often recognized as the main cause of failure in past earthquakes, and the shape of a building might become a negative factor (Arslan, Korkmaz, & Gulay, 2006).

In TBEC (2018), irregularities are defined under the two basic headings of irregularities in plan (denoted as A) and irregularities in elevation (denoted as B). Irregularities in plan are consistent with one of four different structural irregularity types: torsional irregularity, floor discontinuities, projections in plan, and nonparallel axes of structural elements (i.e., the configuration of structural elements on a nonparallel axis) (Ozmen & Unay, 2007). There are also three types of structural irregularity in elevation (Figure 1). These types are defined under different sub-headings (Tugba Inan & Korkmaz, 2011).

The code also defines the structural analysis assumptions required when such irregularities exist in a building (Mendi, 2005). Irregularity types A1 and B2 govern the selection of a seismic analysis method. In buildings with irregularity types A2 and A3, it must be verified that floor systems are capable to safely transfer seismic load between vertical structural elements (TBEC, 2018). In buildings with nonparallel structural element axes, the internal forces along the principal axes must be amplified.

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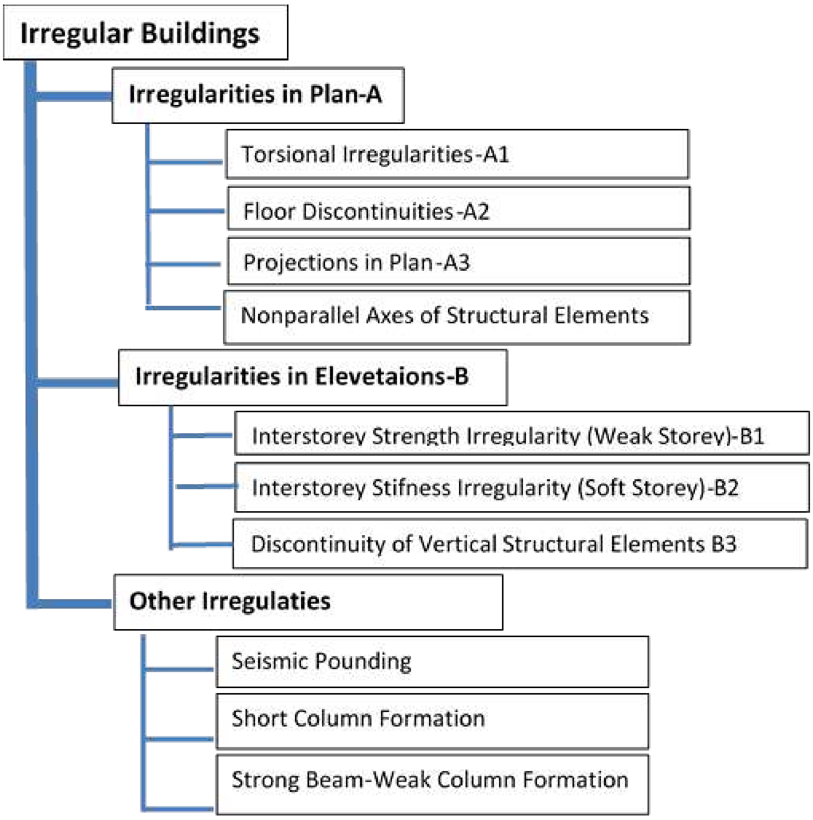

Figure 1. Irregularities defined in the Turkish Earthquake Code (TBEC 2018)

EVALUATION OF A STRUCTURE'S EARTHQUAKE RESPONSE

In seismic calculations, there are two orthogonal earthquake directions in a structure (X and Y). The earthquake loadings are defined and FEA is conducted. After analysing the structure, the displacements of the top and bottom joints in the columns or shear walls are calculated (δ_i) in the two orthogonal earthquake directions. The story drifts are calculated as the difference in the displacements between the two consecutive stories. For the ith story, Δ_i can be calculated as

$$\Delta_i=(\delta_i)-(\delta_i-1) \quad (1)$$

Story drifts are calculated by considering the effects of ± 5% additional eccentricities in both earthquake directions. The maximum (Δ_{imax}) and minimum (Δ_{imin}) story drifts were determined for the two orthogonal earthquake directions on each individual story of the building (Figure 2).

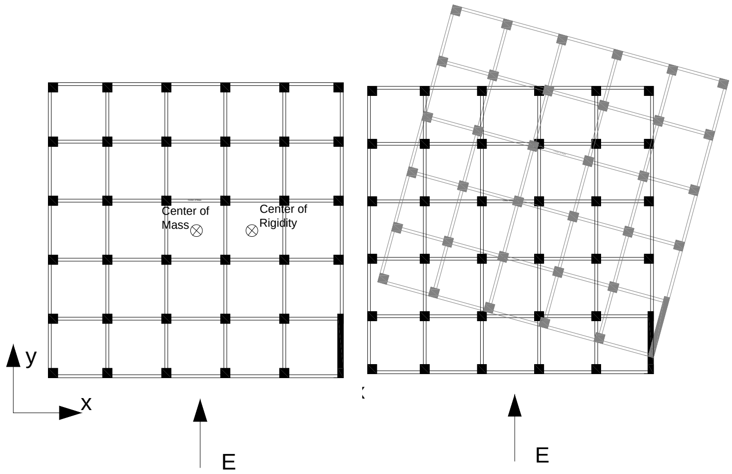

Figure 2. Calculation of maximum and minimum story drifts

The average relative story drift of the ith story in either of the earthquake directions, which are orthogonal to each other, can be calculated as

$$\Delta_{i\text{-}ave}=((\Delta_{imax})+ (\Delta_{imin}))/2 \quad (2)$$

The torsional irregularity factor (η_{bi}) is defined as the ratio of the maximum story drift at any story to the average story drift at the same story in the same direction, and can be formulated as

$$\eta_{bi}=(\Delta_{imax}) / (\Delta_{i\text{-}ave}) \quad (3)$$

When a structure's torsional irregularity coefficient ηbi is greater than 1.2, torsional irregularity (type A1) is said to exist in that structure (TBEC, 2018). In a case where type A1 irregularity exists at any ith story such that the condition $1.2< \eta_{bi} <2.0$ is satisfied, the ± 5% additional eccentricity defined above and applied to this floor must be amplified by multiplying it with coefficient (D_i) (depending on the earthquake direction), which is called the amplification factor and can be formulated using Eq.4. The design eccentricity (e_d) is now calculated from Eq. 5 and the analysis is repeated.

$$D_i=(\eta_{bi}/1.2)^2 \quad (4)$$

$$e_d=e+0.05x\ D_i \quad (5)$$

Here, ed is the design eccentricity and e is the existing eccentricity of the structure. Although the code gives certain recommendations for assessing the degree of irregularity and corresponding penalties and restrictions, it is important to understand that these recommendations are meant as discouragement and to make the designer aware of irregularities' potential detrimental effects (Duggal, 2007).

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If η_{bi} is greater than 2, the structural system is changed and re-analyzed. Most of the seismic codes, along with the TBEC-2018, define torsional irregularity as a significant irregularity because of the devastating effects documented for buildings with this irregularity after earthquakes (Gülay & Çalım, 2003).

There are some restrictions on the utilization of the equivalent earthquake loading (EEL) method in structures where torsional irregularity exists. In general, the dynamic analysis is preferred as a safe method, for torsional irregular structures.

Earthquake loads act on a structure's center of gravity, but the structure's rigidity center responds to these loads. The distance between the center of gravity and center of rigidity should be at a minimum. If the eccentricity is large, a torsion moment will occur around the center of rigidity and creates additional shear forces in the columns. It is very difficult to change the location of the center of gravity. On the other hand, the center of rigidity can be modified by experimenting with cross-sections and the locations of columns and shear walls (Ozmen & Unay, 2007). In other words, the center of gravity and the center of rigidity can coincide through regular disposition of the vertical structural members (Tugba Inan & Korkmaz, 2011).

PLAN GEOMETRY AND TORSIONAL IRREGULARIT

The relationship between building plan geometries and torsional response was investigated using finite element models (FEM) of the selected structural systems. Cases involving projections in plan, and non-orthogonal axes of the system were evaluated within the study. The generated 3D models were analysed under lateral earthquake loadings. Obtained results were compared in terms of their earthquake behaviour.

Six different, 9-story structural models, including the reference building, were modelled to investigate the relationship between irregularities and the consequences of earthquakes. The reference structure was a typical moment-resisting, beam–column dominated RC (Reinforced Concrete) frame, which is the most common seismic framing system used for building construction in Turkey (Sezen, Elwood, Whittaker, & Mosalam, 2003). The reference model's frame measured 25 m by 25 m in plan and had 5@5 m bays in both the X and Y directions. The floor plans were identical in all storys. The first model, or reference model, did not contain irregularity and was named as "Regular Frame".

Three-dimensional mathematical models were created using the ETABS finite element program to carry out separate linear dynamic analyses in the longitudinal and transverse directions. The columns were designed to be square for simplicity.

The proper representation of building stock was the primary concern in the design and detailing of the model buildings. Because the majority of Turkish buildings were constructed according to the 1975 Turkish Earthquake Code, the selected model buildings were designed according to this code and considering vertical gravity loads (Inel M., Ozmen H.B., Bilgin H., 2008). The vertical loads consisted of live and dead slab loads, infill wall loads on beams and the dead loads of columns and beams. The total gravity load was calculated as 1.4 times the dead load (G) plus 1.6 times live load (Q). To prevent creep failure, the Turkish Reinforced Concrete Code (TS500, 2000) dictates that, the capacity of a column (Acxfck) must be at least twice that of the load calculated using the 1.4G+1.6Q load combination. Here, G is the dead load and Q is the live load acting on the columns' tributary area. Note that the story weight consists of the dead load and 30% of the live load (for residential buildings according to TBEC (2018)) at the time of the earthquake.

A concrete strength of 20 MPa was selected and the reinforcement ratio of the columns was set at 1.5%. The uniform slab gravity loads were 2.5 kN/m2 for the dead load case and 3 kN/m^2 for the live load case. The dead load of the infill walls was assigned as distributed loads on the beams. The thickness of the slab was 150 mm and the typical floor height was set at 3 m. The beam cross-sections were assumed to be T-shaped for the interior beams and L-shaped for the exterior beams. All beams had 250 mm cross-sectional widths. The column and beam dimensions used in this study were typical frame element proportions present in the existing Turkish building stock. No effort was made to create a strong column–weak beam system because such systems were not considered in the 1975 version of the Turkish Earthquake Code. The building was assumed to have 5% damping in all of its deformation modes (Inel et al., 2008; Munshi & Ghosh, 1998; Tezcan & Alhan, 2001).

Analyses were performed in the ETABS package program. This program is very similar to SAP2000 and has special advantages for building-type structures. This structural software was chosen because it represents a common platform between structural engineers and architects that enables collaborations (Inan, Korkmaz, & Çağatay, 2012).

The columns were modelled with frame members, while the slabs were modelled with shell elements. Slabs were assumed to be

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infinitely rigid and rigid diaphragms were assigned. Foundations were not considered, and fixed supports were assumed at the base of each building. Seismic analyses were carried out in accordance with the recently published Turkish Earthquake Code TBEC (2018), which shows similarities to the FEMA-356 (2000) guidelines (Inel et al., 2008; Tezcan & Alhan, 2001).

The model structures were assumed to be located İzmit city (located in the regions of high seismicity) and the importance factor, I, was set equal to 1.0 (for residential and office buildings). Structural behavior factor, R, was set equal to 4 for reinforced concrete moment resisting frames of nominal ductility (Sezen et al., 2003).

Buildings with Re-Entrant Corners and Projections

Some structures contain projections in plan constituting re-entrant corners due to the land dimensions, architectural considerations or functional necessities, or to animate buildings. Shapes such as H, L, T, U, Y, +, or a combination of these forms are typical examples of building configurations that contain projections or wings in plan. Such buildings are commonly designed for high-density housing and hotel projects because they enable large plan areas in compact forms, which have different vistas and lighting opportunities from different angles (Christopher Arnold, 1996). Buildings with projections have often been severely damaged during earthquakes (Figure 3) (Mendi, 2005; Wakabayashi, 1986).

The problem with projections in plan is explained by means of Figure 4. If several blocks meet, the structure becomes susceptible to EQ loads. The inside corners are called re-entrant corners and the connection point is called the notch point. If an earthquake comes from the Y direction as shown, the projection located parallel to the earthquake direction (block A) behaves more stiffly than the perpendicular projection (block B). Both projection blocks experience different displacements and push or pull each other at re-entrant corners or notch points. Critical stresses accumulate at the notch points where the projections connect. The magnitude of the accumulated stresses depends on the wing height, slenderness ratio, length and length ratio. A good example of damage in a re-entrant corner was observed in the 1999 Marmara Earthquake (Figure3).

Figure 3. Damage in the re-entrant corner of an L-shaped building (source: Anonymous, 2000, Arslan and Korkmaz 2007)

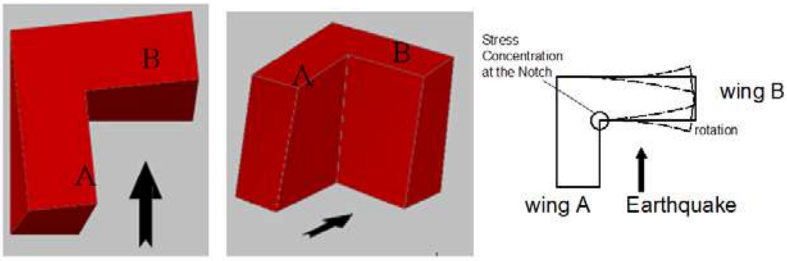

Figure 4. Behaviour of an L-shaped structure with a projection.

The other problems associated with projections can be summarized as follows.

- Because the center of mass and center of rigidity cannot geometrically coincide in this shape, they cause additional torsional stresses on the structure that are very difficult to analyze and predict (C Arnold, Reitherman, & Whitaker, 1981).

- Long structural systems with an extended form in plan can experiences greater variations in soil conditions.

- The introduction of deep re-entrant angles into buildings introduces complexities into the analysis that makes them potentially less reliable than simple forms. Long wings cause problems in behavior prediction (Dowrick, 2009; Duggal, 2007; Mendi, 2005; Ozmen & Unay, 2007).

- Plan configuration can be symmetrical, as illustrated in Figure 5, but become irregular due to re-entrant corners. H shapes, although symmetrical, should not be encouraged either.

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The horizontal shearing effect is a common problem due its occurrence in very short as well as tall buildings (Figure 6). The taller the structure, the greater the dimension of critical movement near the top will be (J. Ambrose & Vergun, 1999).

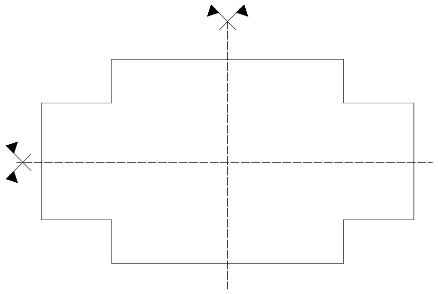


Figure 5. Plan geometry with symmetry but also irregularity

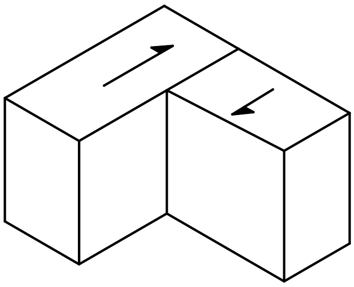
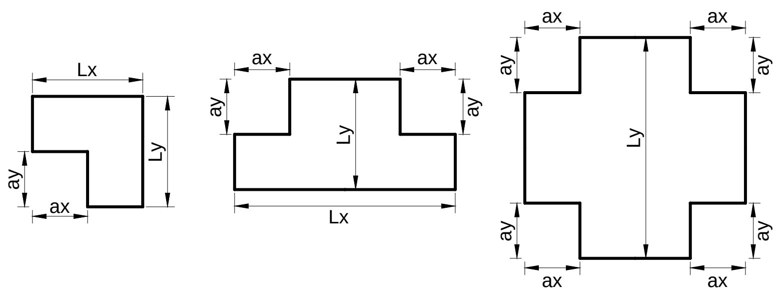


Figure 6. Horizontal shearing effects in projections in plan

The TBEC (2018) highlights the fact that the ratio of projections to the entire plan is very important in terms of a building's seismic behavior. Plan irregularities related to projections are defined in TBEC (2018) under the heading for A3 type irregularities as the cases where the dimensions of projections in both perpendicular directions in plan exceed the total plan dimensions of that story of the building in the respective directions by more than 20%. In buildings with irregularity type A3, it shall be verified by calculation in the first and second seismic zones that the floor systems are capable of safe transfer of seismic loads between vertical structural elements (Figure 7). In Figure 8 several structural layouts having projections in plan are given.



a) b) c)

Figure 7. A3 type irregularity (ax/Lx>0.2 and ay/Ly>0.2 at the same time)

According to TBEC (2018), for an A3 type irregularity to exist, the dimensions must satisfy $a_x/L_x>0.2$ and $a_y/L_y>0.2$ simultaneously. In Figure 7-a, the explanation is clear. If $L_x= 10$ m, and $a_x=2$ m, then there is an A3 type irregularity. But in the case of Figure 7-b, L_x must be 10 m and a_x must be 2 m to form an A3 type irregularity. The total projection length becomes 4 m in the X direction.

The building in Figure 9 was analyzed to determine the critical projection ratio. The structure had the same plan area as that in the previous case, but this building had different projection ratios (a_x/L_x). The projection lengths were determined to measure 2.5 m, 5 m, 10 m and 15 m in the X or Y directions. The span lengths or distances between columns were kept constant for all cases except for the 2.5 wing length cases. The dimensions of the columns in the wings were identical to the column dimensions in the main structure.

Figure 8. Several building layouts with projections in plan

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Representative illustrations of the analysis cases are depicted in Table 1. The number of storys was chosen as a parameter and varied between 1 and 13 storys. The dimensions of the square columns were changed according to the number of storys. Except for the models in the first column (cases I, M, and R), an A3 type irregularity occurred because the projection ratios in both directions exceeded the limit ratio of 20%.

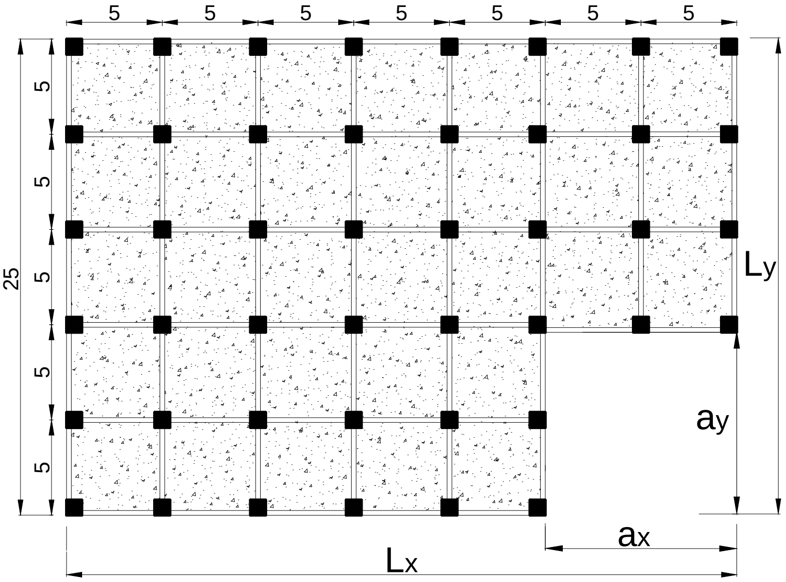
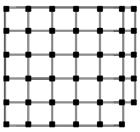
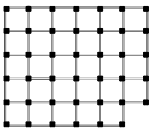
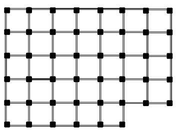
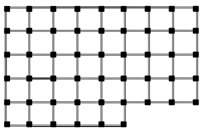
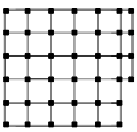
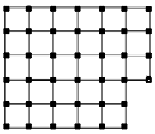
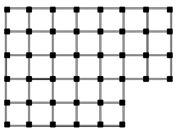
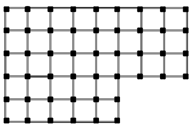
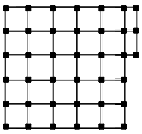
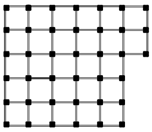
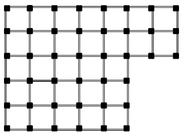
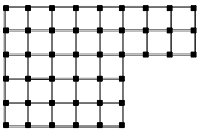


Figure 9. Model structure for projections in plan

Table 1. Analysis cases for projections in plan

a_x / a_y	2.5 m (9%)	5 m (17%)	10 m (29%)	15 m (38%)
5 m (20%)	 Case I	 Case J	 Case K	 Case L
10 m (40%)	 Case M	 Case N	 Case O	 Case P
15 m (60%)	 Case R	 Case S	 Case T	 Case U

The models were analyzed considering two orthogonal earthquake directions separately to determine the drifts of their columns. The torsional irregularity factors were calculated by referring to the TBEC (2018) and are compared in Figure 10.

For constant a_y values, the torsional movements showed an increasing trend as the a_x dimension increased (Figure 10 a-b-c). The torsional irregularity coefficients were at a maximum for 1-story cases and tended to decrease in 2-story cases. However, an increase became noticeable again as the number of stories increased after that. If the projection length in the X direction (a_x) was equal to the 15 m, the torsional irregularity factor was above the code limit of 1.2 for cases a_y= 15 m, 10 m and 5 m.

In Figure 10-d-e and f, the torsional irregularity factors are compared while keeping a_x constant and taking a_y as a parameter. In Figure 9-d, for a constant a_x value of 15 m and models with up to 7 stories, the η_{bi} value of the structures increased as a_y decreased. But in models with a total number of storys greater than 7, the η_{bi} values increased as the a_y value increased. The same observations were valid for the cases with a_x=10 m and a_y=15 m, 10 m, 5 m as a parameter (Figure 10-e).

According to TBEC (2018), A3 type irregularities existed in the models for Cases L-P and U, and the corresponding η_{bi} values were higher than the code limit (with A1 type irregularities observed). On the other hand, although A3 type irregularities existed in Cases K, O and T, the torsional irregularity factors were below the limit of 1.2 (there were no A1 type irregularities). There were no A3 type irregularities in the other models, which also had torsional irregularity factors below the limit value.

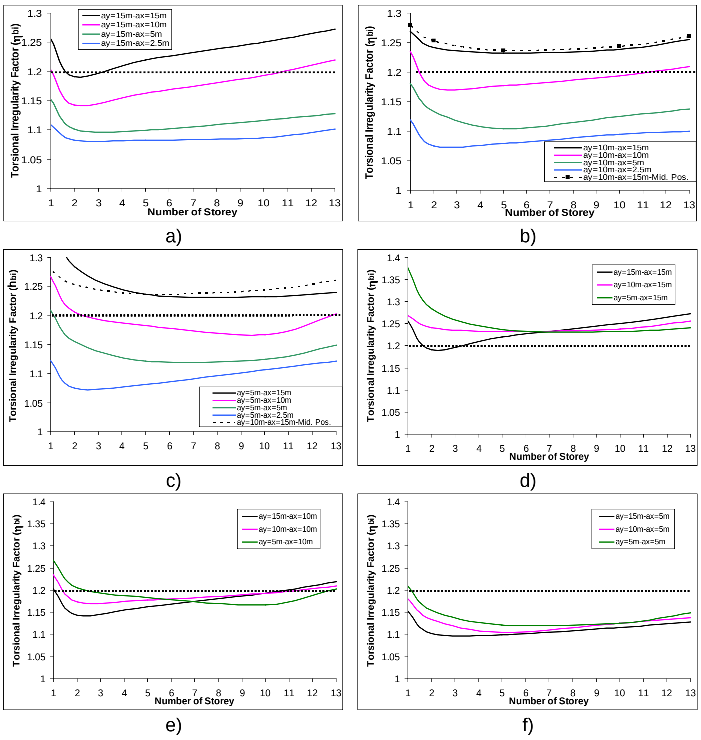


Figure 10. Torsional irregularity factors (η_{bi}) for different projection ratios in plan

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The effect of wing configuration and location was also investigated (Figure 11.). The wing on the top right of the model was placed on the middle right of the structure (in plan). This case was run for only the a_y=10 m and a_x=15 m dimensions (a_y=10 m, a_x=15 m, Mid. Pos.) and the corresponding η_{bi} values were compared with those of the first configuration in Figure 10-b. There was no difference between these two configurations.

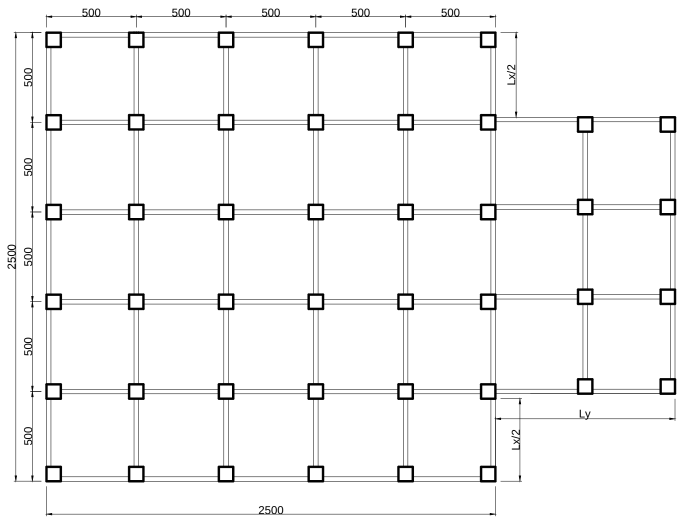

Figure 11. Effect of wing location

Nonparallel Axes of Structural Elements

Irregularities may exist in the configuration of a reinforced concrete structure if one or more of the columns or shear walls have an inclined axis with respect to the perpendicular earthquake directions. In the case of columns and shear walls with non-orthogonal placement, the principal axes of the vertical structural elements in plan are not parallel to the major orthogonal axes (Figure12). This type of irregularity is commonly seen as a result of:

• street intersections,

• space organization requirements in the design,

• taking advantage of the maximum parcel area, in line with owner requirements,

• abiding by the parcel form(Tugba Inan & Korkmaz, 2011), or

• aesthetic requirements or animating the building facade.

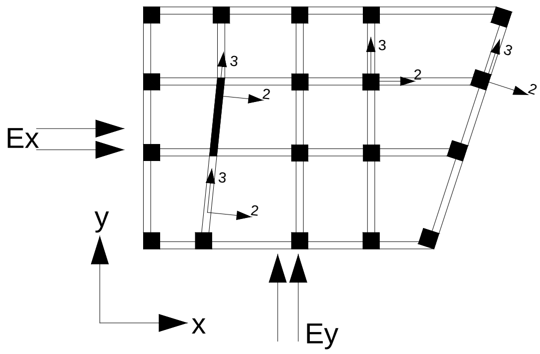

Figure 12. Non-orthogonal axis irregularity

The structural problems related to non-orthogonal axes systems include:

• an overly complicated building structural analysis that requires a detailed three-dimensional dynamic analysis,

• difficulty in predicting lateral load distributions,

• exposure of structural elements to additional internal stresses in earthquake conditions, and overloaded beam connections under lateral earthquake loads.

Some building layouts with nonparallel axes are given in Figure 13.

Figure 13. Building layouts with nonparallel axes

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To investigate the effects of non-orthogonality on the distribution of moments and shears in vertical structural elements and torsional irregularity, a 9-story model building with one non-orthogonal and five orthogonal axes was studied (Figure 14). A dynamic analysis was performed to obtain the internal forces and base shear. A model building with 36 columns and 6 axes parallel to the both the X (1 to 6) and Y directions (A to F) was selected. All axes were orthogonal in the reference model, while only the F axis was non-orthogonal in the other models. Four cases with different non-orthogonal axis orientations were considered, and these orientations were altered by changing the angle α between the principal axis of the columns and the orthogonal *Y*-direction. The total area of the structure, dimensions of the columns and beams were kept constant in each model, while the angle α was varied to measure 0^{o} (reference model) , 0^{o}, 5^{o}, 10^{o}, 20^{o} or 30^{o} measured in the counterclockwise direction. Each case was analyzed for four earthquake directions. For each α value, the direction of the earthquake was assumed to occur in four different directions: parallel to the X-axis, parallel to the *Y* axis of the structural system, parallel to the main principal axis and perpendicular to the main principal axis of the non-orthogonal columns.

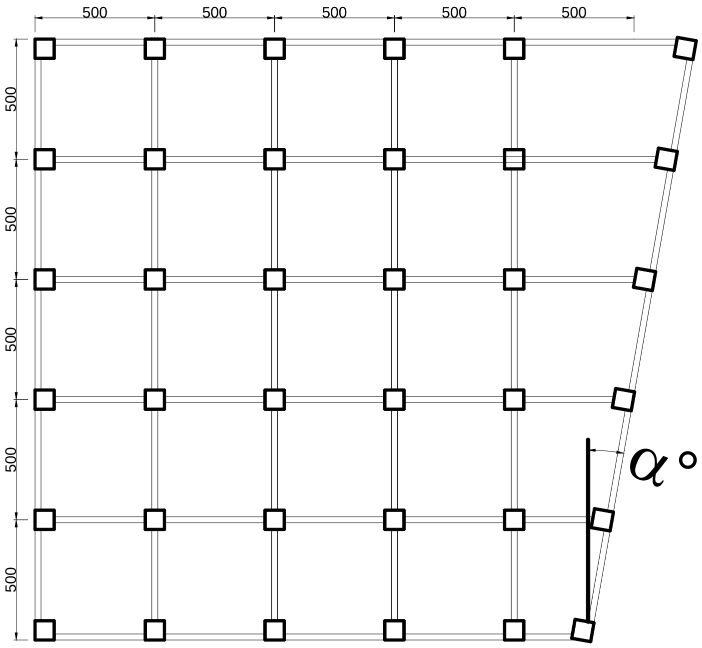

Figure 14. Non-orthogonal axes

The torsional irregularity factors were calculated from the relative point drifts of the columns and the results of which are illustrated comparatively in Figure 15 for α= 0^{o}, 5^{o}, 10^{o}, 20^{o}, 30^{o}. It is seen that, there was no clear difference between the 5- and 10-degree cases, while the η_{bi} value of the 30-degree case fell above the code limit of 1.2.

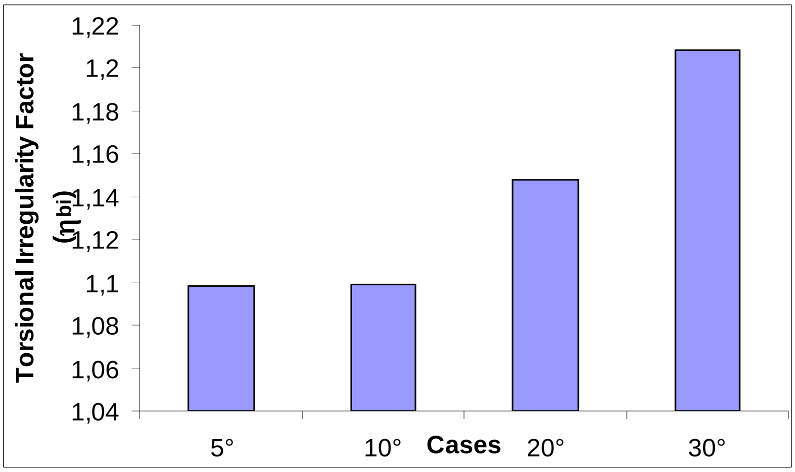

Figure 15. Torsional irregularity factors for different axis angles

Torsional Irregularity due to Structural Configuration

Torsional irregularity generally exists on a structure due to its plan geometry. To prevent torsional deformation, a designer should provide symmetry in both the building's form and structure (J. E. Ambrose & Vergun, 1985). However, the organization of structural members or a structural member's rigidity distribution may also create torsional irregularity. Sometimes, although a building whose form is a square or rectangle may be simple and symmetrical in plan, torsional forces can be created due to irregularities inside the building. A lack of symmetrical configuration in the columns or improper shear wall design may disturb the structure's symmetry and produce torsional effects, which are difficult to assess properly and can be destructive (Duggal, 2007; Mendi, 2005).

A school building in the Van city of Turkey (Figure 16), has a symmetrical rectangular plan. The structure had two parallel shear walls on its adjacent corners, creating an overly rigid side, and was torsionally balanced along the wall direction. In the other direction, however, the symmetry of the vertical members was disturbed. There were two separate parts, a flexible side and a stiff side, because the rigid walls were located on one side of the building. From the outside, the structure appeared regular. Unfortunately, the earthquake came from the weak direction. Torsion occurred around a vertical axis, leading to the building's destruction. The less rigid portion of the structure displayed more torsion than the rigid side. First, the school building twisted, and then farthest edge of corner columns failed and collapsed due to the torsional eccentricity. The concrete quality and details of the

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reinforcement arrangements were the other factors affecting the failure (Figure 17) (Korkmaz, 2015).

Figure 16. Gedikbulak Village school, Van, Turkey (source: http://okulweb.meb.gov.tr)

Figure 17. Primary school in Gedikbulak Village, after failure (source: https://fotogaleri.ntvmsnbc.com/helikopterden-deprem-alani.htlm?position=37)

The location of shear walls should be chosen carefully, keeping in mind that the centers of gravity and rigidity are supposed to be as close together as possible. If the shear walls are concentrated on one side of the building, there will be excessive torsional eccentricity and uneven displacements in the structure (Ozmen & Unay, 2007), and shear walls can be responsible for excessive damage during the earthquakes, as observed in the school building.

A typical building model was selected and analyzed to represent this theory. A sample building set was selected for reflection that included regular buildings both with and without shear walls and buildings with irregular shear wall configurations. The main reference structure was a typical moment-resisting beam–column RC frame with 25 m by 25 m in plan and identical to the regular structure in Section 3. It had 5@5 m bays in both directions. For the first two cases, the building plans were symmetrical in both the X and Y directions, while symmetry was maintained only in the X direction for the latter two cases.

The total number of storys was selected as a parameter and varied from 1 to 13. The first structural model did not contain any shear walls and was named the regular model case (Figure 18). In case A, two 5-m-long parallel shear walls were placed in the middle of the structure. Both the regular and Case A models were symmetrical in the X and Y directions. Torsional irregularity was created in the building by changing the locations of the shear walls, shifting them to create three different cases of eccentricity, as shown in Figure 18. In Case B, two shear walls were shifted 5 m in the X direction, while in Case C, the shear walls were shifted 10 m along the X direction. The modelling approaches for each case were similar to the assumptions given for Case D.

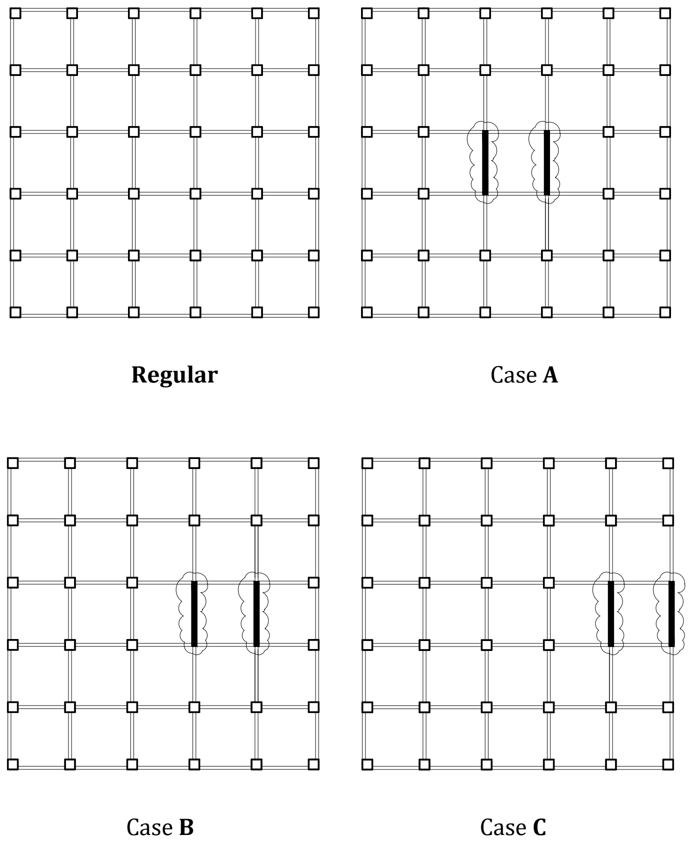

Figure 18. Models for analyzing the effect of shear wall location

An additional accidental eccentricity of 5% was applied even if the structure's existing eccentricity was zero, as dictated by TBEC-2018. A dynamic analysis was carried out and the joint drifts were determined. Torsional irregularity factors were calculated for every floor and are tabulated in Table 2. The first column (1) in the Table represents the number of storys in the model, the second column (2) shows the initial additional eccentricity, η_{bi}-max, and the third column (3) shows the calculated maximum torsional irregularity factors after the first analysis run. When the $\eta_{bi\text{-}max}$ value exceeded the TBEC-2018 limit value of 1.2, the additional eccentricity of 5% was multiplied by an amplification factor D_i (columns 4 and 5) and the model was reanalyzed. The new η_{bi}-max values are listed in column 6.

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Table 2. Calculated eccentricity values

Eccentricity Values - Case A					
1	*2*	*3*	*4*	*5*	*6*
Number of Storys	*ex_1 %*	*η_{bi}-max*	*Di*	*Di * ex_1 %*	*η_{bi}-2-max*
13	0,05	1,143	-	-	-
10	0,05	1,143	-	-	-
5	0,05	1,176	-	-	-
3	0,05	1,198	-	-	-
2	0,05	1,273	1,105	0,0552	1,333
1	0,05	1,500	1,563	0,0781	1,600
Eccentricity Values - Case B					
Number of Storys	*ex_1 %*	*η_{bi}-max*	*Di*	*Di * ex_1 %*	*η_{bi}-2-max*
13	0,05	1,36	1,12	0,056	1,36
10	0,05	1,38	1,13	0,056	1,38
5	0,05	1,53	1,37	0,068	1,55
1	0,05	1,75	2,12	0,106	1,77
Eccentricity Values - Case C					
Number of Storys	*ex_1 %*	*η_{bi}-max*	*Di*	*Di * ex_1 %*	*η_{bi}-2-max*
13	0,05	1,55	1,33	0,067	1,57
12	0,05	1,55	1,35	0,067	1,57
10	0,05	1,58	1,38	0,069	1,60
7	0,05	1,65	1,55	0,077	1,67
5	0,05	1,72	1,84	0,092	1,73
3	0,05	1,77	2,12	0,106	1,78
1	0,05	1,81	2,29	0,114	1,83

Variations in the torsional irregularity factor with respect to the number of storys for cases B and C are given in Figure 19. The graphs clearly show that Case C had a higher torsional displacement than Case B. Calculated torsional irregularity factors were greater than 1.2. It was interesting to note that the ηbi values were higher in structures with 1 to 4 storys than in structures with 10 to 13 storys. The reason for this result could be attributed to the fact that, as the number of storys increased, the dimensions of the columns also increased. On the other hand, the lengths and thicknesses of the shear walls were kept constant. The influence of a shear wall on the lateral load carrying system decreased as the number of storys and column dimensions increased.

In Figure 20, the calculated maximum top story lateral displacements, under the orthogonal earthquake loadings, are plotted with respect to the number of storys. Cases B and C corresponded to the displacements with an additional eccentricity of 5%, while the values for Cases B-2 and C-2 are calculated from the cases with additional eccentricities of (Dix 5%). Case R shows the displacements of the reference building with no shear walls. Symmetrically placed shear walls decreased the maximum lateral displacement. On the other hand, Case C (with 5% additional eccentricity) displays values very close to those of Case R (with no shear wall). The shear wall configuration of Case C did not limit the lateral displacements but did cause torsion

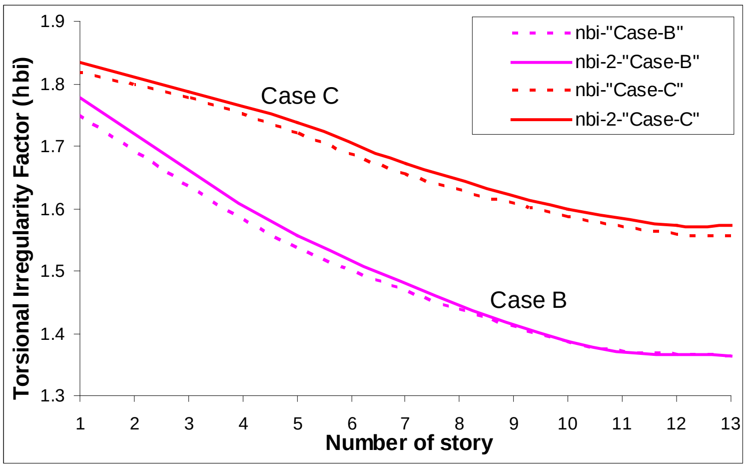

Figure 19. Torsional irregularity factor with respect to the number of storys

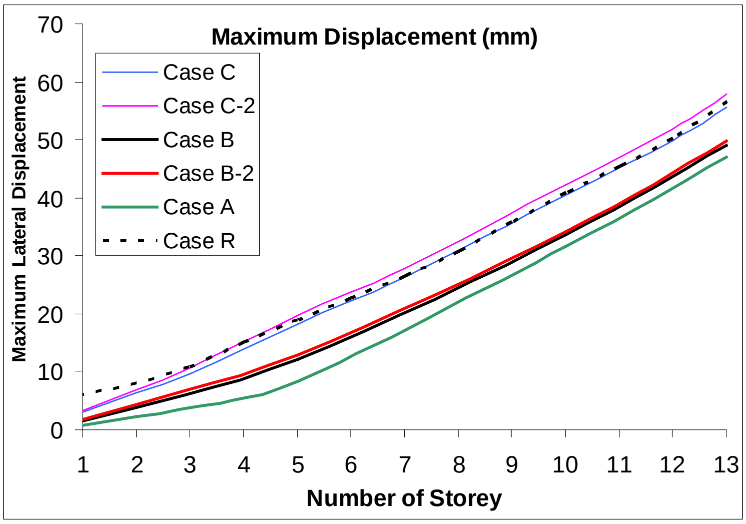

Figure 20. Maximum lateral top displacements under orthogonal EQ loading cases

CONCLUSIONS AND RECOMMENDATIONS

The projections in plan (A3 type irregularity) and the ratio of projection as well as torsional response were analyzed in this study. The torsional rotation was found to be proportional to the projection ratio in plan. Although A3 type irregularities existed in models K, O and T, the torsional irregularity factors were below the code limit. On the other hand, when the projection ratios in the X direction were increased by 38%, Cases L, P and U displayed A1 type irregularities as well. The projection orientation (i.e., middle or side placement of the projection) had no significant effect on the torsional response.

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In this study, 4 model structures with non-orthogonal axes and one regular structure were analyzed. One of the external frames in each structure was inclined at angles of 5°, 10°, 20° and 30°. From a torsional response viewpoint, the 5° and 10° cases showed no significant differences. In the 30° case, however, the structure's torsional irregularity factor exceeded the code-defined limit and showed an A1 type irregularity.

The internal forces in the column at the intersection of the 5-F axes was evaluated. The calculated internal forces were divided by the corresponding value obtained in the regular case. At 20° and 30°, the V3 and M2 internal forces or moments increased by approximately 1.18 times. This amplification remained limited in the V2 and M3 forces. On the other hand, at 5° and 10°, all four internal force values were close to the values obtained in the regular case.

The torsional moment of column 5-F was also evaluated. In this case, the number of storys was also a parameter. The maximum amplification of the torsional moment was 3.5 times at 30°, 2.5 times at 20° and below 2 at 5° and 10°.

The last section of the study illustrated vertical structural element configurations and torsional responses. In Case A, the shear walls did not disturb the symmetry of the building and the lateral displacement decreased considerably. On the other hand, in Case C, these shear walls were placed at the outermost sides of the structure and the symmetry along the Y axes no longer existed. The maximum lateral displacement of the structure was close to the case in which there were no shear walls. However, these asymmetrical shear walls disturbed the structure's torsional balance and the maximum torsional irregularity factor was found to lie between 1.9 and 1.6. The maximum torsional movement was obtained in low-rise structures because their column dimensions were smaller than those in high-rise buildings, and the shear walls thus became more governing for the behavior of the structure.

Linear elastic materials are assumed within the study, Cracked section properties may have effect on the results. Also more numerical analysis needs to be done to account for soft storys, short column effects and architectural design.

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Resume

Dr. Serra Zerrin Korkmaz graduated from Selçuk University, Department of Architecture in 1997. She completed her master's degree in 2001 and her doctorate in architecture in 2007. In her doctoral study, she worked on improving the earthquake *performance of rural houses and received support from TUBITAK and the World Bank. In 2015, she became an associate professor in the department of building science. In general, the study area is related to the impact of architectural design on earthquake resistance of buildings.*

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Research Article

Assessment of Seismic Behaviour and Safety of a Masonry Heritage

Ahmet Murat Turk*

Abstract

Turkey is a highly seismic country where numerous major earthquakes have devastated or damaged the existing historic structures owing to there is a large number of historical structures, mostly religious ones like mosques, and churches. The minarets are essential parts of mosques and there are many of these historic structures across the country which were built since Seljuq Empire started to rule the Anatolia and followed by Ottomans. As Turkey located in a highly active seismic zone, the possible damage of the minarets, the tallest part of the mosques, should be examined and the safety measures, in terms of seismic retrofit, should be considered. It is engineering communities' responsibility to satisfy the longevity of these existing heritages by the help of science and knowledge.

To realize this objective, a case study is planned which addresses the problem of seismic capacity of a stone masonry minaret as a part of the architectural heritage in Istanbul, and a typical historical mosque is chosen. Mathematical model of the minaret is prepared in order to obtain possible deformation profile, lateral displacements, free vibration modes and most likely failure modes under seismic excitation by using response spectrum analysis.

Keywords: *Historical, heritage structure, minaret, seismic, masonry, performance*

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Most recent developments in the in-situ testing of structures and computational procedures for structural analysis have made reaching to the important results about the behaviour of the old masonry structures. The numerical results have shown that the greatest damage accumulated near the shoe region and the lower part of the shaft. The evaluation of these results is promising in terms of seismic safety of these heritages with minimized intervention on the structure without compromising the authentic view and function.

INTRODUCTION

In Turkey, which is very rich in terms of cultural heritage, historical structures show a great variety. Due to the presence of Anatolia on an active earthquake zone, historical structures in the country have been affected by earthquakes several times. Some have been damaged and repaired, and some were completely collapsed. Reducing the damages caused by earthquakes is possible with the help of continuous maintenance and monitoring of the architectural heritages. Long periods of ignorance, ongoing construction activity around these structures weakens historical structures and makes them more vulnerable. Due to the problem of protecting the architectural heritage from earthquakes, many countries give the same priority to the work to be done before, during and after the disaster. Such actions should address the strategic, tactical and operational stages of pre-disaster risk assessment, risk mitigation and preparation, emergency response and disaster recovery stages for the management of the risks that may arise by earthquake hazard in historical buildings. The decisions for the restoration and strengthening of historical buildings are required to be based on a comprehensive analysis of their structural behaviour against earthquakes and to comply with accepted international principles for the protection of historical buildings. Because each historical building has its particular design, construction system, material properties and it offers a condition that should be evaluated by examining the present damages in detail. The earthquake damage to be challenged, ground conditions at the site, the characteristics of the structural system should be investigated, and intervention proposals needs to be developed accordingly. The changes and impacts of the suggestions on the existing historical structures needs to be evaluated in terms of protection principles; alternative solutions should be studied if necessary. The main document of international protection rules for such structures is the “International Charter for the Conservation and Restoration of Monuments and Sites (Venice Charter 1964)” which has been adopted and then recognized as a significant statutory document by ICOMOS in 1965. One of the basic principles of the Venice Statute is the implementation of conservation interventions with

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an approach that takes into account the documentary and aesthetic values of historical buildings. Repair of historical buildings built with traditional materials and techniques is required to be cautious, interventions to be made, plan layout, appearance, material and construction systems are not subjected to change. For that reasons, the assessment and the seismic protection of historical heritage structures has remained one of the challenging subjects for the structural engineering community to study and owe to the vastly complex behaviour of the materials, especially under dynamic loading.

Historical structures like city walls, castles, bazaars, mosques and minarets have experienced diverse levels of damages during past earthquakes of Anatolia. As an old city and the capital of different empires, the historical records have shown the devastation of strong earthquakes occurred near Istanbul and across the lands of Anatolia. In Istanbul, more than 550 strong earthquakes have been recorded since the establishment of the city around 330 AC by the Roman Empire. The latest and strong one, produced by the faults near to Istanbul under the sea of Marmara, in 1894 Earthquake, 69 minarets were recorded as heavily damaged, 30 collapsed, across the Old Peninsula (Batur 1994). Since 1894, the city of Istanbul has not been affected by a strong earthquake produced by the fault system bordering the south coasts of the city.

In the religious structures, the height is an important factor to amplify the impression on the public. Consequently, the tall parts of these structures, minarets of mosques can be assumed as the symbols of Islamic architecture. Minarets are often constructed elegantly, as they are visible within a wide area in their neighborhood, and mostly used to hallmark a spot with an Islamic character. For the Islamic architecture, mosques are made of a combination of main dome and sub-domes and minarets which are carried by arches, walls and piers. At least a minaret is essential for each mosque complex which has a slender cylindrical shape where they can be constructed as separate structure near the main part or attached to the roof of the mosque. The typical height of a minaret is changing typically between 10 m to 70 m where the topmost part of the minaret is roofed by a conical cap, which is constructed by using a wooden frame covered with zinc sheets.

In order to understand the dynamic behaviour of historical masonry minarets, the use of on-site testing and computational methods have been utilized extensively with the purpose of advancing the life safety and strengthen the historical structures against earthquakes. As an example, in-situ dynamic vibration measurement study was performed on the Bezm-i Alem Valide Sultan Mosque (also known as Dolmabahçe Mosque) minarets, and ambient vibration data were recorded with a detailed report (Oğuzmert, 2002). An innovative strengthening method for the minarets was proposed in previous analytical studies by using FRP wrapping (Turk and Cosgun 2012, Turk 2013). The behaviour of masonry minarets subjected to dynamic earthquake loading is analyzed and evaluated [Oliveira et al 2011). In other studies, the dry joint masonry test specimens are tested and the results are presented. Under the in-plane combined compressive and shear loading, the structural behaviour and ultimate strength ability, failure mechanisms are studied [Lourenco 2006, Lourenco et al 2005).

Most of the earlier studies show that the dozens of historical minarets in Istanbul pose a serious collapse risk and threat human life in a strong earthquake. Therefore, structural assessment and modelling of these structures attract more attention from conservation societies, and due to the rigid rules of historic preservation of heritage structures, conservation agencies customarily demand less invasive practices in order to protect the view and unique architectural functions.

Despite the durability of historical masonry minarets has been verified over the several decades, the failures and collapses of similar type minarets have been seen during the earthquakes in Turkey in 1999 and prompted of the severity of losses, destruction and long-term consequences. Lately, Istanbul was hit by an earthquake with a magnitude of M_w=5.8 on Sept 26, 2019. The aftermath of the tremblor, hood and upper part of an existing minaret collapsed, fell onto the mosque attendants (Figure 1). Minaret was built by using reinforced concrete but the performance of the structure even under a moderate earthquake was poor, and the doubts have arisen on other existing minarets including historical masonry ones.

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Figure 1. Photo of the collapsed minaret in Avcılar, Istanbul (URL 1)

In this study, an existing historical minaret in Istanbul is studied as a case study. By using the on-site-measured structural parameters and the latest version of Turkish Seismic Code (TBDY 2019) which has been in force since January 2019, an analytical study is performed which is different from previous analytical studies (Oğuzmert 2002, Turk and Cosgun 2012, Turk 2013). The minaret structure is studied by using response spectrum analysis following the spectral values defined by the seismic code (TBDY 2019), and the obtained performance levels are discussed according to the "Guidelines for the Management of Earthquake Risks for Historic Structures" published by the General Directorate of Foundations (Tarihi Yapılar İçin Deprem Risklerinin Yönetimi Kılavuzu 2017).

CASE MINARET AND THE PROPERTIES OF THE MATERIALS

In Figure 2, the general view and physical dimensions are given for the minaret of Bezm-i Alem Valide Sultan Mosque in Istanbul (Turk and Cosgun 2012). The mosque was opened in 1855 on the seafront as a part of the Dolmabahce Palace complex near the European coast of Bosphorus Strait.

The minaret footing is constructed by using very thick polygonal limestone blocks and connected with the main wall of the mosque, consequently fully fixed support assumption is made for the analysis.

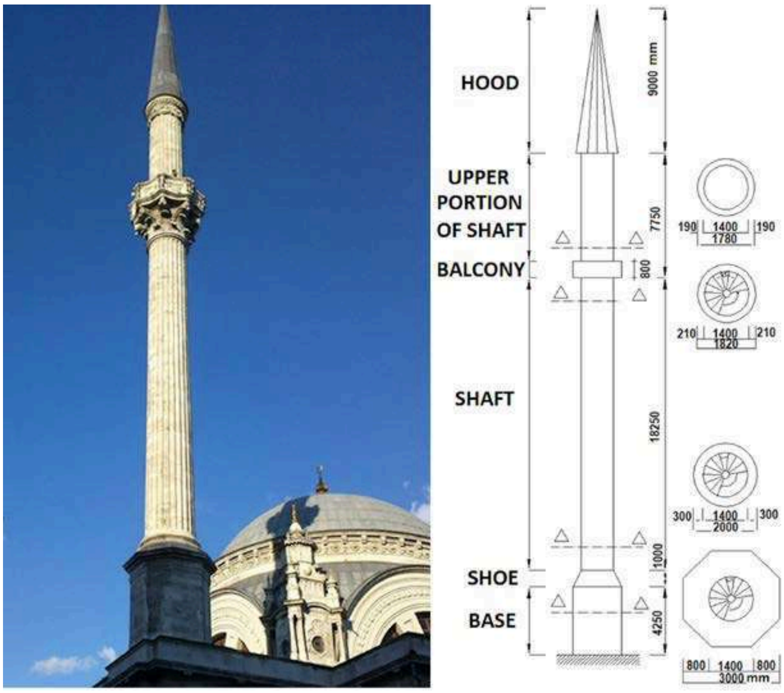

Figure 2. Photo (taken by author) and the dimensions of the minaret (Turk and Cosgun 2012)

The masonry minaret was constructed by single-leaf, cast-iron clamped limestone blocks (locally it is called as Küfeki stone) similar to all the historical buildings in Istanbul. Küfeki stone has been used for all masonry structures in Istanbul, which was a capital city of the Ottoman Empire. The geological background of the stone belongs to Miocene formation, and it contains $CaCO_3$ (more than 90 %) and has matrix structure of accumulated and metamorphosed sea shells (Arıoğlu and Arıoğlu 1997, Erguvanlı and Ahunbay 1989, Ahunbay 1988, Arıoglu and Arıoğlu 1999). In 2000, during the restoration practice of Mosque, material characteristics were determined for the limestone specimens of the minaret as given in Table 1 (Oğuzmert 2002).

Table 1. Mechanical properties of limestone used for the structural analysis

Physical Properties of Limestone	Min.	Max.	Average
Uniaxial Compressive Strength (MPa)	12.3	19.2	16.7
Unit Weight (kN/m³)	22.5	24.5	23.4

As a result of a previous study on limestones collected from queries near Istanbul, the ratio of elastic modulus, E, on uniaxial compressive strength, f_c, is proposed as 720. (Arıoğlu and Arıoğlu 1997). For the structural model of the minaret, the modulus of elasticity, E, is assumed as 8856 MPa which is the multiplication of 720 and f_c=12.3 MPa (minimum compressive strength of tested

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limestone samples (Table 1). The Poisson ratio and unit weight of the stone are taken as 0.24 and 23.4 kN/m^3, respectively in this study.

MODAL AND SPECTRAL ANALYSIS ON THE CASE MINARET STRUCTURAL MODEL

For the evaluation of the structural performance of the minaret model, a series of modal and spectral analyses are implemented by using the finite element method (FEM). Three-dimensional finite element model is constructed to investigate the dynamic response of the minaret with the ANSYS software. This software has different capabilities like linear, nonlinear, static, dynamic analyses of all types of structures. In this study, linear FEM analyses are performed by employing SOLID 185 elements which use 8 nodes having three degrees of freedom per node and during the analysis 786120 elements and 1239585 nodes are utilized for the minaret model (ANSYS 2018). Masonry is recognized as anisotropic composite material, but through the FEM modelling, a homogeneous isotropic material model approach is chosen by disregarding the mechanical differences between limestone units and mortar joints called as homogenization where the interaction between masonry blocks and mortar is not considered. Simplified linear analysis with the assumption of homogenized material can be utilised as a method for preliminary assessment and evaluation of the need to perform a more compound analysis.

In the model, the bottom of the minaret is assumed as fixed support, soil-structure interaction and base rotation are neglected during the analyses. Linear material behaviour is assumed, and the degradation of the stiffness, material softening and hardening properties are not taken into consideration.

The mosque is located in a highly seismic region with stiff soil layers located near the seashore where soil class is assumed as ZD consistent with seismic code (TBDY 2019) and Type C soil class according to Eurocode 8 and NEHRP (NEHRP 2003). TBDY 2019 describes the limits for ZD soil class with parameters of $15 \leq N \leq 50$ and 70 kPa $\leq c_{u30} \leq$ 250 kPa and $180 \leq V_{s30} \leq 360$ m/s where N is SPT blow number, c_{u30} is undrained shear strength, and V_{s30} is defined shear wave velocity for the top 30 m depth.

In order to simulate a constant damping ratio, 5 % is presumed whereas an earlier study showed that the ambient vibration tests concluded 3-5% damping those performed on Bosnian historical minarets (URL 2). In a study performed on different minarets near Istanbul, ambient vibration tests showed 0.5-1% damping for low amplitude motion (Oliveira et al 2011).

New Turkish Seismic Code imposes a new Earthquake Hazard Map of Turkey containing the geographic location of the structures (URL 3). Mainly, four seismic levels of earthquakes are expected in the safety assessment of the structures: DD-1 (Very rare, with the probability of exceeding over 50 years is 2% and the return period is 2475 years), DD-2 (Rare, with the probability of exceeding over 50 years is 10% and the return period is 475 years), DD-3 (Occasional, with the probability of exceeding over 50 years is 50% and the return period is 72 years) and DD-4 (Frequent, with the probability of exceeding over 50 years is 68% and the return period is 43 years) (Figure 3). The horizontal and vertical elastic spectra of these earthquakes are defined in the code on reference ground conditions for a particular earthquake level. In historical buildings, it is generally sufficient to consider the horizontal earthquake component. However, it may be necessary to consider the vertical earthquake component in large openings or cantilevers.

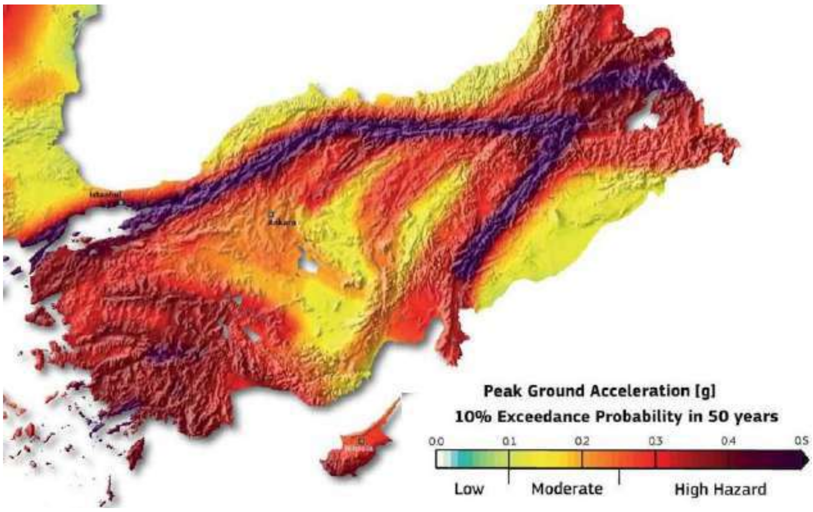

Figure 3. Peak ground acceleration map for 475 years return period (10 % exceedance in 50 years) (URL 4)

Special earthquake hazard analyses and site-specific earthquake spectra are required to determine the importance of the structure evaluated. DD-1, DD-2, DD-3 and DD-4 level spectral acceleration values are prepared according to the rules of Turkish Seismic Code 2019 by considering local site soil conditions (Figure 4) (TBDY 2019).

Turkish Seismic Code does not contain any specific instructions regarding the seismic assessment of historical masonry structures. Besides, Clause 3.5.1.2 imposes attainment of life safety (LS) performance level for all masonry structures under the impact of DD-2 level earthquake. For the minaret, Turkish Seismic Code 2019 offers to use the seismic load reduction factor (R_a), over strength factor (D) and as and building importance factor I parameters as R=2.5, D=1.5 and I=1.0, respectively. Seismic

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reduction factor, R_a, equations are given as below where T_B is given as corner period for the horizontal elastic acceleration spectra (TBDY 2019).

$$R_a(T) = \frac{R}{I} \quad if\ T > T_B$$

$$R_a(T) = D + \left(\frac{R}{I} - D\right)\frac{T}{T_B} \quad if\ T \leq T_B$$

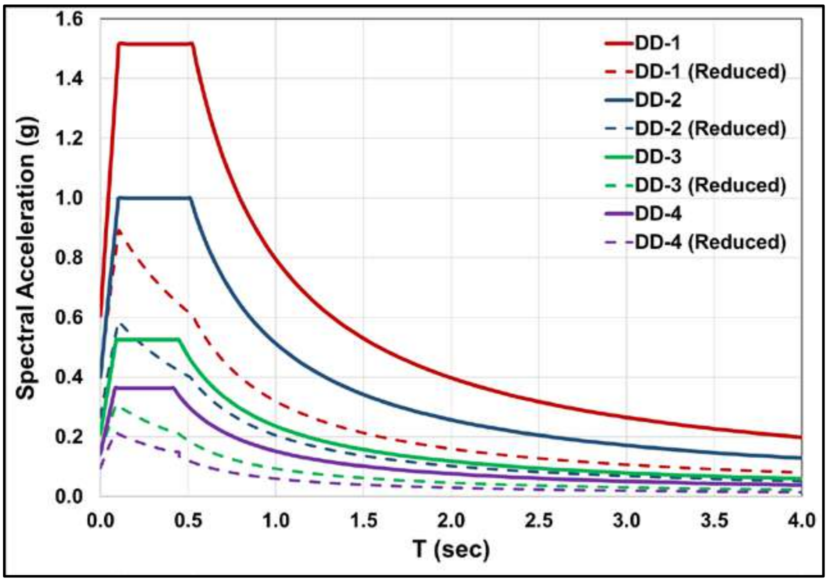

Figure 4. Acceleration response spectra predicted for the location by Turkish Seismic Code 2019 (TBDY 2019)

Beside the Seismic Code, the seismic performance of the minaret structure is determined according to the performance limit conditions given in the “Guidelines for the Management of Earthquake Risks for Historic Structures” (Tarihi Yapılar İçin Deprem Risklerinin Yönetimi Kılavuzu 2017). In order to assess the lateral deformation performance, the guidelines adopt the coefficient of R_a as unity for elastic FEM analysis (Table 2, Table 3). Besides, for the determination of performance in terms of strength, seismic load reduction factor, R_a, shall be considered as $1 \leq Ra \leq 3$ where it is taken as 2.5 for the structural minaret model.

Turkish Seismic Code imposes “Life Safety” performance level for masonry structures under the impact of DD-2 seismic hazard level. Besides, “Guidelines for the Management of Earthquake Risks for Historic Structures” recommends different performance levels for historical structures according to their importance in the local, national and global scale. In this study, the minaret has been categorized as a nationally important heritage structure. Consequently, the performance states are considered as three different seismic hazard level; DD-1, DD-2 and DD-3 (Figure 5, Table 2 and Table 3).

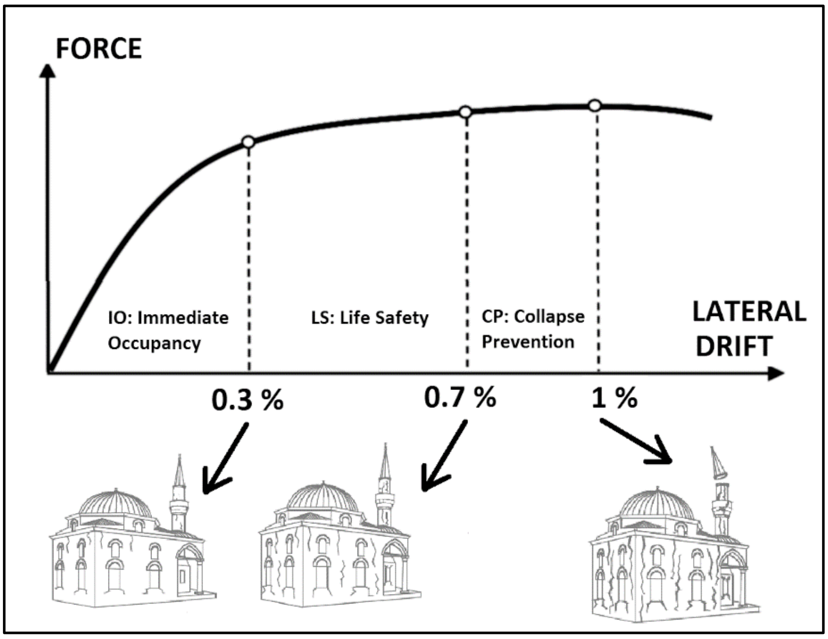

Figure 5. Recommended performance levels for a typical historical masonry structure

Table 2. Recommended performance levels for historical structures which have nationwide importance under the effect of different seismic hazard levels

Seismic Hazard Level	Performance State Attained
DD-3	Immediate Occupancy (IO)
DD-2	Life Safety (LS)
DD-1	Collapse Prevention (CP)

Table 3. Recommended for the assessment of historical structures for different performance states

Performance State Attained	
Immediate Occupancy (IO)	Elastic analysis; a) Material strength is not exceeded (where R_a=1) b) Maximum lateral drift ratio does not exceed 0.3 % (where R_a=1)
Life Safety (LS)	Elastic analysis; a) Material strength is not exceeded (where 1 ≤ R_a ≤ 3) b) Maximum lateral drift ratio does not exceed 0.7 % (where R_a=1)
Collapse Prevention (CP)	Elastic analysis; a) Material strength can be exceeded by 50 % (where 1 ≤ R_a ≤ 3) b) Maximum lateral drift ratio does not exceed 1.0 % (where R_a=1) R_a = Seismic load reduction factor

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In a previously performed in-situ tests on the case minaret, the fundamental period had been measured as 1.136 sec (0.88 Hz) after a micro tremor study by using ambient vibrations (Oğuzmert 2002). By using the mechanical properties of the limestone given in Table 1 and the macro modelling approach, finite element model of the case minaret is constructed, including inner stairs and hood. The highest six periods of the the minaret model are given in Table 4 where the mode shapes of the structural model are shown in Figure 6. Fundamental period is calculated as 1.119 sec. which is 2% different than the measured value during ambient vibration tests as 1.136 sec.

Table 4. The calculated periods of minaret FEM model

	Minaret Model	
	T (sec)	**Direction**
Mode 1	1.119	Lateral
Mode 2	1.118	Lateral
Mode 3	0.216	Lateral
Mode 4	0.216	Lateral
Mode 5	0.092	Lateral
Mode 6	0.092	Lateral

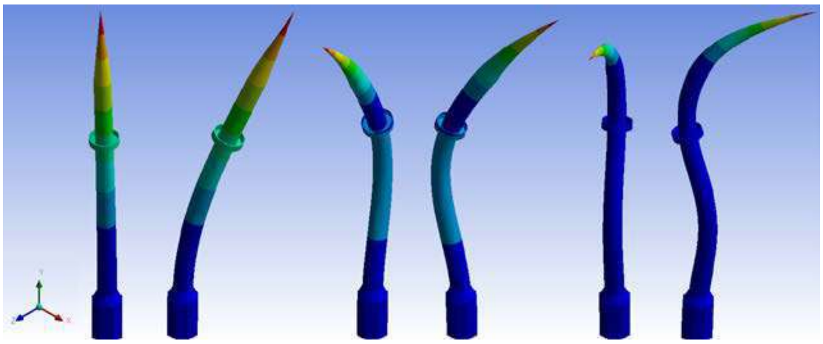

Figure 6. Mode shapes of the minaret model (Mode 1 to 6 are lined up, left to right)

Owing to the similarity of natural periods of the minaret that had been measured on-site and are calculated by dynamic analysis, the mechanical properties employed in the analysis are agreed valid for further analysis, response spectrum analysis, and performance evaluations.

RESULTS OF THE RESPONSE SPECTRUM ANALYSIS

Minaret model is analyzed under the effect of lateral loading with the help of the response spectrum method. The top of the upper shaft and bottom of the hood therewithal is assumed as the reference point for roof displacement calculation. Therefore, the roof height of the minaret model is considered as 31250 mm ignoring the hood. The obtained deflected shapes of the minaret models under dynamic loading are flexure dominated, and largest lateral displacements occurred at the roof acting as a cantilever structure. Table 5 summarizes the calculated maximum lateral displacements under the effect of DD-1, DD-2, DD-3 and DD-4 level seismic hazard for the case of R_a=1.

Table 5. Maximum lateral displacements of top of minaret according to response spectrum analyses for different seismic hazard levels

	Calculated maximum lateral top displacement (mm)	**Calculated maximum lateral drift ratio (mm/mm)**
DD-1 (R_a=1)	354	1.13 %
DD-2 (R_a=1)	228	0.72 %
DD-3 (R_a=1)	104	0.33 %
DD-4 (R_a=1)	67	0.21 %

The spectral analyses are completed for both elastic and inelastic behaviour assumption where R_a is calculated according to code (TBDY 2019). The maximum roof elastic drift ratios of minaret model are calculated as 1.13 %, 0.72 %, 0.33 % and 0.21 % for DD-1, DD-2, DD-3 and DD-4 seismic hazard levels respectively (Figure 7). According to the limits defined in Table 3, calculated lateral drift ratios appear over the limits.

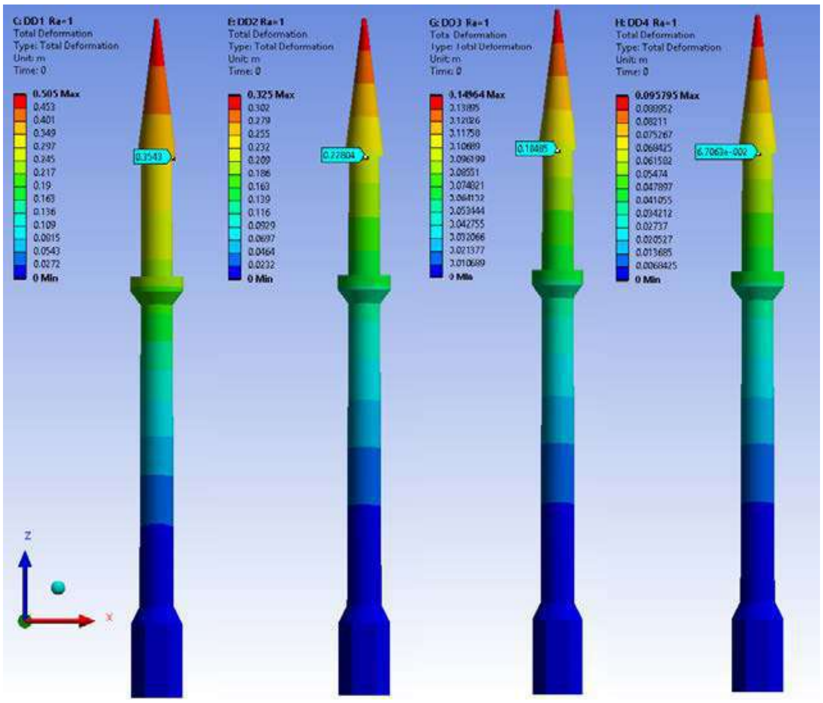

Figure 7. Top displacements of minaret model in case of DD-1, DD-2, DD-3 and DD-4 seismic hazard levels

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For the minaret model, highest maximum equivalent stress distributions are given in Figure 8. Those are prepared for different seismic hazard levels. The maximum tensile stress on the masonry has been calculated as 8.38 MPa which is greater than the uniaxial tensile strength of masonry, calculated as 2 MPa nearly. Abovementioned possible tensile stress value seems higher than the limiting tensile strength of the material for unreinforced and unconfined cross-sections.

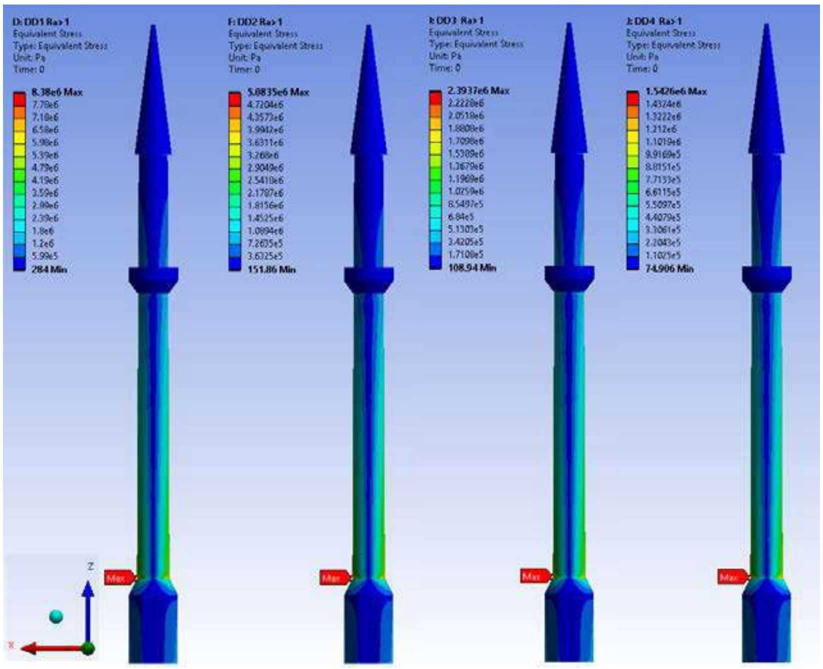

Figure 8. Equivalent elastic stress distribution of model for DD-1, DD-2, DD-3 and DD-4 seismic hazard levels (1 ≤ Ra ≤ 2.5)

In Figure 8, the maximum tensile stresses obtained for the model subjected to DD-1, DD-2 and DD-3 are bigger than the limited tensile strength of masonry. So, according to the guidelines, stresses exceeded the allowable strengths. In terms of deformation and strength capabilities, the minaret should be concluded as unsafe.

Evaluating the stress distributions on the structure indicates the critical failure zones. Masonry has nonlinear material properties and concluding the results of the linear elastic analysis may cause misjudgment about deformation and strength, especially for collapse prevention performance target. To overcome this problem, a nonlinear analysis should be followed by using nonlinear material properties for masonry material.

As stated by the results of FEM analysis, high tensile stresses arose, especially above the shoe zone (Figure 2) causes the masonry minaret tagged as unsafe against seismic loadings.

Under these conditions, the architectural heritages appear vulnerable in case of rare, occasional and even service earthquakes. Due to the complex nature of the problem, the solution is beyond typical engineering practice and demands in-depth material information and structural behaviour experience on such type of structures. For the architectural heritage structures, despite it is hard to attain current earthquake demand levels, possible structural interventions should not be bypassed in order to increase the seismic performance without decreasing the architectural value of the structure. After modelling the structural behaviour, the potential weaknesses are discovered and the proper structural intervention method should be selected which has the least impact on the architectural and historical form and texture. Recently, in two different studies, seismic strengthening intervention proposals are given for heritage structures in Italy where the results appears inspiring in terms of safety and conservation of historical structures (Valente and Milani 2019, Micelli and Cascardi 2020).

CONCLUSIONS AND RECOMMENDATIONS

The main goal of this case study is to increase the understanding of the seismic behaviour of traditional masonry minarets, for providing a basis for future assessment and research. The paper reports the possible failure mode and the seismic safety condition for a typical existing historic minaret structure located in Istanbul owing to the results of FEM analysis. The calculated seismic demand of the minaret, as stated by the current seismic code is compared with the capacity with the aim of defining the most likely mode of failure for the minaret. Lateral deformation and tensile strength capacities are exceeded in case of a strong earthquake (10% probability of exceedance in 50 years with 475 years return period) and flexural failure causes collapse.

Analyses show that the most vulnerable part of the minaret is right above the shoe zone, and this matches the real cases seen during the latest earthquakes in Turkey 1999. So as to eliminate possible damage risk for existing minarets, the weakest zones shall be retrofitted by confining or jacketing the masonry with relatively high strength materials.

For further research, proper and feasible retrofit methods should be examined by utilizing the nonlinear material models for dynamic loading, and the in-situ seismic instrumentation shall be installed in order to understand the real behaviour under seismic loading.

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(URL 4) SHARE-EU. http://www.share-eu.org, European Seismic Hazard Maps.

Resume

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Research Article

A Comparative Analysis of the Spatial Characteristic of Apartment Buildings in Gaziantep,Turkey

Yurdagül Görücü*
M.Serhat Yenice**

Abstract

This study aims to analyze the planning and design process, basic principles, and the change-transformation process of the apartment type residential buildings in Turkey, Gaziantep. The scope of the research consists of residential buildings built in the post-Republican period in Gaziantep. The basic materials of the research are zoning-city plans, plan explanation reports, plan diagrams of buildings and photographs based on field research. The method of the research is based on a comparative analysis of spatial changes in apartment buildings according to historical background. These changes evaluated from the analysis of a series of variables ranging from parcel-level to plan projects, access graphs to spatial size and ratios. As a result of the study, it is seen that the access graph and space sizes of the apartment-type residential buildings dating back to the 1960s, have significantly changed. However, differences and variations are mostly observed in the first plan typologies and it is noteworthy that this diversity has reduced, and similar plan schemes have been widely used in recent examples.

Keywords: *Housing, morphology, spatial analyses, Gaziantep.*

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INTRODUCTION

A house or apartment is the basic unit of society and the primary unit of human habitation. Having satisfactory accommodation is one of the most valuable aspects of people's lives. Therefore, housing is a significant element affecting people's material living standards. Housing costs have a large share of the household budget and constitute the main component of household welfare (Kurian and Thampuran, 2001; Streimikiene, 2015). Generally, housing and housing construction are the most critical components of a country's social and economic development (Franic et al., 2005).

This is an indication of a society's culture which exposes the features and meanings of the time. In other words, housing is the product primarily of socio-cultural factors of the community. A culture built into housing layouts and houses conveys culture through their configurations (Rapoport, 1969). In this respect, apartment buildings are no doubt, an exciting research topic. These buildings, which define the cultural identity and change of a period, also offer various clues about the structure of societies. Therefore, researches on spatial-functional analysis and configuration of apartment buildings have been increasing (Choi, 2013; Ju et al. 2014; Byun and Choi, 2015; Brkanić et al. 2018).

First apartment-style residential examples constructed dates back to the late 19th century in Turkey. These buildings were spatial reflections of Westernization Movements. While the industrial revolution was continuing in Europe, the Ottoman Empire was experiencing years of declining. However, the continuation of the relations with the western countries of the minorities living in the Ottoman Empire caused a cultural change (Görücü, 2018). This cultural interaction also changed the layout and façade of the traditional houses. It would be more accurate to interpret the apartment building movements in this context. Due to the capital, the first apartment buildings in Istanbul started to spread throughout the country, especially in big cities (Pamuk, 1996; Sey, 1998; Ulusoy, 2006; Öncel, 2010).

Turkey, along with Republican political regime, showed a rapid change with reforms that improve the economic and cultural areas. However, especially the physical structure of the Anatolian cities preserved itself.In Turkey, there has been many changes in the political and economic areas since the 1950s after World War II, as Turkey experienced rapid urbanization, and cities came to expand dramatically due to the population density. Rural depopulation became an important issue; many housing

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problems, including slums-called as 'gecekondu'- and insufficient housing, were confronted. Such problems were also seen in Gaziantep, the largest city of the south-east region of Anatolia, as well.

In the last three decades, the urban population increased 2.5 times. Undoubtedly, this affected the city of Gaziantep, the largest city in the south-eastern Anatolia region. Rapid population growth in cities led to housing problems (Yenice and Karadayi Yenice, 2018). In this period, both the housing needs of the increasing population and the changes in the economic, social, and cultural conditions were brought to the agenda. However, since the condominium act was not declared in these period, the construction of these apartment buildings under the ownership of one person remained limited due to the severe economic conditions. The Property Ownership Law introduced in 1965 was a turning point in apartment buildings construction. With this law, the housing presentation format in the cities has changed entirely and apartment buildings have increased with the sharing of economic costs in housing construction (Balamir, 1975; Gür, 1989; Keleş, 2000; Yenice 2014). Apartment buildings, a western housing typology with high population density, were imported and transformed to resolve these housing problems. Apartments were preferred by many people and became the most common housing type in a relatively short time in Turkey.

In the aftermath of the 1980s, while new residential areas spread, single houses those represent the vernacular heritage of the city were demolished to be replacaed by new apartment buildings. This ongoing transformation process had lead the disappearance of these buildings, which are the architectural documents reflecting the socio-economic and cultural characteristics of a period. The destruction of these buildings brought attention to the preserveation of the structures that are important architectural documents.

Thus, this research focuses on the apartment housing type and the spatial configurations of internal space. This research will display certain structural features of the spatial configurations of dominant apartment types in Gaziantep. It also aims at analyzing the planning and design process, basic principles, and the change-transformation process of the apartment type residential buildings in Gaziantep city based on historical background. Within the scope of the study, it is aimed to examine the change-transformation process of the apartment buildings according to a series of variables ranging from urban building island scale to architectural plan and spatial organization, and to analyze them in detail within the framework of typological analyses.

SCOOPE and METHODOLOGY

The subject of this research is the apartment-type residential buildings in the city of Gaziantep, Turkey. The basic materials of the study consist of buildings-license and architectural projects of the apartments, and field surveys. Moreover; city maps, master plans, disclosure reports and photographs were also used. The methodology of this study based on a comparative analysis of the changes in the housing plan schemes, spatial usage, and the size of these areas. Quantitative analysis was used for the comparison of spatial configurations. The analysis was applied as a method to analyze unit plans of apartment buildings.

This methodology consists of two stages. In the first phase of the method; the growth directions and development periods of the city of Gaziantep determined according to urban development plans. In this context, the facade characteristics of the apartment buildings were determined and documented. License and architectural projects of 47 apartment-type houses have been reached from the relevant municipal archives and classified according to their license dates. Urban block, parcel information and the architectural plans of the determining apartments were researched in the archives of the Metropolitan Municipality Directorate of Zoning. The plans were separated into 20-year periods from 1960 to present day according to the license dates. The second phase of the research methodology is based on the preparation of detailed analysis tables for 47 apartment-type housings with architectural projects and periodically comparative analysis.

The second phase of the research methodology is the preparation of detailed analysis tables of the apartment buildings. These tables contains the essential characteristics of the apartment buildings such as parcel information, housing size, number of floors, independent sections, rooms, etc. (Table 1). The next stage of the research method is to explain the transition conditions of the spaces by using the access graph approach. Thus, access depths obtained by analyzing the access and length of the way to reach the areas.

Spatial analysis is a numerical technique that allows one to express and analyze the general characteristics of space. In this technique, the areas are divided according to human experience, and numerical analyzes can be made on these sections by means of maps and graphs. Besides, it creates a configurational theory in

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architecture by generating a theoretical understanding of how people plan and use spatial configurations. In other words, an attempt to identify how spatial configurations express a social or cultural meaning and how spatial configurations generate social interactions in built environments.

Table 1. List of apartment buildings examined in the scope of the study

Registred parcel	Built year	Parcel area (m²)	Building floor area (m²)	Number of stroey	Number of dwelling in a floor	Total dwelling	Number of rooms	Dwelling size (m²)
1116/6	1968	600	296	5	2	12	3	142
1115/6	1969	600	324	5	3	14	3	95~105
506/68	1970	763	395	5	3	15	3	125~130
500/136	1970	563	268	5	2	10	3	135
499/154	1972	714	258	5	3	10	2	95~84
1115/1	1972	600	415	4	4	16	3	98
1120/2	1977	851	437	5	4	20	2 ~ 3	78~128
446/127	1977	382	206	3	2	6	3	97
386/148	1977	620	276	4	3	12	2	87
219/46	1978	513	284	4	2	8	3	129
1121/22	1978	533	255	5	3	14	2 ~ 3	75~86
499/174	1980	805	346	6	3	15	2 ~ 3	96~115
1122/77	1980	635	245	5	2	8	3	115
284/240	1982	972	334	5	3	12	2 ~ 3	79~123
1120/31	1983	720	358	4	3	12	2 ~ 3	86~129
387/139	1984	1322	335	5	3	15	3	106
388/153	1984	735	258	5	2	8	3	123
387/156	1984	1064	332	6	2	12	3	159
389/148	1984	1013	292	6	2	10	3	139
387/137	1984	596	330	5	3	15	3	106
388/155	1985	718	270	7	2	12	3	128
375/4	1985	928	268	5	2	8	3	129
488/6	1986	570	198	4	2	8	3	94
285/335	1986	1232	450	6	3	15	3	145
496/83	1986	653	276	4	2	8	3	132
397/22	1986	975	297	6	2	10	3	142
286/515	1986	733	268	4	2	6	3	128
1120/16	1987	704	370	4	3	12	3	116~125
386/160	1987	618	286	4	2	8	3	137
282/438	1987	977	332	6	3	15	3	105~108
381/165	1988	939	295	6	2	12	3	135
1122/78	1989	635	234	5	2	8	3	109
377/158	1991	1099	275	7	3	18	3	130
375/5	1991	770	284	6	2	10	3	130~139
286/515	1992	733	220	5	2	8	3	104
374/165	1993	818	275	6	2	10	3	131
376/1	1993	964	300	6	2	10	3	143
372/227	1994	981	360	5	2	8	3	172
392/115	1997	1100	273	6	2	10	3	129
398/173	1998	888	318	5	2	8	3	152
444/187	1998	412	267	5	2	8	3	127
2017/1	2002	1103	335	6	2	10	3	143
6918/3	2006	852	255	6	2	10	3	172
5127/1	2008	1603	478	8	2	28	5	129
3692/2	2009	1860	465	8	2	30	3-4	145~175
321/4	2012	1556	465	10	3	27	3-4	165~180
1357/1	2015	3000	840	14	2	52	4	198

Morphological studies are needed to understand the relational structures. Morphological characteristics of the plans are explained with the method developed by Hillier and Hanson (1984). This method has been used to compare plan typologies from different periods. In the access graph, the rooms at the depth equal to the starting point are positioned on the same horizontal line, and the depth values are numbered from zero. The access graphs are named according to various parameters such as symmetric/asymmetric, distributed / non-distributed. If there is a symmetric feature in the access graph, there is equal access to many rooms from one room. Otherwise, the access graph is asymmetrical if it can access from one room to another, but from several rooms respectively. Besides, there is a cyclical feature if one room is accessed from one room to another with only one path instead of multiple paths. The cyclic feature is divided into two, with and without distribution. In distributed graphics, the paths to space are looped. In the non-distributed graphics, it is a single straight line.

In the study, tha analysis was done by grouping the the buildings under three time periods. The first period, characterized by the end of the Second World War, covers 1950s and 1980s. This period is defined as the period of rapid urbanization in Turkey. It is characterized by the rural depopulation and the desire to meet the increasing need for housing in the cities. Ownership of the Property and Gecekondu Law was declared in this period. These laws deeply affected the physical structure and transformation of the Turkish cities.

The second period covers 1980s and 2000. The main character of this period is that the level of urbanization reached a satisfactory level. Cities were transformed into significant capital accumulation as they were trying to adopt to both liberal economic development in the national economic structure and to the world economy of that period. Another essential feature of this period is the redefinition of the jurisdictions of central and local governments. Local dynamics came to the fore with various legal arrangements allowing cities to produce their own master-plans. Moreover, the Mass-Housing Development Administration was established to meet the housing needs of low-middle income families.

The third period starts 2000's and continues to the present. The neo-liberal economic development model was adopted in this period. Urban transformation and renewal actions have changed the physical structure of cities. Since the 2000's, the neo-liberal economy and the lifestyles directed by globalization have been influential in our country (Yenice, 2014). The meaning of the house for the people has changed. The houses became a social and economical indicator, that is, the houses with additional facilities became more popular, rather than the ones with good interior organization. In addition to this, they became an excellent investment tool for the future.

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FINDINGS AND DISCUSSION

Gaziantep, according to data from the 2017 Address Based Population Registration System (ABPRS) is Turkey's eighth and the largest city of the Southeast Anatolia Region with a population exceeding 2 million (Fig. 1). Gaziantep has a critical industrial infrastructure that is textile and machine-oriented. The city, with a rich cultural heritage, is one of Turkey's essential tourism centers which is also famous with vibrant culinary culture. In 2016, Gaziantep joined UNESCO in the Creative Cities Network in the field of Gastronomy. So, Gaziantep is an urban settlement area that needs to be addressed in different scales and accompanied by special planning activities.

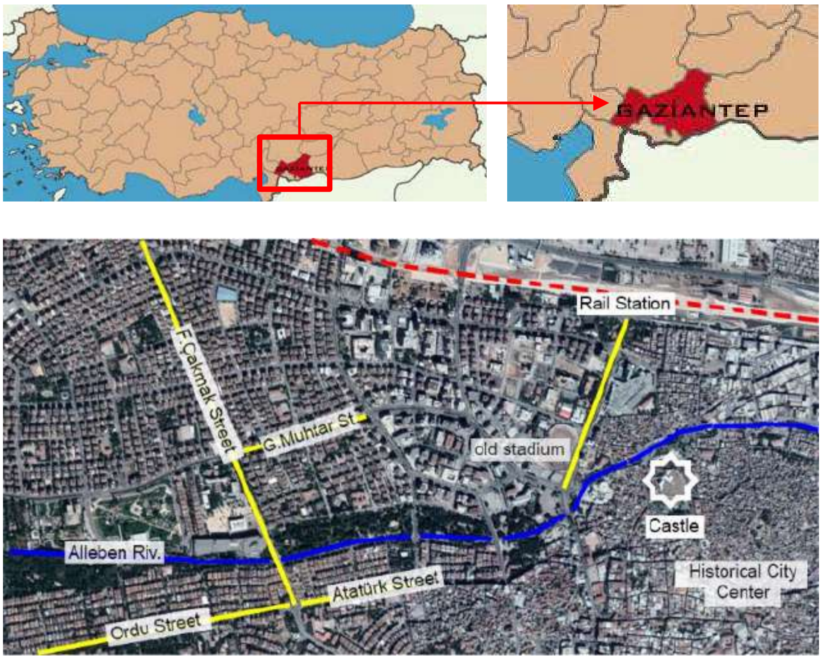

Figure 1: Location of the Gaziantep city and study areas of Gaziantep city center and its surroundings

In the study, six different urban areas were selected from the districts of Şehitkamil and Sahinbey in the city center of Gaziantep. The development of the city in the historical process was taken as the basis for the sampling area. Study Area 1 is located in the urban development area of the Gaziantep Development Plan of 1955. The fact that it is close to the railway and station areas built during this period is another factor affecting the choice of areas. Other regions identified as new residential development areas during the 1970s and 1990s were also selected as the study area. When deciding on the areas to analyze, the transportation axes such as the Station Street, Ordu Street, Maresal Fevzi Cakmak Street, were determined as the main variable and different apartments from each area were selected.

Spatial Analysis between 1960s and 1980s

General Characteristic

The apartment type housings, which were built between 1960s and 1980s, are generally built as a discrete structures. They were constructed in a single structure - parcel arrangement (Table 2). Structures usually occupy 51% of the floor area of the parcel. The buildings in this period are typically usually 4-5 floors. The spatial characteristics of apartment buildings are summarized in the table below (Table 2).

Figure 2. Examples of apartment's façade characters in 1960-1980 period

Table 2. Parcel characterizes of apartments in 1960-1980 period

	Min.	Max.	Avg.
Parcel Size (m^2)	382	851	613
Building Floor Area (m^2)	206	437	310
Base Area co-efficient	0,36	0,69	0,51
Total Floor Area co-efficient	1,61	2,76	2,29

Plan Scheme and Access Chart

The apartment type housings built between 1960s and 1980s are generally based on 3 types of plan typology and access graph. The first one is the planning scheme scattered from one room to another. In this scheme, which resembles the middle-hall type of house in a traditional Turkish residence, the sofa is used as a common living area. Day and night hall separation is not clear (Figure 3a). The second plan scheme has another circulation area separated from the entrance area of the residence. Generally, service spaces, wet areas, and bedrooms are connected to this circulation. There is a night and day hall separation. (Figure 3b). In the third plan scheme, it is directly connected to the living room from the entrance of the residence. There is a connection from the living room to the night hall (Figure 3c). As the access graphs checked according to the plan schemes, the value of the access depth was seen as 3 for single circulation plan schemes. It shows symmetrical features. Moreover, the value of privacy is low since it is directly proportional to the depth value (Figure 4a).

The depth of the access graph of the second plan type is 4. As the depth value increases, the value of privacy will increase, and this plan type has a higher privacy value than the first plan type. The

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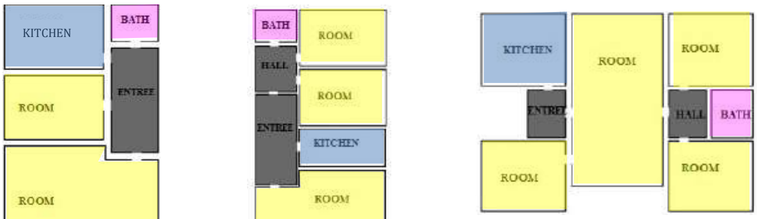
deepest places are bedrooms and balconies (Figure 4b). The plan of the third plan scheme, which is the scheme of the transition from the living space to the other rooms, has a depth value of 6. There is a conditional transition from the living room to the night hall. The kitchen is accessible by passing through the hall. These features indicate that the plan schema is asymmetric (Figure 4c).

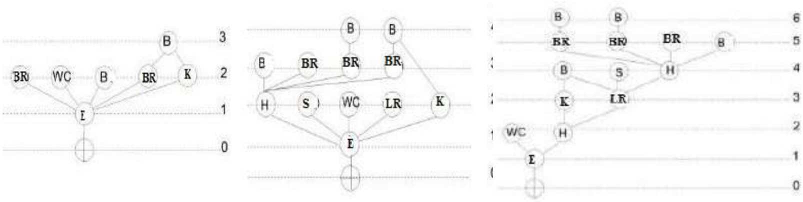


(a) (b) (c)

Plan scheme with single circulation (a) and two circulation spaces(b)

(c) In addition to the two circulation spaces, the plan scheme of the living space is the transition space.

Figure 3. Typical plan schemes and spatial organizations of apartment buildings in 1960-1980 period



Access graph with single circulation (a) and two circulation spaces (b)

(c) In addition to the two circulation spaces, the access plan of the living space is the transition space.

Figure 4. Access graph between 1960s and 1980s

Spatial Usage Size and Ratio

When the apartment buildings, constructed from 1960 to 1980, are examined, it is seen that the kitchen usage area varies between 6m^2 and 10m^2. The average kitchen area is 8m^2. The kitchen occupying a small area was not large enough to accommodate the family. The dining area is designed to be separated from the living area in the houses built during this period. Besides, living room size differ between 26m^2 and 42m^2. The average living room area were 35m^2. The common usage areas account for 40% of the housing area (Table 3). In this period, the accommondation, dining, and daily living spaces of the apartments were designed separately, but were thought to be related to each other in a single area.

Table 3. Spatial distribution of apartments in the 1960s and 1980s period (%)

Criteria	Min.	Max.	Avg.
Common Area (%)	32	48	40
Kitchen (%)	5	7	6
Private Areas (%)	22	32	30
Service Areas (%)	4	14	12
Balcony (%)	10	14	12

When the apartment buildings of the 1960-1980 period are examined, it is seen that the usage of the shared space varies between 32% and 48%. The average percentage of common areas was 40%. The kitchen use area ranged from 5% to 7%, private area use was between 22% and 32%, and service area usage was between 4% and 14%, and balcony usage was 10% and 14%. The average kitchen area was 6%, the private area usage was 30%, the typical service area was 12%, and the average balcony was 12% (Table 15).

Spatial Analysis between 1980s and 2000s

General Characteristic

The apartments built between 1980s and 2000s years generally had the discrete and a single parcel structure. The structures were usually 5-6 floors (Fig. 5). However, at the end of the 1990s, 10-12-story buildings were built.

Figure 5. Examples of apartment façade characters in 1980-2000 period

Table 4. Spatial distribution of apartment buildings in 1980-2000 period (%)

	Min.	Max.	Avg.
Parcel Size (m^2)	570	1322	835
Building Floor Area (m^2)	198	450	303
Base Area co-efficient	0,25	0,55	0,36
Total Floor Area co-efficient	1,26	2,76	1,88

The features of the apartment buildings at the parcel level are summarized in Table 4. It is seen that the size of the apartment buildings, constructed between 1980s and 2000s, varied between 570m² and 1322m². The average parcel size is 835m². It is seen that the building base footprint ranged between 198m² and 450m². The average building floor area is 303m². The base area co-efficiency is between 0,25 and 0,55. Building footprint usually

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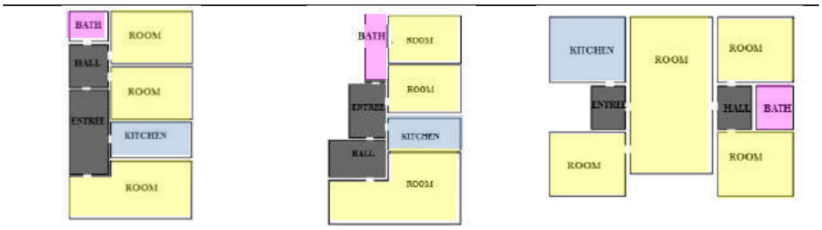
occupies 36% of the parcel. The floor area co-efficiency is between 1,26 and 2,76 and the average co-efficient value is 1,88 (Table 4).

Plan Scheme and Access Chart

The apartment buildings, built between 1980s and 2000s, are generally based on three plan typologies. The first is the plan schemes, which include a second circulation space after the entrance. Generally service areas, wet areas and bedrooms are connected to this circulation. There are night-hall and entrance (Fig. 6a). The other is the planning scheme, which has a circulation space other than the entrance, and night hall (Fig. 6b). Thirdly, there is a space connecting with the entrance and night-hall. This space, using as a living room, is a common area. The transition from the day hall to the night-hall provides from the living room (Fig. 6c).

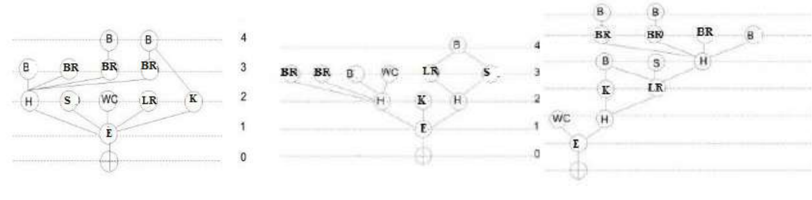


Plan scheme with two circulation (a) and three circulation spaces(b)

(c) In addition to the two circulation spaces, the plan scheme of the living space is the transition space.

Figure 6. Typical plan schemes and spatial organizations of apartment buildings in 1980-2000 period

The access plan for the first plan type has a depth value of 4. The access graph shows asymmetric properties. There is no equal access, because access to the rooms is provided through the night hall or other room (Figure 7a). The access depth value of the other plan type has 4. There is an asymmetric feature of this type (Fig. 7b). The access value of the third plan type is 6. The living room is the space providing the loop (Fig. 7c).



Access graph with two circulation (a) and three circulation spaces(b)

(c) In addition to the two circulation spaces, the access graph of the living space is the transition space.

Figure 7. Access graph between 1980s and 2000s

Spatial Usage Size and Ratio

When the apartment buildings, constructed in 1980-2000 period are examined, it is seen that the kitchen area usage is between 9m^2 and 24m^2. The average kitchen area is approximately 14m^2. The living room area varies between 24m^2 and 46m^2. The average living area is 36m^2. Common area usage varies between 27% and 45%. The average common area use was 41%; whereas, the average kitchen area is 9%. The use of private space ranged from 18% to 30%; service area utilization rate was between 6% and 7% and balcony was % 15 to 19% (Table 5).

Table 5. Spatial ratios of 1980-2000 period

Criteria	Min.	Max.	Avg.
Common Area (%)	27	45	41
Kitchen (%)	8	10	9
Private Areas (%)	18	30	26
Service Areas (%)	6	7	7
Balcony (%)	15	19	17

Spatial Analysis of the Apartments form 2000 to Present

General Characteristic

The apartment buildings, built between 2000s and the present period, generally have the characteristic of building in the discrete structure and single structure - parcel layout. The buildings were usually constructed 5-6 stories. However, the housing types produced over 10 storey and over are becoming widespread (Fig. 8). Buildings base area usually occupy 25%-30% of the parcel area. The characteristics of the apartment buildings at the parcel level are summarized in Table 6. It has been seen that the parcel size of the apartment type houses, which were built in 2000's, and has changed between 852m^2 - 3000m^2. The average parcel size is 1662m^2. It was seen that the building base area ranged between 255m^2 and 840m^2. The average building base footprint is 473m^2. The average building base area co-efficient value is 28%. The total floor area co-efficient is between 1,80 and 3,92. The average value is 2,48 (Table 6).

Figure 8. Examples of apartment's façade characters in 2000s

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Table 6. 2000 and later period parcel and location properties

	Min.	Max.	Avg.
Parcel Size (m^2)	852	3000	1662
Building Floor Area (m^2)	255	840	473
Base Area co-efficient	0,25	0,30	0,28
Total Floor Area co-efficient	1,80	3,92	2,48

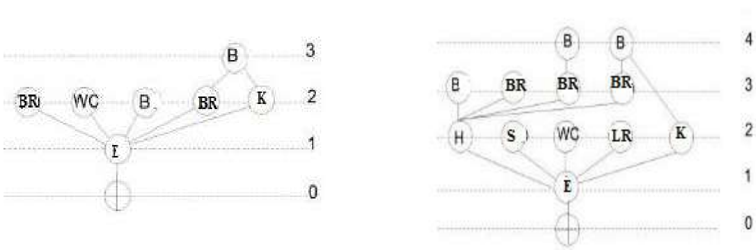
Plan Scheme and Access Chart

The apartment buildings, built in 2000's and later period, are based on two plan typologies. The first one is the planning scheme that scattered from the entering to the room. There is no discrimination between day and night usage areas (Fig. 9a). The second typology is the plan diagrams, which are the secondary circulation space after the entrance, usually service spaces, bath, wc, etc., and bedrooms connected to this circulation. The day and night usage areas are separated from each other by night-hall. (Fig. 9b).

Plan scheme with two circulation (a) and three circulation spaces (b)

Figure 9. Generally plan scheme and circulation connections of apartment buildings in 2000s

The access plan for the first plan type has a depth value of 3. The access graph shows asymmetric properties (Figure 10a). The access graph depth of the second plan is 4. This plan type also has an asymmetric feature (Figure 10b).



Access graph with two circulation (a) and three circulation spaces(b)

Figure 10. Access graphs from 2000's at present

Spatial Usage Size and Ratio

It has seen that the kitchen usage area varies between 6m^2 and 24m^2. The average kitchen area is 18m^2; while, the living room is between 18m^2 and 53m^2. The average living room and living area is 38m^2. It is also found that the use of common area varies between 25% and 49%. The average common area use was found to be 40%. The usage area of the kitchen is between 5% and 20%, the use of private space is 19% and 31%, the service area is between 8% and 10%, and the use of balcony varies between 4% and 16%. The average use of these areas are as follows: kitchen 11%, private space 25%, service area 9%, and balcony 15% (Table 7).

Table 7. Spatial proportions in 2000 and later period

Criteria	Min.	Max.	Avg.
Common Area (%)	25	49	40
Kitchen (%)	5	20	11
Private Areas (%)	19	31	25
Service Areas (%)	8	10	9
Balcony (%)	8	24	15

CONCLUSION

The findings of the study showed that the average parcel size has increased gradually over the years. On the other hand, the ratio of the building base footprint area has decreased. The ratio was 0.50 in 1960-1980s, but it decreased to 0.30 (Table 8).When the ratios over the years are compared, it is possible to say that the provisions of the current legislation and regulations are effective. The maximum coefficient value of the building base area usage decreased to 0,40 in the 1980-2000 period, which was around 0.30 towards the end of the 1990's. After 2000, the maximum building base area coefficient value is between 0,30 and 0,25.

When the plan schemes of the apartment buildings were compared, 3 different plan schemes were observed in the 1960-1980 period. The first plan type is distribution to the rooms from the entrance. The second is the distribution of the hall to the rooms. In addition to the entrance hall and night hall, the living room became part of the circulation.

Table 8. Comparative analysis of changes at parcel level (average)

Average Values	Periods		
	1960-1980	1980-2000	2000s
Parcel Size (m^2)	613	835	1662
Building Floor Area (m^2)	310	303	473
Base Area co-efficient	0,51	0,36	0,28
Total Floor Area co-efficient	2,29	1,88	2,48

In other words, there is a direct connection from the living room to the night-hall. This spatial relationship is also found in traditional Antep houses. Therefore, it can be said that the traditional structure was maintained in this period. Day-night hall distinction in 1980-2000 period's houses is clearly seen compared to the previous 10 years. During the period of the 2000 and after, the flats in the apartment buildings in the 1980-2000 period have

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continued. Therefore, it can be said that the social structure has gradually changed from extended family to nuclear family structure.

In the 1960-1980 period, there were 3 different types of access graphs in the apartments. The first one is the form that is distributed from room to other rooms, with a depth value of 3. The second one is with subjects that are distributed in the type of access graph, entree, and hall. The depth value of this type is 4. Privacy value is directly related to the value of depth; that is to say, an increase in the degree of privacy can be seen over the years. Since two steps were built to reach the bedrooms and one step for the kitchen, these schemes show asymmetric properties and varied accessibility options. The third graphic shows the entrance and the living room as part of the circulation; that is, there is a direct connection from the living room to the night hall, with a depth value of 6. Unlike the apartments built in the 1980-2000 period, the day and night usage distinction is evident in this period. In the period from 2000 to present, the access graph of apartment buildings has not changed.

Surprising results are found when the space size of the apartments are compared, for example the size of the kitchen. The size of the kitchen areas increased from 6-9m^2 to 10-24m^2. Although not a big change is observed in the minimum kitchen area size, the maximum kitchen area size gradually increased until present (Table 9). The main reason for this difference is that Gaziantep has a different and rich culinary culture compared to other industrial cities. The kitchen has been gradually losing importance because of the changes seen in the family structure. As stated above, there is a shift from extended family structure to nuclear families. Also, women have been spending less time to cook because of the current working conditions. However, it is surprising that the importance and size of the kitchen continues to increase in Gaziantep.

Table 9. Comparative analysis of kitchen size (m^2)

Periods	**Min.**	**Max.**	**Avg.**
1960-1980	6	10	8
1980-2000	9	24	14
2000-Present	6	24	18

Income status should also be considered when interpreting the data. The size of the kitchen has increased with the size of the houses proportionally. This may offer interesting input for the studies related to sociology and culture. The sizes of the living room and family room should also be compared. Today, the size of the living rooms vary between 18 and 26 m^2 minimum and 42 and 53 m^2 maximum. This is related to economic income; when the level of income increases, the size of the houses increase as well. However, it is surprising to see that although the size of the living rooms increae, the size of the daily (family) room decreases to approximately 12m^2.

All in all, the findings of the study provide some suggestions for the apartment-type housing designs. Different variables including social, economical, and cultural structures and regulations are effective in changing the layout of the apartment buildings. On the one hand, depending on the use of night and day space separations are separated from each other, while different typologies in the past period decreased by reducing the number of similar solutions. In other words, the alternatives or variety encountered in the housing plan solutions falls or even developed within the framework of the same spatial fiction. In terms of area size, the increase in the share of kitchen and balcony areas in the total building area indicates that the usage opportunities and the time spent in these areas have increased. Although the results are limited to the apartment buildings in Gaziantep, the results may provide some important evidence for the sectors that have a say in the design and production of housing.

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Resume

Yurdagül Görücü received her Bachelor Degree from İzmir Institute of Technology (Turkey), Department of Architecture in 2012. She began his academic career as a research assistant at Hasan Kalyoncu University. He completed his master's degree in 2017. She has been working at Hasan Kalyoncu University, Faculty of Fine Arts and Architecture, Department of Architecture as a Res. Asst. since 2014.

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Research Article

Modern Diffusers for Interior Design

Havva Demirpolat*

Abstract

In this study; the elements of the new generation ventilation systems are explained with the general design principles of the HVAC systems. Nozzles and diffusers which are the last elements of HVAC systems are explained with examples.Latest decades, air distribution elements have become the decorative elements in the interior. Air distribution elements are the last elements which complex air conditioning system. In addition to providing air and particle movement control and thermal comfort in the interior, they are also extremely important technical equipment when considering the space design. Thanks to developing design and manufacturing technologies, the latest ventilation equipment has become extremely flexible and has aesthetic appearance. Different modern diffusers are presented with a sample application project in this study. The architectural structure considered as a case study is a complex consisting of showroom, office, sales and service departments serving in the automotive sector. The planer glass facade coating system is the determining element in architecture in general, while the interior stainless steel details and mounting elements form the basic style of the sample building. In the building which is an intensive human and vehicle movement, the glass facade provides maximum natural lighting and passive heating at the same time. For the summer months, mechanical ventilation is preferred, and the Cr-Ni ventilation equipment that

Keywords: *Diffuser, nozzle, large space building, HVAC, interior design*

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provides harmony with the steel structure is the most noticeable interior detail. In this article, a wide interior analysis was carried out with installation plans and sample application visuals as well as mechanical ventilation details.

INTRODUCTION

Today people spend a great majority of their time in enclosed spaces. Nowadays, architectural structures are designed to allow for many activities such as meeting, shopping, restaurant-cafe, offices, sports and health facilities and residence. In these structures, interiors that are generally used for mixed purposes are striking. In these constructions are observed with different usage purposes such as open office, mall and atriums designs. Comfort is the most important design criterion for non-standard spaces for different purposes. Thermal comfort is at the top of these criteria. The thermal conditions that people usually need for living and working are obtained by experience and these values are used in the space design. While the comfort of the environment is provided in the most appropriate way, the aesthetics of the space is another important criterion. It is very important to complete HVAC process by selecting the correct distribution elements and positioning them correctly in high cost designed structures. Thermal values in the environment, acoustic and air velocity may vary depending on the dispensing elements used. This work was devoted to the literature to provide accurate diffuser and nozzle selection in large-space building for designers.

An experimental study was performed use of nozzles in high-performance buildings by Haidong Wang et al. (Haidong,2018,347-357). A study was performed by Lun Zhang et al. on innovative cooling systems and design in large-area spaces (Lun, 2015,,228-238). In this study, it was found that secondary airflow systems supported by jet diffusers are 34% more efficient. Haidong Wang et al. studied the improvement of air quality and the effect of secondary flows through the use of nozzles in long-span structures. A CFD model was designed and observed to increase the ventilation qualities of the secondary flows (Haidong, 2015,816-823). D. Int-Hout, he presented the selection criteria of vent and diffuser in HVAC systems. (Hout,2004,24-28). Bingelli C. in his study, he explained the conditions of indoor air conditioning in general and examined different applications.(Bingelli, 2003, 194-213) Patrick Sisson has also deal with the use of ventilating equipment in contemporary architecture in his work. He explained the development and shaping of modern architecture in time in parallel with the developments in air conditioning and ventilation systems. (Sisson,2017)

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In modern, high-tech buildings, sharp and measured elements of ventilation systems can be used as a design objects. Circular cross-section and rectangular cross-section air ducts could be manufactured as Cr-Ni, galvanized sheet, spiral, PVC, polyurethane, and fabric. Thanks to the sealing elements and acoustic insulation, the ducts and vents which allow designing at very low noise levels also give the identity of the buildings they design as design objects. It is also preferred that the building shell is generally flexible in high-tech constructions and that it is used in many places without hiding up the hanging elements and plenum boxes due to the steel structure. Generally, selection and material criteria of installation and ventilation equipment: mechanical calculations and parameters such as pressure losses, noise levels, airflow and blowing speeds are discussed. There has not been any study in the literature on the use of indoor diffusers and ventilation equipment as design elements.

MODERN DIFFUSERS FOR HVAC SYSTEM

In the design of HVAC system in large-space buildings, heating, cooling and supply air values are calculated primarily to provide comfort conditions suitable for the purpose of use of the building considering factors such as the number of people, lighting, computer and electronic device condition, wind, shadow and sunshine effect and architectural constraints. Account and design are made based on the pressure loss in duct, vent flow rate values together with the appropriate cross-sectional duct. Finally, diffuser selection is made for the HVAC system. In past decades when passive ventilation systems have not been enough galvanized rectangular ventilation ducts hidden in plaster ceilings and/or walls and square honeycombs and culverts mounted on gypsum surface are designed. The use of linear vent, damper vent, and square honeycombs is increasingly reduced due to the lack of aesthetic and proper ventilation conditions in new generation buildings. Slot diffusers, jet nozzles, are preferred in the interior due to their thin display. Because of the sound levels are low even at high speeds, concerts and meeting rooms are quite suitable for low sound levels such as conference rooms.

Slot diffusers; They are preferred by architects with their elegant appearance and they are widely used in air conditioning systems due to the fact that they offer homogeneous air diffusion at the same time. The ability to change the blowing directions up to 180 ° or to close some types when necessary gives the slot diffusers flexibility in use and installation in the field of application.

Standard slot diffusers are used for heating and cooling up to 3.0-3.5m in air conditioning systems, and only for cooling purposes in

4-5m heights. Particularly in large zones, when used for heating purposes at ceiling heights above 3.5m, difficulty could arise when lowering the hot air. The application height could be reached up to 6-10m with variable air flow slot diffusers. Generally slot diffuser is prefered for variable ventilation air-conditioning systems (VAV) in case of 20% of the air amount falling. Otherwise, unwanted currents (reverse air movement) may occur with the cause of the air fall when the minimum trip is approached and this may cause discomfort. Slot diffusers are used almost everywhere where fixed-bed and variable air-conditioning ventilation systems are applied. These can be classified as business centers, restaurants, hotels, shops, banks, residences, hospitals, schools, trains, yachts.

Linear slot diffusers allows continuous application with 90 ° and 135 (Figure 1) corner slots and curved slots. Width values are in the range of 3cm-30cm and the number of slots according to the air blowing from a unit length in these types are able to go up to 8 slots per slot. Painted slot diffusers are very flexible interior design solutions. Plenum box is manufactured by made of 0.6mm galvanized sheet metal with diffusers. However, it is possible to use different interconnection elements to provide mounting flexibility in different projects. The most common of these are flexible connectors which offer a very flexible connection.

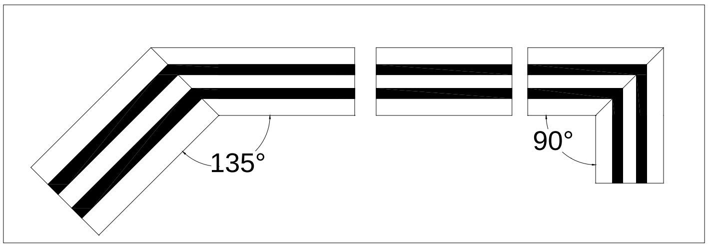

Figure 1. Slot Diffuser Linear and Corner Piece

The use of slotted diffusers directly on the duct face is increasing in high-tech and industrial style building, especially in Europe and the world. In this application, circular or semi circular shaped slot diffusers are used which are mounted on the duct without any intermediate connection element. The flow rate can be set automatically and it is possible to provide different thermal comfort conditions in the interior used for different purposes with a preferred module in variable flow systems. Room thermal condition is kept under constant control via state thermostat. Remote Controllers (Remote adjuster) with set values can also be changed based on ambient climatic conditions. It is necessary to adjust the direction and velocity of the air depending on the difference between blown air temperature and ambient temperature in order to catch long range (6-10 m) in high-structures and to provide a homogeneous distribution. As the air

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circulation speed increases, comfort are reduced, noise level increases. As it is shown in (Figure 2) the air circulation speed increases sensible temperature is reduced with nearly 8 times.

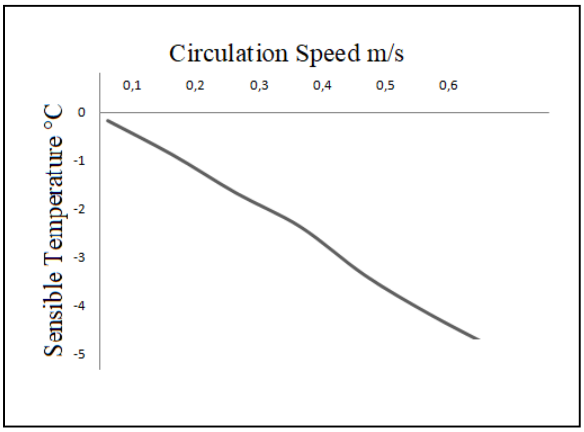

Figure 2. Variation of Sensible Temperature with Air Circulation Speed

Swirl diffusers, as it seen (Figure 3), have a wide temperature range (-30 ° C, 100 ° C) and are preferred for use in high (12-15 m) constructions. It makes suitable for using in systems variable flow and constant flow with turbulent blowing and high inductions. The direction of the air beam can change direction according to the heating and cooling condition by a moving mechanism. The blowing air can move in the direction parallel to the ceiling in the case of cooling whereas it can move downward in the event of heating. Generally, the direction of the blowing angle can be changed by a servo motor or if it is necessary economical manually. It is convenient the use of in combination with different colors and lighting elements

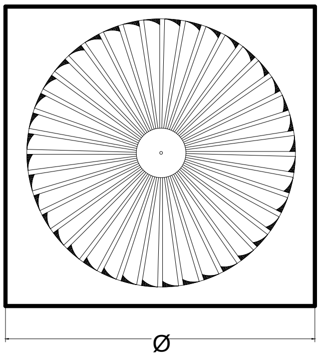

Figure 3. Swirl Diffuser

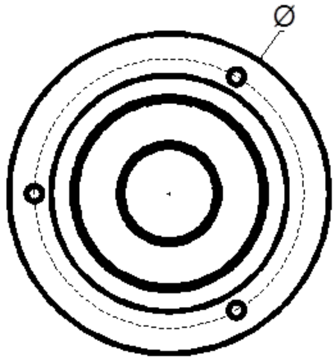

Figure 4. Jet Nozzle Diffuser

Hot air raises top of building whereas the cold air falls down. For this reason, blowing speeds are particularly sensitive to cooling loads. It is stabilized by the ambient air and reaches to the floor surface at a value close to the limit values. Therefore the use of nozzles is becoming increasingly widespread. Especially diffusers are placed on the side walls to obtain a modern and aesthetic appearance in the high office buildings, large space and high structures. So the most effective ventilation angle can be captured. In the jet outlet, the openness can be set to rise somewhat horizontally and the temperature rising from humans and other heat sources can be mixed to provide a homogeneous distribution in the environment. Especially in cooling periods, the jet diffuser can be directed upwards so that cold air blown in summer is not directly directed to humans and distribution is better. In winter, the orientation is made downwards so that the hot air that is blown can be distributed more inferiorly. Jet nozzles, as it seen (Figure 4), can be oriented in every direction +30 ° and -30 ° from the horizontal. The jet nozzles are designed aerodynamically to provide a very low noise level in high air flow. Thanks to this feature, can be used easily in big and high places like concert halls, theaters, museums where silence is very important. The optimal value of noise for open office areas is in the order of 35 dB. It is possible to catch these values through jet nozzles in the interior where a building is a high-rise and airflow values are high. It reaches the range of 30m for the temperature (-30 ° C, 100 ° C) span. Ceiling and wall applications can be done. A sequential or multi-row assembly can be performed. Jet nozzles can be installed with both rectangular duct and circular duct. The nozzle can be directly mounted on duct, or it can be flanged, screwed, riveted with plenum box or flexible connection element. Flexible connections require the opening of a round collar on the channel and a clamping connection. The nozzle is fixed with a hanger system in the flexible connections. In this way, the canal system and the nozzle can be left open without being closed. The nozzle, which is made entirely of aluminum coating process, can be used

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as an electrostatic painted in any color or in most applications as unpainted.

"The most important plumbing system in a building with High Tech application is the heating and ventilation system", Eşsiz stated (Eşsiz,1999). "Instead of a general climate system, today's understanding is to create, in every small independent space, the environmental conditions that anyone using that space can control. In this case, the user will feel most comfortable and be more productive in his work. In general, some climate standards, which are defined without changing local conditions, are implemented with minimal intervention"Eşsiz stated too.But nowadays this norm has been abandoned. Installation and operating costs, interior and facade aesthetics, system maintenance and repair problems have caused the abandonment of independent departmental solutions. The climate control systems that provide local control in the centralized systems (VAV), called variable-flow systems, are nowadays in all modern constructions. These systems, which are compatible with external facade compensation devices that enable automatic control and can be scheduled instantly and seasonally, are more economical in terms of installation and operating costs. Systems with open and/or independent sections that are completely independent and capable of automatic control in each vent have the possibility to operate at the same heating and cooling load. It is suitable for buildings that require very different climatic conditions, like hospitals.

A SAMPLE STUDY: AUTO SHOWROOM

The architectural structure considered as a case study is a complex consisting of showrooms and offices, sales and service departments serving in the automotive sector in Konya. The device has been selected to arrange inner temperature which is 26 degrees for summer and 22 degrees for winter. R134A or R410A refrigerant has used. The electrical system has protected with relays. System designed with automatic drain pump, there has a remote control for each indoor unit and the signaling cable has built under the plaster. Each unit has individually controlled. The plenum boxes has special manufactured according to the measurements in the project. Plenum boxes has insulated with acoustic foam. Flow control damper and connection hangers has manufactured by galvanized sheet. A cooling chiller system with load of 250 kW the cascade system with heating load of 600kW has been used. Sequential jet nozzles have been used in open office plan, showroom and high-rise service areas on ventilation system. Nozzles have been designed in double rows to better accommodate the effect of glass radiation. A homogeneous airflow

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could be provided in this environment. In average nozzle groups, air flow has been provided by the airflow of 750m3/h.

Unpainted nozzles with metallic appearance has used because of the steel details used in the intermediate partitions, ceiling and duct coverings. It has a modern and aesthetic appearance and they look very harmonious with its surrounds. The steel structure is also the carrier of the duct and piping system to which the nozzles are connected at the same time. Nozzles applied on the indoor front are directed to match the glass facade surrounding the high-dense area. In this way, it is possible to provide a homogeneous environment for the summer and winter months at low volume levels in the environment. The automatic drainage system has been used with the same channel structure. Ventilation and air conditioning of closed office environments has also been solved using the same duct system using slot diffusers. Flow controls have been provided with automatic switches and dampers.

Sample building in as shown in (Figure 5a,5b) is a showroom providing service in the automotive sector with a lot of vehicles and human traffic. A lot of cars and trucks are exhibiting in the building. Lots of people and cars activation causes to increase pollutants. There has no time for extensive restoration of the building serving 365 days. For this reason, steel structure roof and partitions have been preferred. Big advantage of the steel structure and nozzles used in the metallic form here is that there is no change in color after the deposition of dust and particles depending on usage over time and no image change around the nozzle. Because of accumulation of impurities on frame, deformation occurs in a short time. Slow flow causes fouling on EU3-EU5 and hepa filters quickly. At the same time, the pressure losses increase while the electricity consumption and noise increases. Time-dependent deformation is not observed on metallic ducts and diffusers.(Figure 6) Prolonged effective ventilation, clean and aesthetic appearance is preserved. Corrosion does not occur, mold and fungus formation is not observed due to proper drainage systems. No repairs or painting is required. Solvent and chemical requirements are reduced. A detailed assesment is shown in Table 1 for diffusers.

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Figure 5a. Showroom and Service 1:Floor Plan

Figure 5b. Showroom and Service 2.Floor Plan

Figure 6a. and 6b. Showroom and Open-Office Nozzle Groups

Table 1. Assessment of auto showrooms interior in terms of diffusers criterion

Criteria	Modern Diffuser
Color	Unpainted, metallic appearance, Electrostatic powder paint (RAL)
Surface	Modern and aesthetic appearance,
Material	Natural material with low carbon footprint,Cr-Ni,Aluminium,galvanized steel sheet materials.
Functionality	Variable depending on need climate condition, Flexible production
Aesthetic	Variable depending on need, harmonious with its surroundings environment.A rich appearance with less varieties of material.
Plan Type	Modern architecture suitable designs
Acustics	Air flow velocity and acoustics level is convenient for open plan showroom 35dB
Sustainability	Flexible architectural structure with natural material, No repairs or painting is required, solvent and chemical requirements are reduced.
Form	Environment-form relationship is optimized

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CONCLUSIONS

Efficiency and sustainability are today's architectural design elements. For this reason, it is very important that the proper ventilation systems are designed, and the system can be used efficiently. In conventional methods, the efficiency of the linear grilles and fan-coil systems used in high-rise structures remains low and the desired air mixing ratios are not achieved in the environment.

Due to the flexible architectural structure, which has dynamic usage areas in modern constructions, it makes possible the necessary transformations over time. The details are very supportive of this dynamism that not hiding in the environment. The most important technical details are not hiding ventilation equipment. Diffuser is extremely important vent equipment, which is also considered in terms of being an architectural identity and decoration object at the same time. Ventilation equipment has made a significant contribution interior design thanks to improved production technologies and material science. It has been observed that the use of these systems in designs modern constructions. New age vent systems have sharp and light manufacturing and they accords with earthquake and fire regulations.

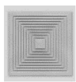
In the past decade, galvanized sheets has been replaced by ducts that are much more aesthetically pleasing, in many forms with circular cross-sections, painted and unpainted in color, and capable of mass production. It has been observed that the ducts made in circular forms have a much better acoustics and thus provide silent and efficient ventilation for summer and winter months at high airspeeds in high-rise structures. The spiro ducts and accessories, which have good sealing and heat transfer properties, are used without being hiding in technological constructions.

With the changing duct forms, the use of the new generation vents has become an inevitable point. It has been observed that the diffusers, which are the extreme points of the installation structure directly affecting the concept of comfort and modernism on the buildings, are the most striking elements of different architectural solutions. New generation distributors with high performance can be shown among the basic elements of industrial style buildings. It is inevitable that the usage of the technical equipment used in these structures increased technological construction style. It is expected that the use of diffusers and ducts like a decorative elements will be spread to the houses and individual space design. Modern diffusers are economical and long life using. They look ergonomic compatible with its surroundings. It does not require cleaning frequently. There is no fouling on and around the surface.

Disadvantages of modern diffusers are calculation and design difficulties. Assembly of diffuser must be made precisely. In this for reason, there is a need skilled project and practice team.

There is shown **Table 2** effects of diffusers on interior design.

Table 2. Modern diffusers for HVAC Systems

Diffusers	Air Quality	Functions	Aesthetics	Acoustics	Color
 Anemostat	The range of air flow can be adjusted.	Suitable for ventilating ceiling height not exceeding 3.5 meters wc and similar small spaces, and the economic model. They are used in small ventilation systems.Max. 300m^3/h	It is generally used in hotel,yacht and hospital bathrooms . Diameter is in the range of 100mm - 200mm .	90m^3/h Flow 44dB.	Electrostatic powder paint (RAL) Standart RAL9010
 Vent	It can be produced with dampers The induction effect on hot and cold flows is weak.	They are not preferred in high structures. Suitable for 2,6m-4m	Mounted on wall and ceiling. Generally galvanized sheet metal ducts are mounted with flexible straits. Not suitable for open channel applications.	2500m3/h 50dB. Avarage velocity and flow 0,2m/s, 500m^3/h 30dB.	Standart RAL9010 It can be painted different colors
Slot diffusers 	Since the blowing directions can vary up to 180 °, they provide a homogeneou s environment .	Suitable for 3m-10m In case of need, the slot number can be increased.	Suitable for continuous mounting and can be mounted in parallel rows to create a linear image. Generally, it is prefered for hotel, atrium, mall, office modern interior design. Easy and flexible mounting	±10°Temper ature difference and 2500 m^3/h flow about 35dB It is acceptable.	Electrostatic powder paint (RAL Alüminum anodic coating
 Swirl diffusers	It is convenient for heating and cooling system. Effective ventilation is possible via turbulance .	effective use in the range of 2,6m-6m. It allows flow setting and orientation.	Almost everywhere is available, thanks to its smooth design, it is compatible with building decoration. Not much prefer for open ducts applications	Flow range 200-2500m3/h max.50 dB	Electrostatic powder paint (RAL) Metallic tissue

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 Jet Nozzle diffusers	It is convenient for heating and cooling system. Clean,effective and silent ventilating for high building.	It can make ± 30 ° rotation motion. High level 6m-30m can be used in all interiors. Can be used individually or as a group according to preference and preference .	It is applied to the wall. It reflects Machine aesthetics to the space. Any kind of channel installation can be done. exposed on the channels available appropriate connection equipment.	High flow rates (5000m³/h). 32 dB acceptable.	Electrostatic powder paint (RAL) or raw metallic surface

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Resume

Havva Demirpolat was born in Konya 1978. She received the Diploma in Mechanical Engineering from Selçuk University and the Master's degree from Selçuk University. Her Ph.D. degree is from Selçuk University. She is currently working in Selçuk University as aAssist.Professor in Department of Interior Architecture & Environmental Design. Her research interests include fluid dynamics, CFD, sustainable design.