

## A STUDY ON VISIBILITY ANALYSIS OF URBAN LANDMARKS: THE CASE OF HAGIA SOPHIA (AYASOFYA) IN TRABZON

Arzu KALIN, Demet YILMAZ

Received: 05.09.2010, Final Text: 03.04.2011

Keywords: landmark; serial vision; visibility;  
legibility.

### INTRODUCTION

Studies on perceived quality of environments, especially urban environments, look for ways of establishing harmonious relationship between people and the world outside. Disorientation is one of the problems destroying this harmony. A solution for preventing disorientation is achieving a distinctive and legible environment which not only offers security but also heightens the potential depth and intensity of human experience. As Lynch (1960) puts it, although life is far from impossible in the visual chaos of the modern city, the same daily action could take a new meaning if carried out in a more vivid setting.

As a result of rapid urbanization caused by uncontrolled population, random and unplanned formations far from aesthetic decisions are constructed and this constitutes one of the biggest problems of our country. In recent years, urban renewal projects are used to solve this problem by rehabilitating economical, social, physical and environmental conditions. Since even the smallest intervention to the city has its effects on the city life, it is important that urban renewal projects should be considered from multiple perspectives. From this point of view, specific qualities of planning should be carefully evaluated. These qualities can be both physical and social and also need to be analyzed in a different study area which includes motion perception. Nowadays, city dwellers perceive and interpret the city in motion along the transportation routes as a result of intensive infrastructure. In this context, in the planning of landmark areas of a city silhouette, a comprehensive silhouette analysis should also be included in addition to plans, sections, facades and photos taken in certain view points. This brings up the question of 'Whether it is enough to evaluate a landmark which is effective in the city silhouette from a single view point?'

Aferi and Triantafillou (2005) state that the way of seeing an urban environment in different means of the movement (walking, cycling,

driving, etc.) offer an opportunity to capture the uniqueness of places by depicting the elements of urban form, such as edge, node and landmarks. In random urban routes, environment provides a lot of visual cues for the observer but if we think about the whole visibility opportunities of a landmark from various directions, what happens? This may raise a few more questions;

- What kind of a sequential visual data set, can be obtained about a landmark as an important component of the city silhouette, while approaching or moving away from it?
- Are there any specific points in these serial visions (sequential visual data set) at which the landmark is most clearly visible?

The serial (sequential) vision mentioned in this study reflects the possible visual experience of passersby and was captured by sequential photo images while approaching or moving away from Hagia Sophia (as its Turkish name Ayasofya) along the existing roads. From this point of view, the present paper is a serial vision analysis of Hagia Sophia church (used as a museum at present) which is situated at a strategic position on the coastline of Trabzon, and is an important landmark in the city silhouette, perceived along different routes. As being a visual analysis, serial vision analysis aims to obtain the most visible single point or interval of points of the landmark from the selected serial visions. Hagia Sophia which sustains an original and rich value in the identity of Trabzon city was in a rural area in the past, whereas today it is surrounded by intensely used transportation and pedestrian axes. Irregular urbanization and new transport networks which have recently surrounded the church's close environment cause both a deformation in the city silhouette and a negative effect in the perception of the landmark. As a solution produced to enhance this landmark, visibility of the church from a perspective in motion should be taken into account. This paper calls importance for this kind of future planning attempts, since it aims at determining the most visible single, or interval of points for Hagia Sophia, and at providing important data for planning decisions for renewal projects regarding the Hagia Sophia.

#### URBAN EXPERIENCE AS A SEQUENTIAL PROCESS

For a city experienced by a moving observer, the cumulative effect of a sequence of views will be critical (Cullen, 1961; Lynch, 1971). Lynch defines 'imageability' of an object by a quality which has a strong evocative mental image in any given observer. Thus, perceiving an environment also means creating a visual hypothesis and building an organized mental image (Lynch, 1960, 1971).

Visual aspects of the urban environment carry a prominent position for its inhabitants in visualization, conceptualization, and eventually perception a city. In her study about making sense of the knowledge base necessary to practice urban design, Moudon (2007) classifies the studies which focus on the perception of urban environment in two groups: picturesque studies and image studies. Referring to Cullen's work, Moudon defines picturesque study as a professional observers' trail in order to identify and describe both verbally and graphically what they think are 'good' environments. In contrast to the picturesque tradition, he distinguishes between the picturesque tradition and image studies since the latter is intrinsically emic and subject-oriented as they are people's image of environments.

Kinaesthetic experience of moving through space is an important part of visual dimension of urban environments. In kinaesthetic motion, there is an experience of self movement and an experience of the external world at the same time. Gibson explains this period as the vision which obtains information about both the environment and the self. The motion in the world is related with a local change in the perspective structure while the locomotion of the self is a global change of the perspective structure of the ambient optic array (Gibson, 1986).

Serial vision is a kind of sequential view analysis of the kinaesthetic experience in urban environments. The observer locates moving objects and spaces in a total structure, orienting himself with regard to the world around him. After an extended period of time, identifiable objects, motions, spaces, oriented structures, and meaning of the environment are organized at an even higher level as complex sequential views (Appleyard, Lynch and Myer, 1966).

The most important study about urban sequential view analysis is Cullen's townscape approach, focusing on the visual qualities and aesthetic experience of urban spaces which is a more personal and expressive response to urban environments and places (Carmona, Heath, Oc and Tiesdell, 2003). Cullen named the sequence of views seen during the experience in moving through towns as "serial vision" and tried to define each view (Cullen, 1961). The main aim in shaping the sequential form of urban views is to preserve continuity while developing embellishment and contrasting the material. Although linear structures such as roads have their own continuity, this must be supported by succession of space, motion, orientation, and meaning which seem to be parts of a connected whole (Appleyard, Lynch and Myer, 1966).

On the other hand, public perceptions of townscapes developed by Lynch encompass issues of perception and sense of place. For Alexander, a city which allows for a rich diversity of cross connections between activities and places provides the designer with a usable but not predetermined series of relationships between activities and spaces (Carmona, Heath, Oc and Tiesdell, 2003). Lynch (1960) defines this as an environmental image which can be analyzed into three components: identity, structure and meaning. Therefore, according to him the environment is visibly organized and sharply identified, and then the citizens can inform it with its own meanings and connections.

#### LANDMARK PERCEPTION STUDIES

In recent years, visual perspectives of vehicle drivers, road traffic and pedestrians, and the role of landmarks in way finding and navigation studies are the most important two topics appearing as central concerns of urban studies related with visual experience of cities. The former group contains studies about aesthetic experience of road traffic, from the point of view of people both inside motor vehicles as drivers and passengers, and outside vehicles as pedestrian and cyclists (Zacharias, 2001; Taylor, 2003; Froment and Damon, 2006; Merriman, 2006; Foltête and Prombini, 2007; Robertson, 2007; Nikolov, 2008); the evaluation of city panoramas, street scenes and picturesque views of urban places (Çevik, 1991; Kalın, 2004; Cooper and Oskrochi, 2008; Jansson and Lagerkvist, 2009; Bernasconi, Straper, Maskey and Hasenmyer, 2009). The latter group has a number of studies investigating the nature of landmark from various points of view such as the knowledge creating extensive spatial ability in way finding

(Cornell, Heth and Skoczylas, 1999; Rosanno, West, Robertson, Wayne and Chase, 1999; Cubukcu and Nasar, 2005; Roger, Bonnardel and Bigot, 2009); the value in aiding visual orientation and navigation (Murrieta, Parra and Devy, 2002; May and Ross, 2006; Peebles, Davies and Mora, 2007); the visibility, legibility and the visual salience (Herzog and Leverich, 2003; Herzog and Kropscott, 2004; Klippel and Winter, 2005; Omer and Goldblatt, 2007; Caduff and Timpf, 2008).

Spatial knowledge is said to be necessary to build a complete mental representation of an environment and visual landmarks are the most remembered, thus the most descriptive elements of this representation (Roger, Bonnardel and Bigot, 2009). This means that the salience of landmark in some sense (visually, auditory, olfactory, or semantic) (Caduff and Timpf, 2008) is accepted as the most important element for the visual image of the city (Lynch, 1960; Cullen, 1961) and the navigation of its inhabitants.

Klippel and Winter define the structural salience of landmarks along routes in two steps; formalization of salience of objects, and conceptualization of their way-finding actions. It is true for formalization process but not enough as the salience or saliency denotes relatively distinct, prominent or obvious features compared to other features. The complexity of spatial layout in an urban landscape causes the most general requirement of landmark that it must be in contrast with the environment in order to have perceptual distinction (Klippel and Winter, 2005).

Despite the vast number of studies, few attempts have been made to define the visibility of a landmark by sequential view process while approaching it. This paper attempts to define the continuous sequential view sets captured from different approaching routes and most visible single or interval of points as a visibility analysis methodology of a landmark.

## METHOD

Various visual analysis methodologies have been proposed for urban landmarks as defining fractal dimensions of street vistas in order to assess levels of visual variety in everyday street scenes (Cooper and Oskrochi, 2008); fractal dimensions of landscape silhouette outlines (Hagerhall, Purcell and Taylor, 2004); path selection choices made in a virtual environment visualizing the information provided by movement in the environment (Bishop, 2001); an isovist, or the subset of points in space that are visible from a particular vantage point (viewshed approach) (Sander and Manson, 2007); segmentation by using color range (Murrieta, Parra and Devy, 2002); dynamic segmentation of the dataset based on natural urban subdivision (Silion, Drettakis and Bodelet, 1997; Caduff and Timpf, 2008); region detection and segmentation of a scene (You and Chien, 2008).

In order to normally process a scene, viewers needed to see the scene for at least 150 ms (millisecond:  $10^{-3}$ ) during each eye fixation (understanding the meaning of the scene, identifying the object being looked at, and locating potential places to look at) but it takes longer than 50 ms to encode the general meaning of the scene (Rayner, Smith, Malcolm and Handerson, 2009). This is important especially in the real-time visualization based scene capturing methodologies in choosing the sample views. Besides the photographic survey based scene capturing studies (Froment and Damon, 2006; Bernasconi, Strager, Maskey and Hasenmyer, 2009) there is another group of studies using more complicated technologies as listed below:

- scanned scenes with multiple cameras or a fish-eye camera on a moving vehicle, which generates a real scene achieve along streets (Zheng, Zhou and Mili, 2006);
- pace-the-scene movie, which is a video-based scene reproduction method for natural scenery (Kamei and Seo, 2003);
- real time visualization of urban scenes having huge complexity of the geometrical data and widely varying visibility conditions (Silion, Drettakis and Bodelet, 1997);
- urban scenery modeling based on analysis of moving images taken from a running vehicle (Parsons et al., 1998; Notomi, Ozawa and Zen, 2000).

As the present study examines the sequential scenes of a landmark from different approaching routes by extracting the silhouette of landmark and segmenting the visibly different regions of the scene, the photographic survey based scene capturing methodology is used to analyze the visibility. Kostianen (2006) defines the ideal segment division, for the purpose of scene analysis, as separating the different objects from the scene. The approach depends on choosing the uniform regions and edges supposed to be the most suitable for the present study as it is a restricted application, where the quality criteria are easy to define and weight.

#### SELECTED AREA

Today, the important landmarks for cities reflect traces of the rapid functional and structural alteration process that the cities undergo can be seen on landmarks which are important for a city. By this point of view, Hagia Sophia in Trabzon city and its environment was selected as the study area since it has also undergone a process of change due to excessive extension of settlement structure, filling of the sea and the construction of coastal highways for vehicles.

Trabzon was founded as a colony in the seventh century B.C. and was ruled by Persians, Greeks, Romans, and Ottomans in its history. It was the capital of the *Empire of Trebizond* from 1204 to 1461 (Uspensky, 2003). Being one of the oldest and biggest cities on the Blacksea coast, Trabzon lies in the northeast of Turkey. The city is surrounded by Rize in the east, by Giresun in the west, by Gümüşhane in the South and by Black Sea in the North. Due to its topography with mountainous structure, it has a coastline elevating



Figure 1. Google earth images of research area,

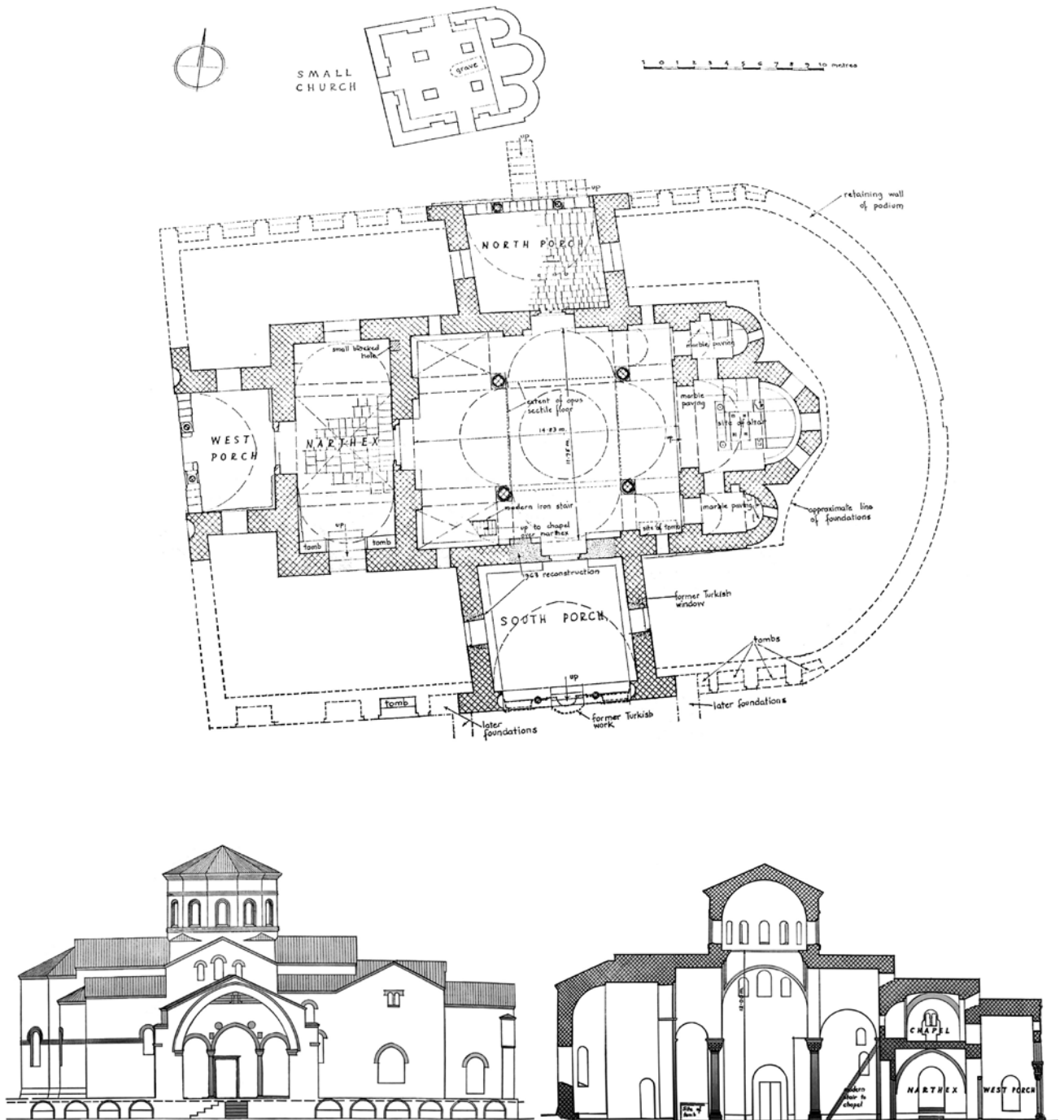


Figure 2. Plan, section and elevation of Hagia Sophia (Balance, 1968).

inwards right away from the coast and has a linear urban structure along its coastline (Figure 1).

Originally called Hagia Sophia, the Ayasofya museum as called and used by the inhabitants of Trabzon, is the one of the most important building of the late Byzantine period. Though the actual date of founding is still



Figure 3. View from inside and outside of Hagia Sophia.

obscure, according to some researchers the main church (probably the monastery) is believed to be founded by Manuel I the Great Comnenos (1238-1263) or his immediate successors (Balance, 1960; Rice, 1968; Bryer, Winfield, 1985). In her detailed research on the architecture of Hagia Sophia, Ballence (1968) mentions it as a monastery church and gives brief information about details of the architecture.

“...the church is basically a cross-in-square with a single central dome on a high drum; three eastern apses, of which the side ones are rounded externally and the central one five-sided; a western narthex of the same width as the church and with a chapel over; and three great barrel-valuted porches, on north, south and west” (Figure 2).

Other useful information about buildings accompanying the church is mentioned in Bryer and Winfield’s (1985) work:

“....a smaller church, triple-apsed with four columns, standing less than 4m less than northern porch of the main church and incorporating an empty grave; a tower standing 22m west of the main church; and remain of monastic buildings within a walled enclosure of about 90x50m.” (Figure 3).

Besides many changes of use – mosque, military storage, cholera hospital, mosque again and museum now- in its history (Rice, 1968), Hagia Sophia has always carried an important role as a powerful landmark for Trabzon because of its visual effect in the city silhouette (Figure 4). It stands 4 km



**Figure 4.** Various views of Hagia Sophia as a landmark.

west of Trabzon's city center surrounded by a small garden on a hilltop elevating from the seashore.

The reasons for the selection of this region as the topic of research is the importance of Hagia Sophia as a city landmark and the need for researching how such an important urban landmark is perceived in motion.

#### PROCEDURE

This paper examines what kind of sequential view series the Hagia Sophia, which is a historical landmark of Trabzon, determines along the transportation and accessibility axes and where the most dominant visibility points and intervals in this series are. In this context, 4 different road axes demonstrating different perception levels such as ascending or descending motion routes along horizontal and vertical directions through Hagia Sophia were determined as routes for analysis.

- 1) Old coastal road constructed in the 1960s,
- 2) New coastal highway completed in 2007,
- 3) The viaduct as a part of this highway,
- 4) The Hagia Sophia slope extending from the old coastal road to the Hagia Sophia entrance.

Considering that a road axis offers two opposite approaching opportunities to a focal point such as a landmark, in order to analyze each walking movement offering sequential views on that route should be addressed



from two opposite directions (two-way). In this context, the following walking directions along the road axes chosen for the visual analysis were determined as the axes to capture photos (**Figure 5**).

- Axes #1 and #2 along old coastal road moving in the east-west / west-east directions respectively,
- Axes #3 and #4 along the secondary road from the old coastal road to the entrance of Hagia Sophia moving in the north-south / south-north directions respectively,
- Axis #5 along new coastal highway moving in the west-east direction (the opposite direction was not handled since the sight does not change),
- Axes #6 and #7 along the highway on the viaduct which is a part of the new coastal highway moving in the east-west / west-east directions respectively.

Then sequential view frames were captured along the determined routes. The shoots were initiated from the point Hagia Sophia entered the view and continued until it disappeared with intervals of approximately 20 meters. Along these walking routes, a total of 138 photographs were taken on a partly cloudy day by using a Canon A-700 digital camera.

Since the shooting interval was relatively short and some captures were nearly identical, the number of photos was reduced in order to achieve the best flow of the serial vision. In this context, the captures in all directions were reduced in a way not to break the continuity so as to remove similar photos having little differences and to reveal the change clearly. Therefore, the number of photos was reduced from 26 to 15 in the first direction, from 24 to 18 in the second, from 18 to 14 in the third, from 10 to 9 in the fourth, from 13 to 10 in the fifth, from 29 to 14 in the sixth and from 18 to 12 in the seventh.

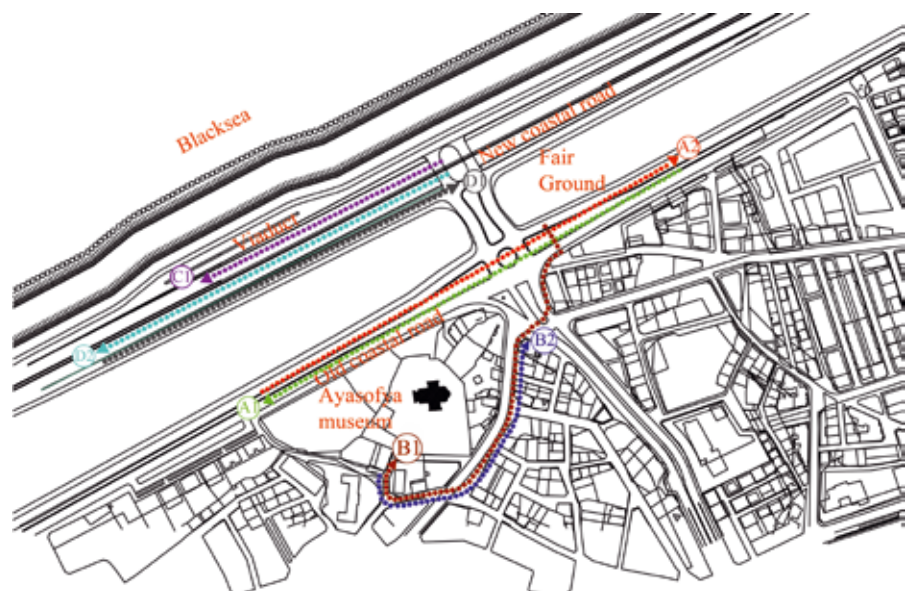
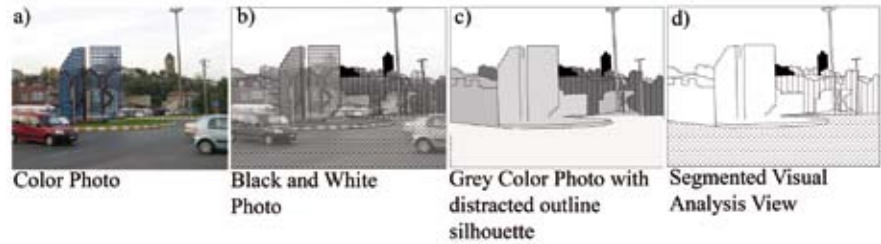


Figure 5. Pedestrian Routes.

**Figure 6.** Hagia Sophia, vegetation and the roads were distinguished by clarifying shape contours and silhouettes in the photos using abstract expression technique. In this sense, first the color photo, a) was transformed into black and white, b) and the contours of the fields with different properties were determined, then those areas determined were scanned as different shades of grey c) and at the final stage Hagia Sophia was darkened, vegetation fields were scanned vertically and roads were scanned horizontally and a segmented visual analysis view d) was created in which the church, vegetation and the road can be read (distinguished).



## EXTRACTION AND SEGMENTATION OF SCENES

In the next stage, sequential view analysis cards were prepared in order to define the visibility of Hagia Sophia in the obtained photo sequences. The sequential view frames in these cards were abstracted by applying the 'distracting the outline silhouette' and 'segmentation' (Kostiainen, 2006) methods to the photos and sequential view sets expressed with graphical representation were prepared (**Figure 6**).

In order to make possible the correct interpretation of the constant differentiation, rhythm, visual unity and the visibility of the church, it is necessary to convert series of photos into abstract expressions. Therefore, the visual image sets have been constructed in a way to include in principle a linear visual image produced with segmentation method, the photo taken, a point showing from where the photo was taken and the route of the movement. The points and intervals from which the visibility of the Hagia Sophia is highest, have been highlighted with a red frame in the segmented visual analysis view series. Finally, the characteristics defined by the visual series produced have been given in the findings section.

## RESULTS

Findings about eight routes on four road axes were divided into four main groups according to horizontal and vertical distances to Hagia Sophia and given in related tables:

**Group A close distance**, the motions Number 1 and 2, in the direction of the motion along the old coastal road (**Figure 7, 8**):

- The first motion route of Group A is determined as a short approaching distance from a close distance from the point where the landmark enters the view since the urbanization along the road obstructs the visibility of Hagia Sophia.
- Both the intense vegetation and the urbanization structure conceal the visibility of Hagia Sophia at most parts of the route, thus causing a silhouette effect in which the landmark has partially effective visibility at certain points. Moreover, the existence of elements leading to visual chaos such as the electric poles, billboards and traffic signs are the other factors playing a part in the destruction of the silhouette effect.
- As the approaching distance decreases, firstly the tower of Hagia Sophia enters the view as an effective element. While approaching, point of view broadens and the structure presents a strong visibility as a whole. Despite the route which has such a closeness that may create a continuous silhouette effect, the entire structure disappears from the view in some frames and it is sometimes enclosed by the buildings and the vegetation because of the curving road. For this

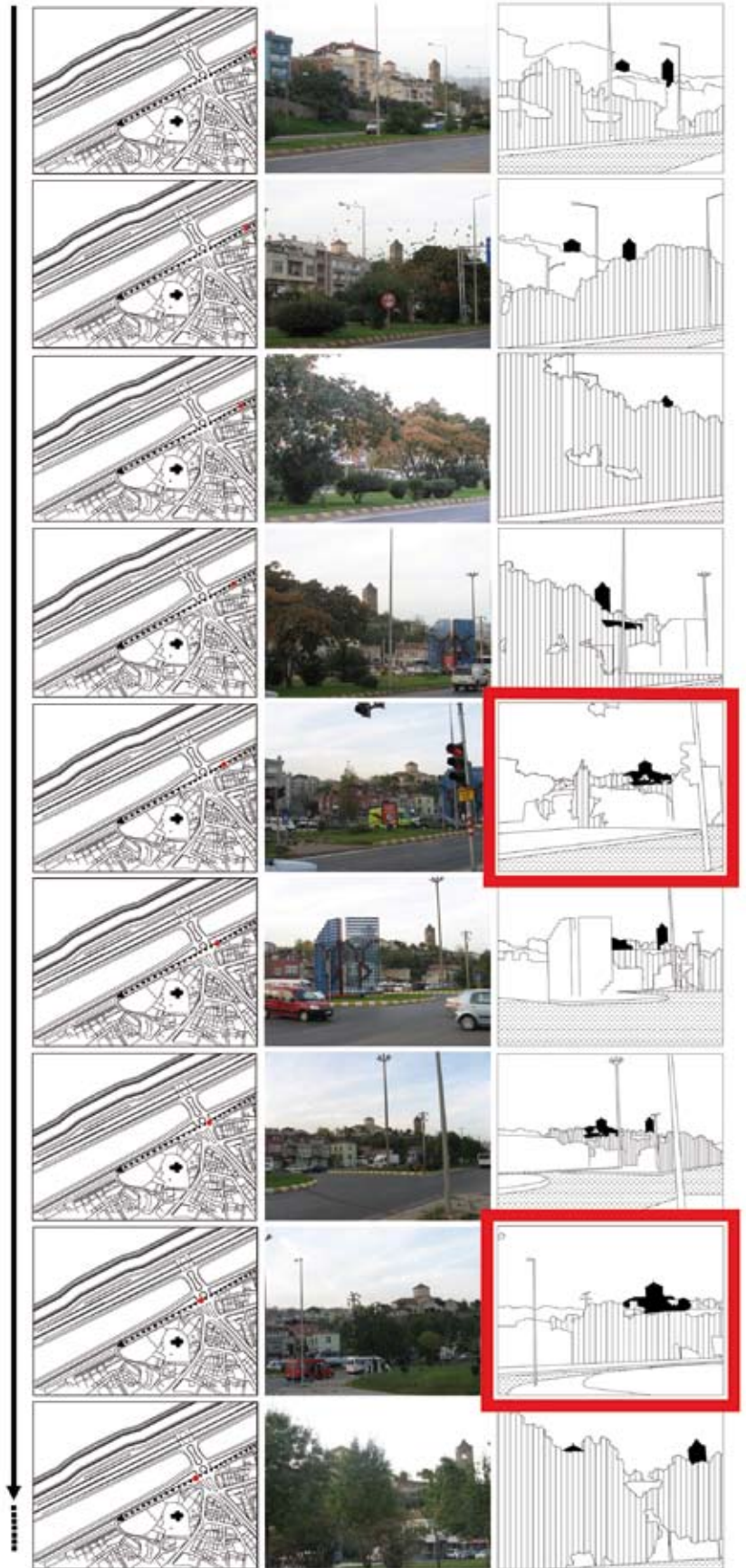


Figure 7. Axis #1 of Group A.

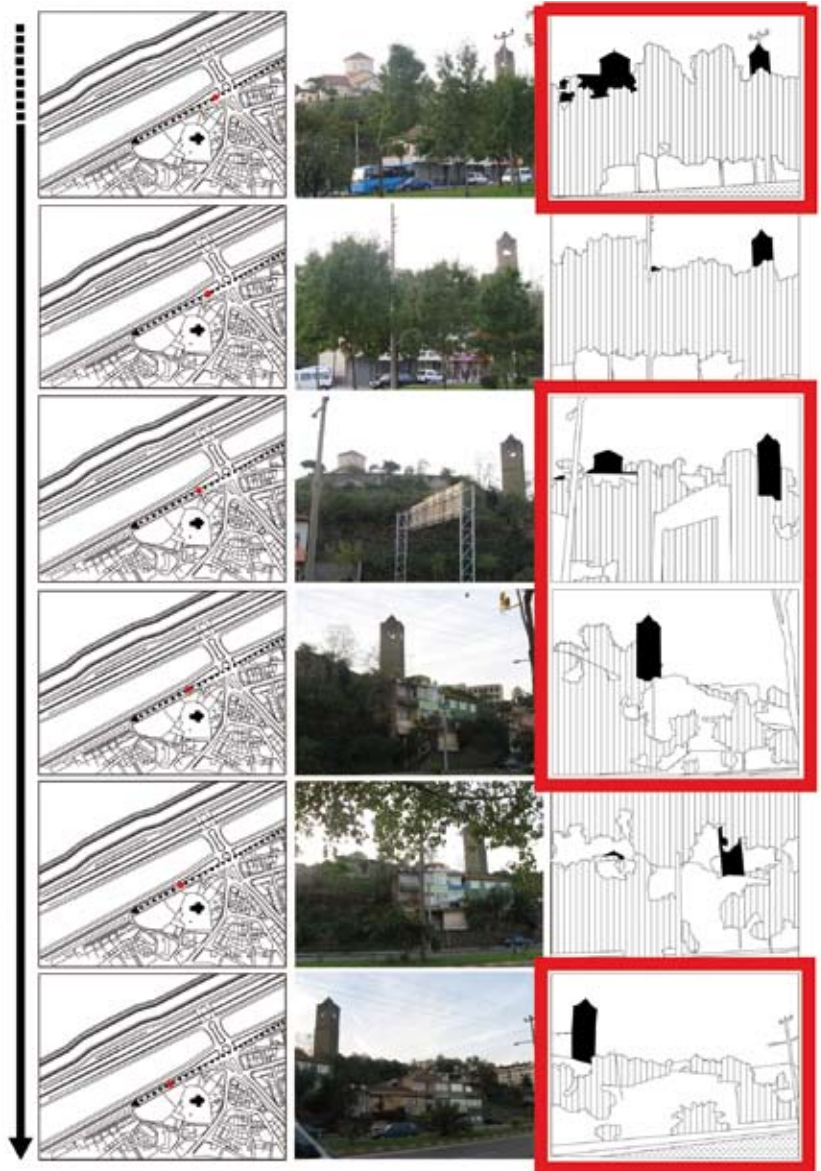


Figure 7. Axis #1 of Group A continued.

reason, although the visibility levels defined by the sequential view frames increase with the decrease of approaching distance, they can not form a continuity. In this context, the 10th, 5th, 8th, 12th, 13th and 15th frames were determined as the points defining the visibility of the landmark.

- In the second motion route of group A, because of the linear structure of the road, the tower of Hagia Sophia is visible from a further approaching distance compared to the first motion route. Along the motion route starting from this point towards Hagia Sophia, the landmark determines a focus primarily with its tower which is constantly growing in silhouette with the entire structure in the last frames of the sequence.
- Along the approaching motion, the vegetation, the structural elements and the relative locations of Hagia Sophia define various degrees of visibility. In the sequential views in which a far and

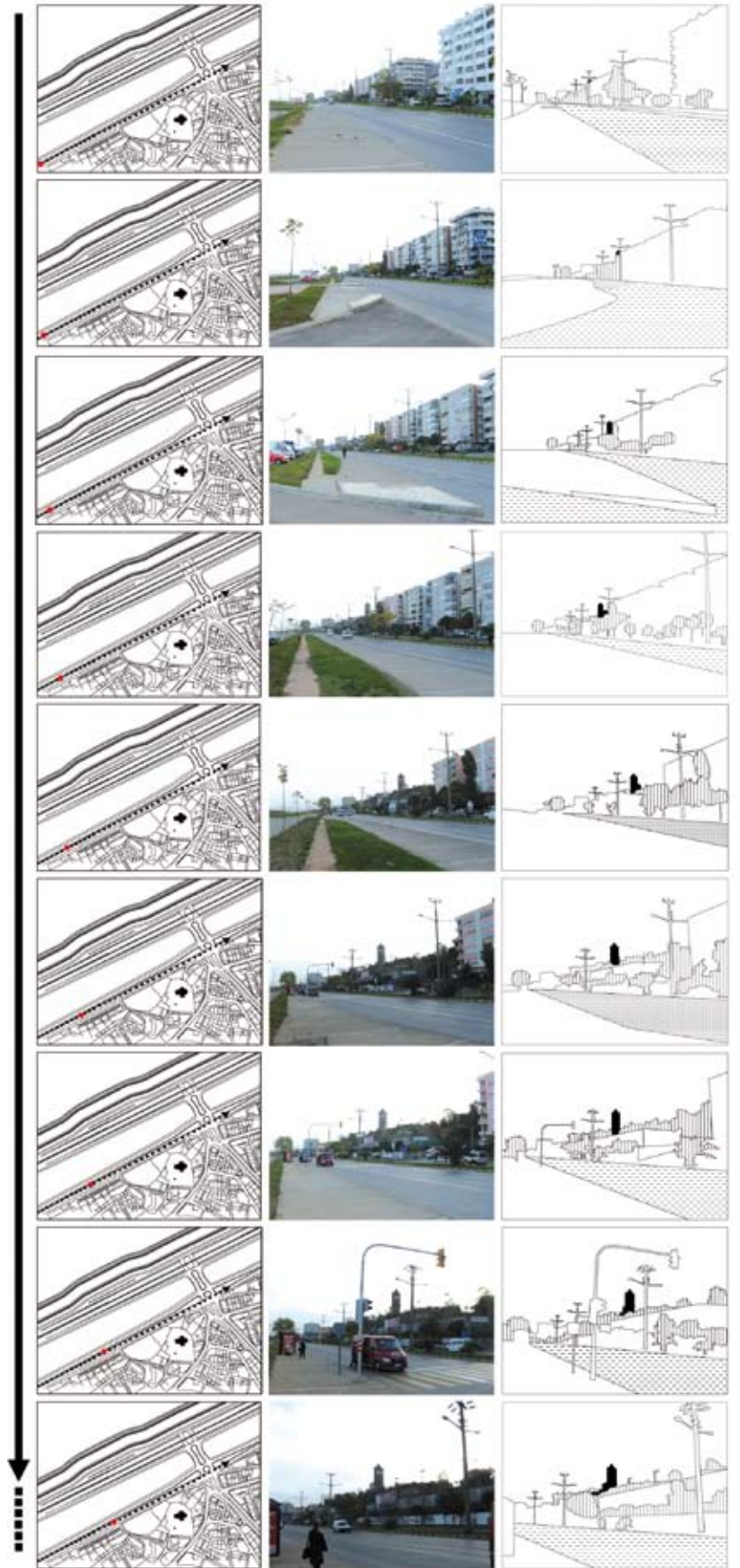


Figure 8. Axis #2 of Group A.

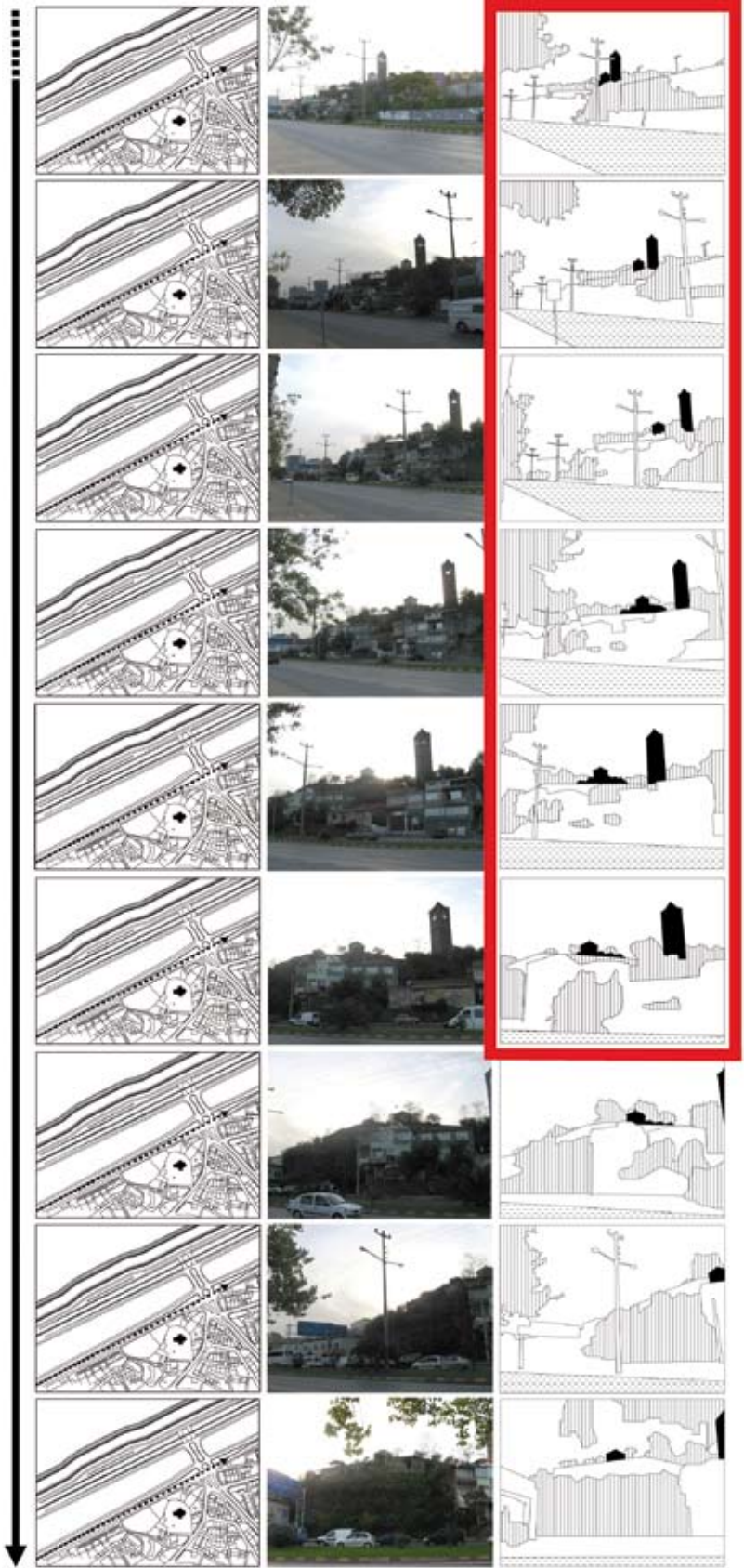


Figure 8. Axis #2 of Group A continued.

slightly changing silhouette effect is dominant, the landmark has the most effective visibility as a whole in the 13th, 14th and 15th frames. Besides in the 10th, 11th and 12th frames the tower defines a visibility level of effectiveness.

- The linear structure of the road and scale and organization of the buildings in a way not obscuring the visibility of the landmark along this direction define a sequential silhouette effect and this causes the images in which the landmark is effectively visible from a continuous interval.
- **Group B close distance ascending and descending**, the motions Number 3 and 4, along the secondary road (Table 3, 4),
- The first movement route of Group B is determined on a route by ascending from a low elevation to a higher one on a curved road and finally reaching the entrance of the landmark.
- Throughout the approaching motion, since the starting point is too close to the landmark and there's a high level of elevation difference between the landmark and the starting point, the sequential view series emerge as individual frames rather than defining a continuous silhouette effect.
- Due to the slope of the road, the elevation of the landmark being much higher than the elevation of the road combined with the intense urbanization on the banks of the road, the visibility of Hagia Sophia is concealed completely and only occasionally the visibility of individual frame vistas were made possible. Moreover, the narrowness of the road along this route, the high blocks of buildings on the sides of the road and the intense vegetation happen to be the other factors concealing the visibility of Hagia Sophia.
- Along this route, the 9th image frame comes forward as the point at which Hagia Sophia has the most powerful visibility level as a whole (due to lower elevation of the point of photo and its point of view, the tower is not visible in this whole). Furthermore, the 6th, 8th, 13th and 14th frames were defined as the other points where the landmark has higher visibility.
- The first movement route of Group B is determined on a route by descending from a high elevation to a lower one on a curved road defining a movement starting from the entrance of the landmark and moving away. The sequential view series of this route has fewer numbers of photos than others because the landmark disappears from the scene after a short motion route.
- While the first motion route of this group defines more scenes as having the effective visibility, this route defines a short interval as the effective scenes. When these view series were examined, it is observed that the factors such as unorganized urbanization, dense vegetation and electric poles cause to decrease the visibility degree by increasing complexity.
- Within the sequential view series along this route, the 6<sup>th</sup> image frame was defined as the most visible point of Hagia Sophia. Furthermore, the 4th, 5th and 7th frames were determined as other points where the landmark has higher visibility.

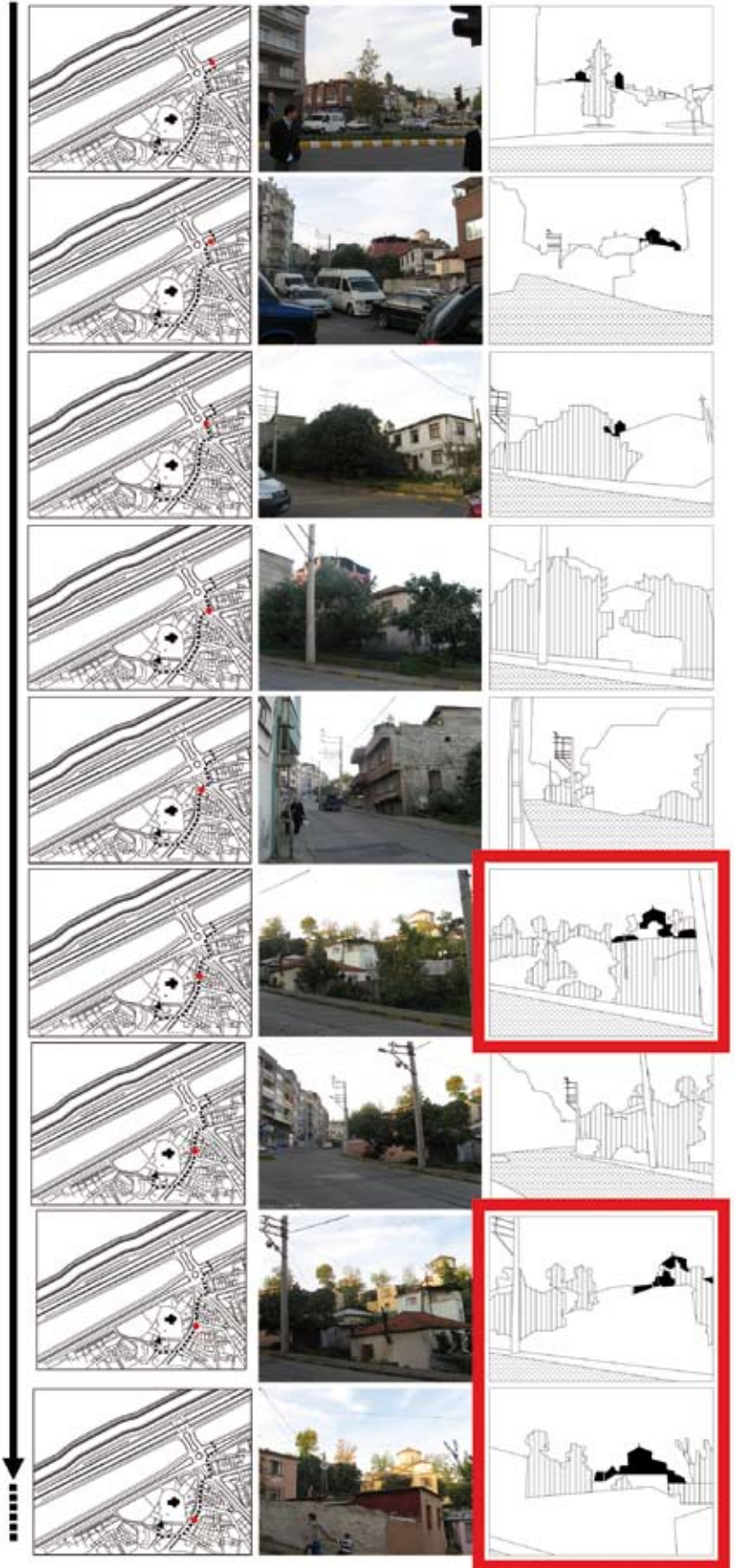


Figure 9. Axis #3 of Group B.



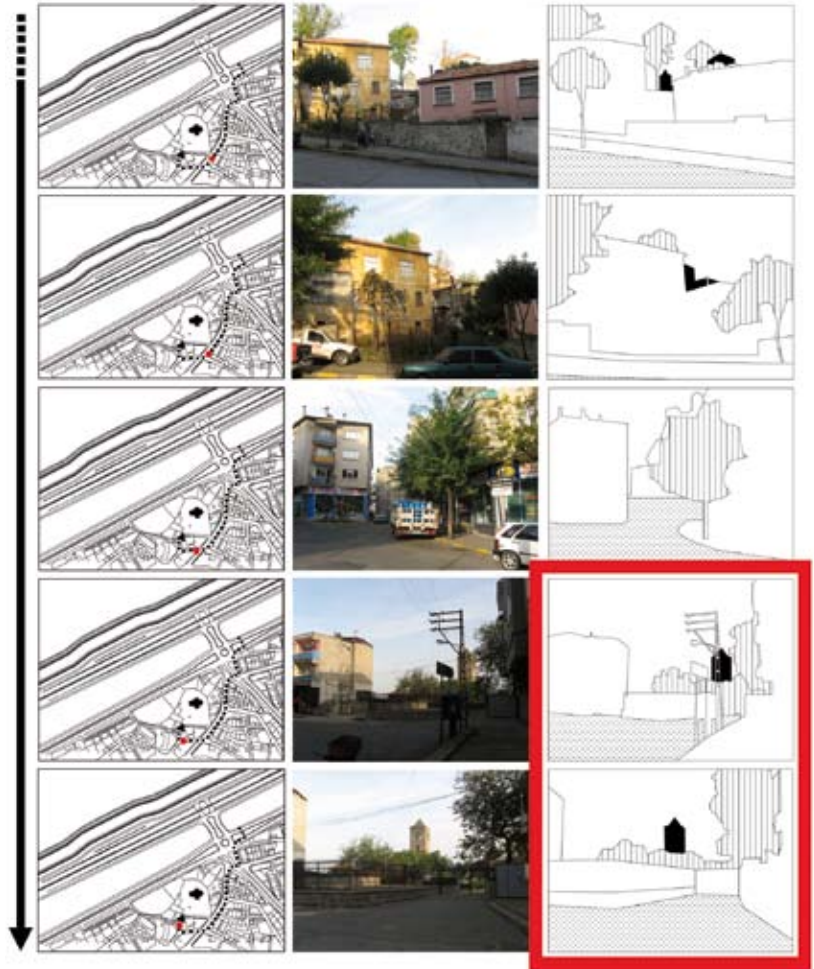


Figure 9. Axis #3 of Group B continued.

- **Group C far distance**, the motion 5 along the new constructed coastal highway (Table 5),
- The motion route of group C was chosen to be parallel to the second motion route of group A but from a further distance to Hagia Sophia than the route A. Capturing the sequential view frames from a distance where the detail effects of the structure can not be distinguished led to the emergence of a continuous silhouette effect. Again in this silhouette effect, the distance caused Hagia Sophia to be perceived as whole and by creating minimum differences in the view, thus defining identical views.
- Another positive effect the distance added to silhouette effect is increasing the depth and in this context determining how the landmark stands out by creating a contrast between the vegetation texture around Hagia Sophia and the urban structure. In this context, the sequential views determined along the motion route of group C being at a further distance than the locations A and B maximized the power of visibility therefore the visibility of the landmark in terms of silhouette.
- The first five frames of this sequential view series creating a continuous silhouette effect were determined as the interval in which the visibility of Hagia Sophia is most effective.

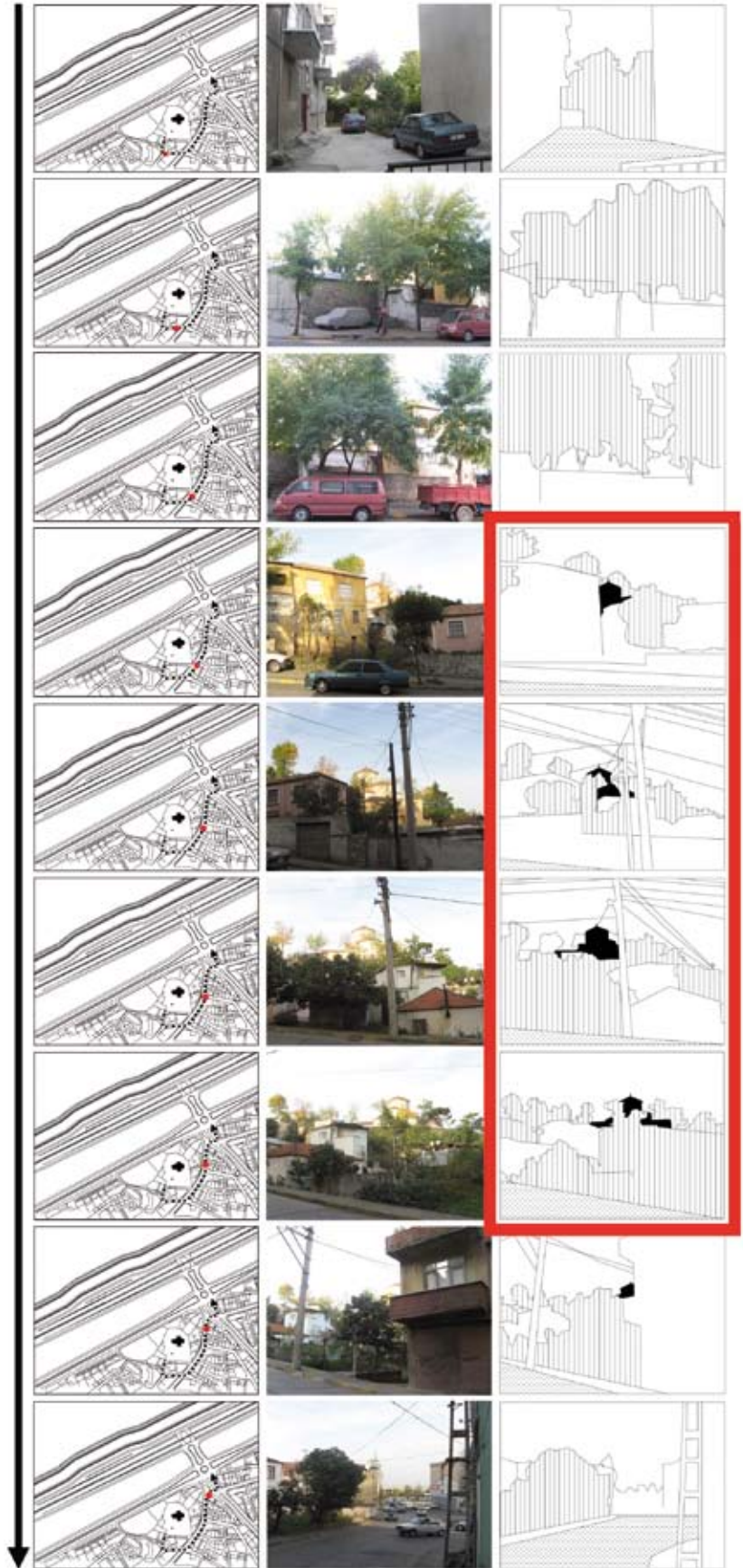


Figure 10. Axis #4 of Group B.

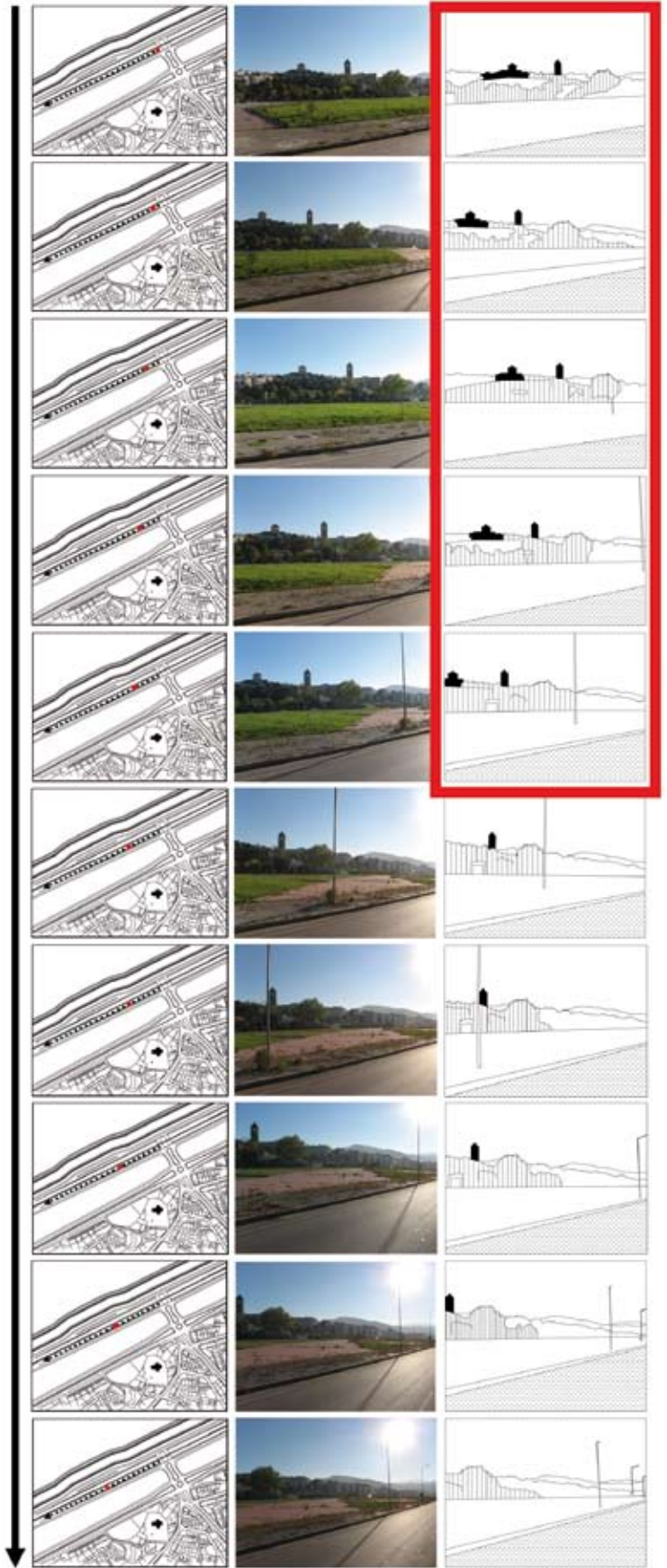


Figure 11. Axis #5 of Group C.

- **Group D far distance ascending and descending**, the motions Number 6 and 7, along the viaduct which is a part of the new coastal highway (Table 6, 7).
- The motion route of group D was chosen to be on the same motion route of group C, and on a viaduct in the same direction, from a lower elevation to a higher one. The distance of the route to the landmark defines a continuous silhouette view for this sequential view series as in group C.
- The long horizontal distance between Hagia Sophia and the motion route eliminates the visual effect created by the quite higher elevation of Hagia Sophia compared to the elevation of the road as in other similar routes. In fact the visibility of Hagia Sophia increases along the viaduct by ascending from a lower elevation to a higher one. Although the intensity of vegetation along the approaching route occasionally interrupts this visibility effect, the continuous silhouette effect is perceived strongly.
- The frames in the sequential view series in which the visibility of Hagia Sophia are effective are determined as a long interval. In the images starting from the 3rd frame until the 11th, Hagia Sophia has a more effective visibility compared with other images.
- The motion route of group D was chosen to be on a line, starting from the high elevation of the viaduct and reaching out to the ground elevation joining with the main road. Continuous silhouette view defined by similar routes is also valid for this sequential view series. The visibility interval of Hagia Sophia in this group is longer and more effective compared to all other groups due to the openness provided by the point of view opposite to the first motion route of the same group.
- Although the long horizontal distance between Hagia Sophia and the motion route change the level of visual effect related with Hagia Sophia being at a higher elevation compared to the road routes as if they're all at the same elevation, the image frames captured from the elevation of the viaduct cause Hagia Sophia to be perceived deeper with the depth effect they provide. In this context, vegetation around Hagia Sophia forms a gradual effect between the landmark and the urban building texture with its background effect.
- This sequential view series also define the views in which the visibility of Hagia Sophia is effective as a long interval. In all images except the 10th and 12th frames, Hagia Sophia is perceived as most effectively visible as a whole.

At the final stage of the findings, the data related with all routes were evaluated together and the points and intervals at which the visibility of Hagia Sophia is most effective on each motion route were shown on the site plan (Figure 6).

## DISCUSSION

Urban environments generating a set of visual inputs of varying complexity defined by different levels of visual orders need to be structured as a satisfactory combination of orientation and variety (Lozano, 1998). Lynch (1960) identifies the perceptible elements that will provide the

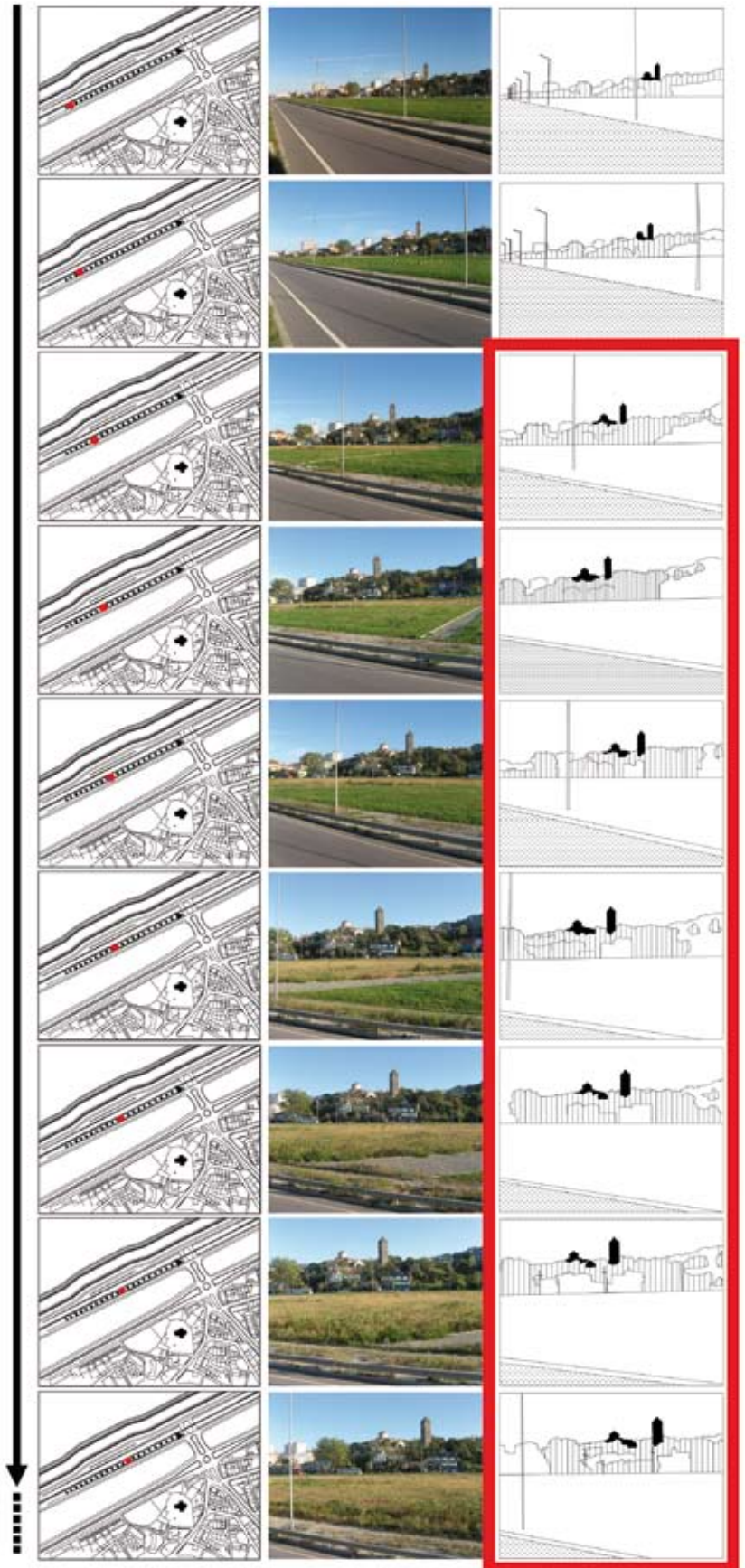


Figure 12. Axis #6 of Group D.

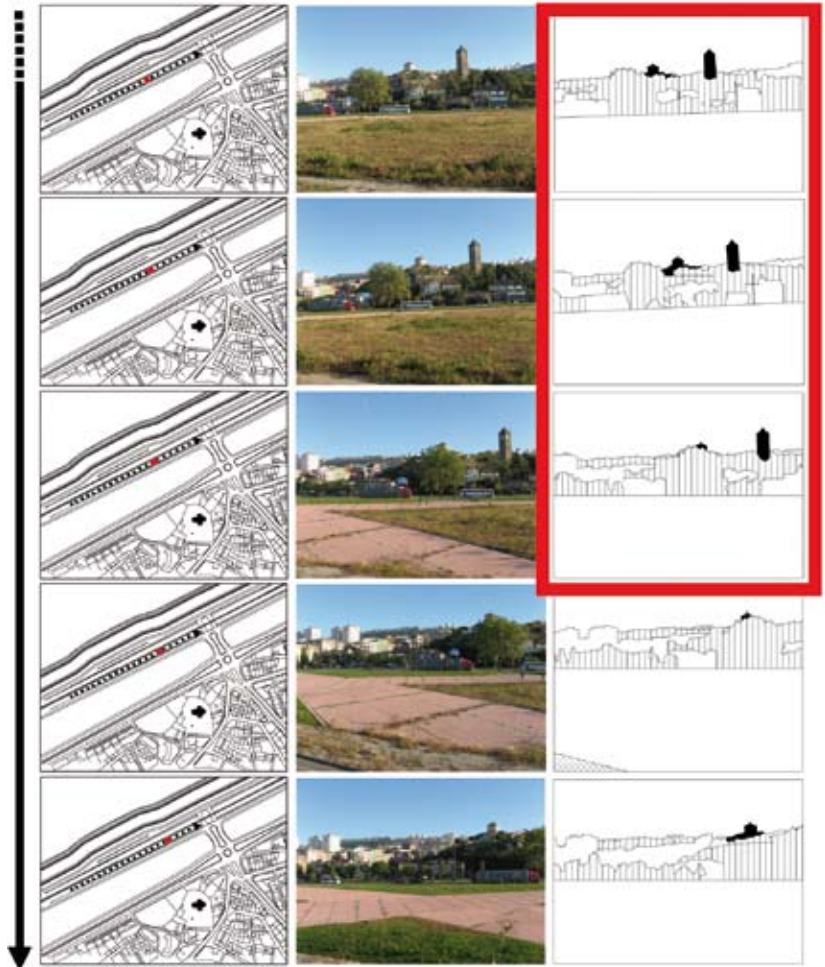


Figure 12. Axis #6 of Group D continued.

legibility of the city in this combination as landmarks in his referential study in this field. The presumption that the fields with high perceptibility and aesthetic quality among urban views have more inclination to become points of emphasis (Heath, 1992) also demonstrates a need for emphasizing the visual experience dimension of those points with effective analyses. In this context, this paper explores how Hagia Sophia showing a landmark property in terms of its urban location, structural difference and meaning value is perceived visually from different approaching directions and points at which the spatial perceptibility in this visual perception defines effective points and intervals. When the data obtained is examined, the following results were found related with the visibility and perception level of Hagia Sophia;

- Hagia Sophia is located on an intercity axis and at a location harmonizing with the sea. With its connections to motorways and powerful border effect, it is highly perceivable. In this context it has an imageability/legibility level defined by all urban landmarks. The perception levels defined as points or intervals along different approaching routes are in agreement with the findings of a number of studies which define imageability/legibility with different variables. Some studies define imageability/legibility as depth in the context of change of ground surface texture (Ulrich 1998; Nasar, 1998, 1998b; Kalin, 2004; Caduff and Timpf, 2008); some as a focal

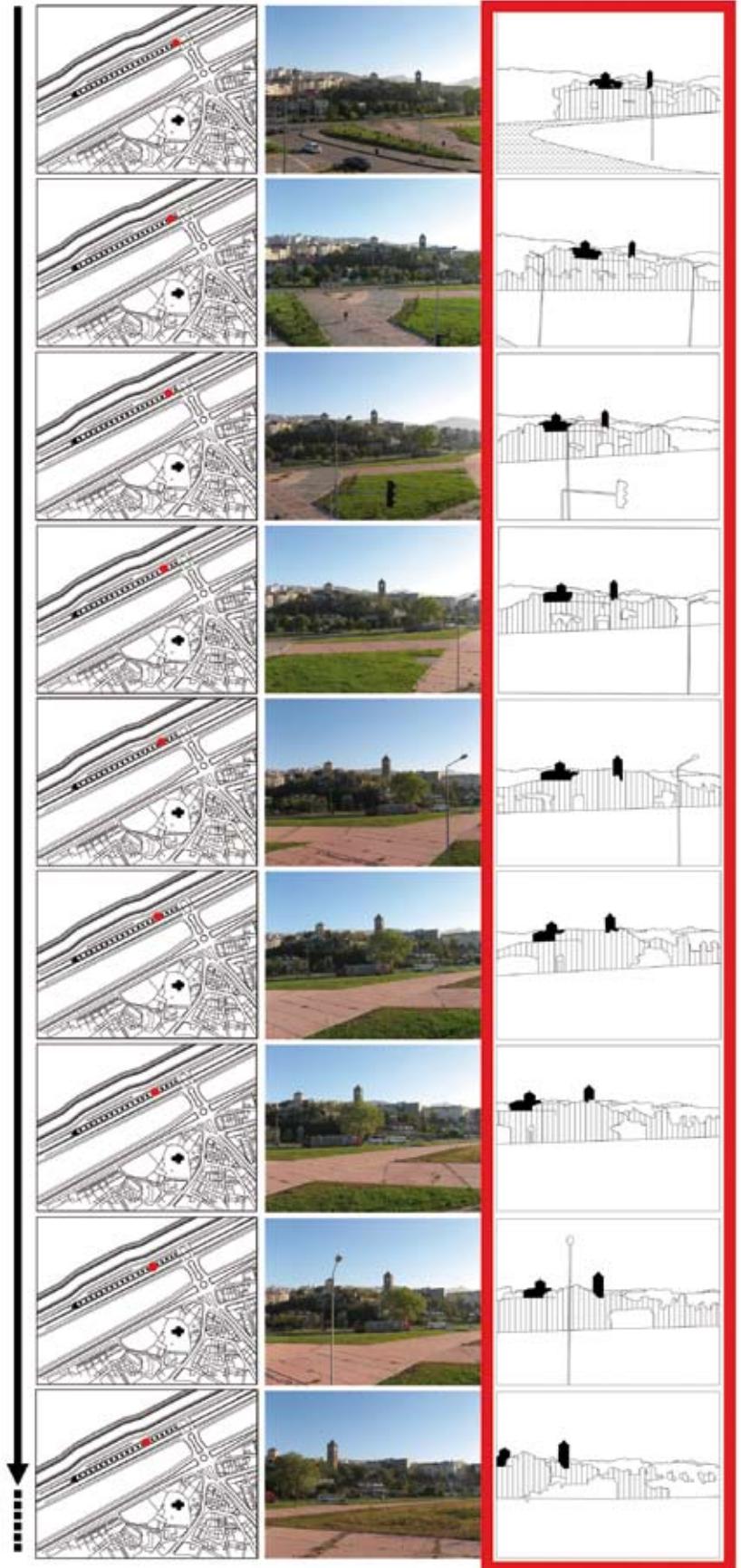


Figure 13. Axis #7 of Group D.

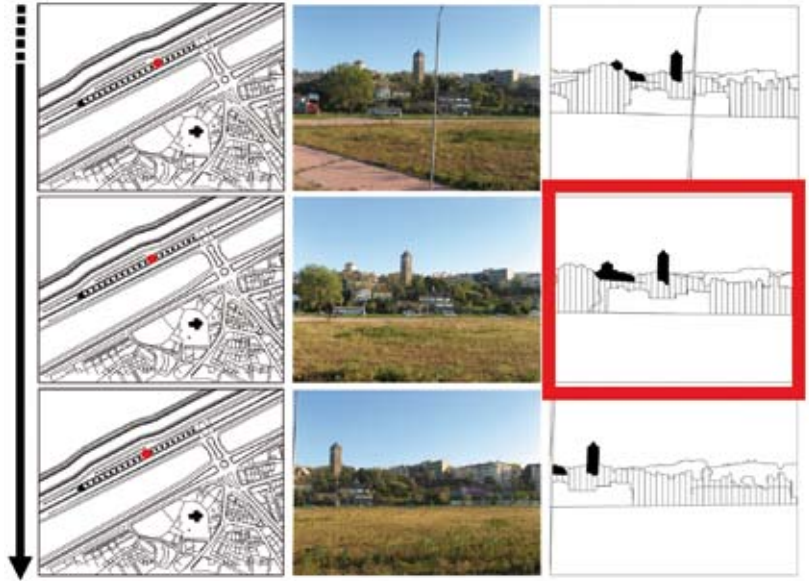


Figure 13. Axis #7 of Group D continued.

point, a mystery element or novelty provided by complexity (Cohen and Wapner, 1976; Ulrich, 1983; Kaplan, 1992; Kalin, 2004; Ode et al., 2009); whereas some works relate it with spaciousness (Herzog and Flynn-Smith, 2001; Tveit et al., 2006).

- Pedestrian motions from the main roads parallel to the sea along the old coastal road and new coastal highway define a linear axis and demonstrate differences in terms of visibility of the landmark and visual quality regarding only the elevation, approaching and distancing. As going away from Hagia Sophia, panoramic views substitute detail views, a continuous silhouette effect is created and the depth effect provided by the urbanization in the background of landmark increases with the elevation. This revealed in the analyses that by going away and ascending, the effective view interval increases. Also showing that dominant landmark points in an urban

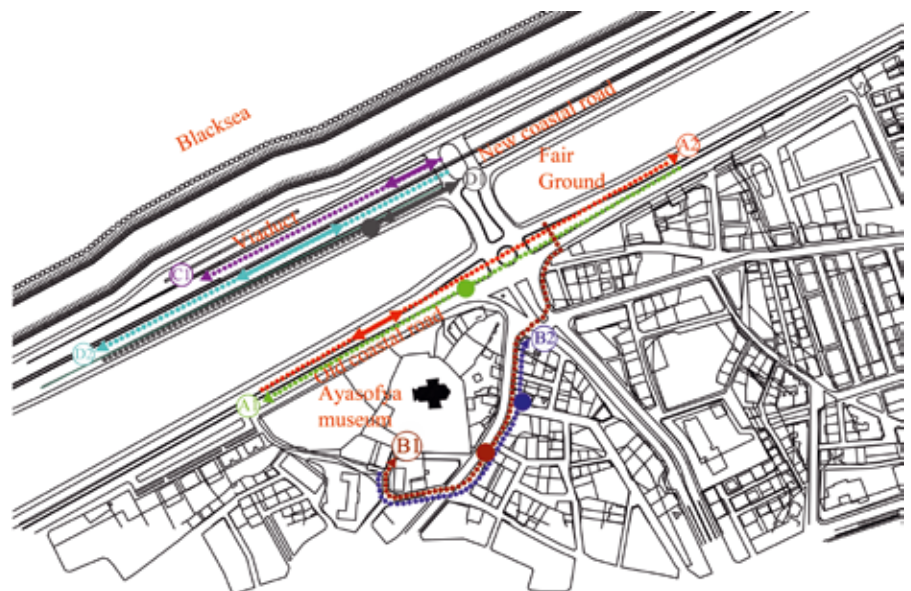


Figure 14. The most effective visibility points and intervals of Hagia Sophia.



panorama are more clearly perceived as they are distinguished from their environment (Klippel and Winter, 2005; Caduff and Timpf, 2008). Besides differentiation in shape, the vegetation in the background increases the depth effect in the view and strengthens the visibility of Hagia Sophia. The vegetation texture which has many functions such as revealing and defining the location, and providing continuity in the silhouette by linking the artificial with natural is perceived chaotic in the movements made in close range of the landmark whereas by going away from the landmark and especially by ascending it is perceived stronger because of its continuity. A number of studies (Ulrich, 1986; Bechtel et al., 1987; Misgrav, 2000; Özbilen and Kalın, 2001; Ode et al., 2009) support the finding that the vegetation in urban views is depicted as visually effective, supportive of the meaning dimension of the area, and aesthetic as perceived by the viewer.

- In the secondary roads, the concavity and the convexity of the road is felt weakly because of intense urbanization, the differences and wide perspectives that could be created by changing directions are obstructed by distorted urbanization and this may cause Hagia Sophia to disappear from the view occasionally. This condition which prevents a continuous silhouette effect, also causes the reappearance of Hagia Sophia at unexpected points leading to surprise and mystery and thus defining an important visual quality. So that in order to obtain a positive dimension of complexity such as mystery, dense urbanization and vegetation should be decreased. Meeting the variety and surprise needs of the observer by emerging at unexpected moments is discussed in the literature on environmental preference and evaluation studies in regards to the positive dimension of complexity creating variety and mystery defined by the distorted vistas or the curves of the road and a curiosity about what will be seen next (Cullen, 1961; Lynch, 1960, 1971; Ulrich, 1983; Çevik, 1991; Lozano, 1998; Kalın, 2004).

In this study, the urban views are analyzed as sequential photos by using traditional methods. Using more complicated visualization techniques and technologies (Silion, Drettakis and Bodelet, 1997; Parsons et al., 1998; Notomi, Ozawa and Zen, 2000; Kamei and Seo, 2003; Zheng, Zhou and Mili, 2006) is thought to provide more extensive data and more detailed evaluation opportunity of the visual images. This paper recommends the photograph processing technique as a method of analysis in order to convey the fact that the visual perception of the individual diminishes with distance.

## CONCLUSION

The study delineates that, the evaluation of sequential views in terms of visibility and visual quality and the perception in motion of Hagia Sophia, as an important part of urban identity with its effect on the silhouette as well as its distinctive physical semantic quality, creates a dimension of great importance at urban scale. In this regard, it is thought that enriching the visual characteristics of a city by strengthening points and intervals obtained through analysis of urban views is important in terms of sustaining urban identity and its quality. Therefore, the analysis of a landmark in urban view in regards to perception in motion should be approached as an important field of study. In addition, current urban

design approaches should orientate to strengthen the visual quality, the visibility and total visual quality of an existing landmark, which is already a component of urban space, in the daily experience of its users and citizens at large.

#### BIBLIOGRAPHY

- APPLEYARD, D. et. al. (1966) *The View From The Road*, Massachusetts Institute of Technology, United States of America.
- AREFI, M., TRIANTAFILLOU, M. (2005) Reflections on the Pedagogy of Place in Planning and Urban Design, *Journal of Planning Education and Research* (25) 75-88.
- BALLANCE, S. (1960) The Byzantine Churches of Trebizond, *Anatolian Studies* (10) 141-175.
- BALLANCE, S. (1968) The Architecture, *The Church of Haghia Sophia at Trebizond* ed. D.T. Rice, Edinburgh University Press, Edinburgh; 8-36.
- BECHTEL, R.B. et. al. (1987) *Methods in Environmental and Behavioral Research*, Van Nostrand Reinhold Company, New York.
- BENEŐS, J., ZVELEBIL, M. (1999) A Historical Interactive Landscape in the Hearth of Europe: the Case of Bohemia, *The Archaeology and Anthropology of Landscapes: Shaping Your Landscape* eds. P.J. Ucko and R. Layton, Routledge, London and New York; 74-94.
- BERNASCONI, C. et. al. (2009) Assessing Public Preferences for Design and Environmental Attributes of an Urban Automated Transportation System, *Landscape and Urban Planning* (90) 155-67.
- BISHOP, I.D. (2001) Predicting Movement Choices in Virtual Environments, *Landscape and Urban Planning* (56) 97-106.
- BRYER, A., WINFIELD, D. (1985) *The Byzantine Monuments and Topography of The Pontus*, Dumbarton Oaks Publication, Washington.
- CADUFF, D., TIMPF, S. (2008) On the Assessment of Landmark Salience for Human Navigation, *Cognitive Process* (9) 249-67.
- CARMONA, M. et. al. (2003) *Public Places Urban Spaces: The Dimension of Urban Design*, Architectural Press, UK.
- COHEN, S.S., WAPNER, K. (1976). *Experiencing The Environment*, Plenum Press, New York.
- COOPER, J., OSKROCHI, R. (2008). Fractal Analysis of Street Vistas: a Potential Tool for Assessing Levels of Visual Variety in Everyday Street Scenes, *Environment and Planning B: Planning and Design* (35) 349-63.
- CORNELL, E.H. et. al. (1999) The Nature and Use of Route Expectancies Following Incidental Learning, *Journal of Environmental Psychology* (19) 209-29.
- CUBUKCU, E., NASAR, J.L. (2005) Relation of Physical Form to Spatial Knowledge in Large Scale Virtual Environments, *Environment and Behavior* (37) 397-417.
- CULLEN, G. (1961) *Townscape*, The Architectural Press, London.

- ÇEVİK, S. (1991) *Mekan-Kimlik-Kimliklendirme Trabzon Sokakları Örneği*, yayınlanmamış Doktora Tezi, Mimarlık Bölümü, KTÜ, Trabzon.
- FOLTÊTE, J.C., PROMBINI, A. (2007) Urban Layout, Landscape Features and Pedestrian Usage, *Landscape and Urban Planning* (81) 225-34.
- FROMENT, J., DOMON, G. (2006) Viewer Appreciation of Highway Landscapes: The Contribution of Ecologically Managed Embankments in Quebec, Canada, *Landscape and Urban Planning* (78) 14-32.
- GIBSON, J.J. (1986) *The Ecological Approach to Visual Perception*, Lawrence Erlbaum Associates, Hillsdale, New Jersey, London.
- GOLLEDGE, R.G., STIMSON, R.J. (1997) *Spatial Behavior: A Geographic Perspective*. The Guilford Press, New York, USA.
- HAGERHALL, C. et. al. (2004) Fractal Dimensions of Landscape Silhouette Outlines as a Predictor of Landscape Preference, *Journal of Environmental Psychology* (24) 247-55.
- HEATH, T.F. (1992) Behavioral and Perceptual Aspects of the Aesthetics of Urban Environments, *Environmental Aesthetics: Theory, Research, and Applications*, ed. J.L. Nasar, Cambridge University Press, USA; 6-10.
- HERZOG, T.R., FLYNN-SMITH, J.A. (2001) Preference and Perceived Danger as a Function of the Perceived Curvature, Length and Width of Urban Alleys, *Environment and Behavior* (33:5) 653-66.
- HERZOG, T.R., LEVERICH, O.L. (2003) Searching for Legibility, *Environment and Behavior* (35:4) 459-77.
- HERZOG, T.R., KROPSCOTT, L. (2004) Legibility, Mystery, and Visual Access as Predictors of Preference and Perceived Danger in Forest Settings Without Pathways, *Environment and Behavior* (36:5) 659-77.
- JANSSON, A., LAGERKVIST, A. (2009). The future gaze: City panoramas as politico-emotive geographies. *Journal of Visual Culture*, 8; 25-53.
- KALIN, A. (2004) Çevre Tercih ve Değerlendirmesinde Görsel Kalitenin Belirlenmesi ve Geliştirilmesi: Trabzon Sahil Bandı Örneği, yayınlanmamış Doktora Tezi, Peyzaj Mimarlığı Bölümü, KTÜ, Trabzon.
- KAMEI, K., SEO, K. (2002) Pace-the-scene movie: A Video-based Scene Representation Method for Natural Scenery, *Systems and Computers in Japan* (34:1) tr from Denshi Joho Tsushin Gakkai Ronbunshi, J85-D-II, n: 4; 604-12.
- KAPLAN, S. (1992) Where Cognition and Affect Meet: A Theoretical Analysis of Preference, *Environmental Aesthetics: Theory Research and Applications*, ed. J.L. Nasar, Cambridge University Press, USA; 56-63.
- KLIPPEL A., WINTER S. (2005) Structural Saliency of Landmarks for Route Directions, *Spatial information theory- COSIT05*, ed. A. G. Cohn and D. M. Mark, Springer, Ellicottville; 347-62.
- KOSTIAINEN, T. (2006) Studies in Probabilistic Methods for Scene Analysis, Report No: B56, Helsinki University of Technology Laboratory of Computational Engineering Publications, Helsinki.

- LOZANO, E.E. (1998) Visual Needs in Urban Environments and Physical Planning, *Environmental Aesthetics: Theory, Research, and Applications*, ed. J.L. Nasar, Cambridge University Press, USA; 395-421.
- LYNCH, K. (1960) *The Image of the City*, The MIT Press, USA.
- LYNCH, K. (1971) *Site Planning*, The MIT Press, England.
- MAY, A. J., ROSS, T. (2006) Presence and Quality of Navigational Landmarks: Effect on Driver Performance and Implications for Design, *Human Factors* (48:2) 346-61.
- MERRIMAN, P. (2004) Driving Places: Marc Augé, Non-places, and the Geographies of England's M1 Motorway, *Theory, Culture & Society* (21:4/5) 145-67.
- MISGRAV, A. (2008) Visual Preference of the Public for Vegetation Groups in Israel, *Landscape and Urban Planning* (48) 143-59.
- MOUDON, A. (2007) Catholic Approach to Organizing What Urban Designers Should Know, *The Urban Design Reader*, ed. M. Larice and E. Macdonald, Routledge, London and New York 438-454.
- MURRIETA, R. et. al. (2002) Visual Navigation in Natural Environments: From Range and Color Data to a Landmark-based Model, *Autonomous Robots* (13) 143-68.
- NIKOLOV, N. (2008) Cinemarchitecture: Explorations Into the Scopic Regime of Architecture, *Journal of Architectural Education*; 41-5.
- NOTOMI, M. et. al. (2000) Modeling Urban Scene by Motion Analysis, *Systems and Computers in Japan* (31:2) 1-19.
- NASAR, J.L. (1998) Visual Preferences in Urban Street Scenes: A Cross-cultural Comparison between Japan and United States, *Environmental Aesthetics: Theory Research and Applications*, ed. J.L. Nasar, Cambridge University Press, USA 260-74.
- ODE, A° et al. (2009) Indicators of Perceived Naturalness as Drivers of Landscape Preference, *Journal of Environmental Management* (90) 375-83.
- OMER, I., GOLDBLATT, R. (2007) The Implications of Inter-visibility between Landmarks on Wayfinding Performance: An Investigation Using a Virtual Urban Environment, *Computers, Environment and Urban Systems* (31) 520-34.
- ÖZBILEN, A., KALIN, A. (2001) The Semantic Value of Plants in the Perception of Space, *Building and Environment* (36) 257-79.
- PARSONS, R. et. al. (1998) The View From the Road: Implications for Stress Recovery and Immunization, *Journal of Environmental Psychology* (18) 113-39.
- PEEBLES, D. et. al. (2007) Effects of Geometry, Landmarks and Orientation Strategies in the 'Drop-off' Orientation Task, COSIT 2007, eds. S. Winter et al., LNCS 4736; 390-405.
- RAYNER, K. et. al. (2009) Eye Movements and Visual Encoding During Scene Perception, *Association for Psychological Science* (20:1) 6-10.
- ROBERTSON, R. (2007) Visions of Urban Mobility: The Westway, London, England, *Cultural Geographies* (14) 74-91.

- ROGER, M. et. al. (2009) Improving Navigation Messages for Mobile Urban Guides: Effects of the Guide's Interlocutor Model, Spatial Abilities and use of Landmarks on Route Description, *International Journal of Industrial Ergonomics* (39) 509-15.
- ROSSANO, M.J. et. al. (1999) The Acquisition of Route and Survey Knowledge from Computer Models, *Journal of Environmental Psychology* (19) 101-15.
- SANDER, H.A., MANSON, S.M. (2007) Heights and Locations of Artificial Structures in Viewshed Analysis: How Close is Close Enough?, *Landscape and Urban Planning* (82) 257-70.
- SILLION, F. et. al. (1997) Efficient Impostor Manipulation for Real-time Visualization of Urban Scenery, In Proc. *Eurographics* (16:3) 207-18.
- TAYLOR, N. (2003) The Aesthetic Experience of Traffic in the Modern City, *Urban Studies* (40:8) 1609-25.
- TVEIT, M. et. al. (2006) Key Concepts in a Framework for Analyzing Visual Landscape Character, *Landscape Research* (31:3) 229-55.
- ULRICH, R.S. (1983) Aesthetic and Affective Response to Natural Environment, *Human Behavior and Environment: Volume 6. Behavior and the Natural Environment*, ed. I. Altman and J.F. Wohlwill, Plenum Press, New York; 85-125.
- ULRICH, R.S. (1986) Human Responses to Vegetation and Landscapes, *Landscape and Urban Planning* (13) 29-44.
- USPENSKY, F. İ. (2003) *Trabzon Tarihi* (Kuruluşundan Fethine kadar) çev. Enver Uzun, Trabzon.
- YOU, J.Y., CHIEN, S.I. (2008) Saturation Enhancement of Blue sky for Increasing Preference of Scenery Images, *IEEE Transactions on Consumer Electronics* (54:2) 762-8.
- ZACHARIAS, J. (2001) Pedestrian Behavior and Perception in Urban Walking Environments, *Journal of Planning Literature* (16:1) 3-18.
- ZHENG, J.Y. et. al. (2006) Scanning Scene Tunnel for City Traversing, *IEEE Transactions on Visualization and Computer Graphics* (12:2) 155-67.

Alındı: 05.09.2010, Son Metin: 03.04.2011

Anahtar Sözcükler: nirengi noktası; seri görünüm; görülebilirlik; okunabilirlik

### KENTLERDE NİRENGİ NOKTALARININ GÖRÜLEBİLİRLİK ANALİZİ ÜZERİNE BİR ÇALIŞMA; TRABZON HAGIA SOPHIA (AYASOFYA) ÖRNEĞİ

Nüfus artışını kaldıracabilecek fiziksel mekânları, fiziksel altyapıları aynı hızla ve düzenle büyütemeyen kentler için doğa ile bütünleşmenin kaybolduğu ve toplumsal yaşam biçimlendirme birlikteliğinin koptuğu plansız, kimliksiz, estetikten uzak, yaşanabilirliği zayıf mekânlara dönüşmek, kaçınılmazdır. Bu değişim kendini en çarpıcı biçimde insan-kent ilişkisinde göstermektedir. İnsanlar kolay anlaşılır, kimlikli, okunabilir kentler yerine çarpık yapılaşmanın olduğu kalitesiz çevrelerde yaşamlarını sürdürmek zorunda bırakılmaktadır. Özellikle kentler için en önemli kimlik öğelerinden biri olan nirengilerin çarpık kentleşme sonucu yoğun

yapılaşmanın içerisinde kısmen algılanan ya da hiç algılanmayan ögelere dönüşmesi kentin algılanabilirlik ve okunabilirliğini de zayıflatmaktadır. Oysa düzenli kentsel mekânların oluşumunda, kaliteli ve kimlikli kentlerin yaratılmasında nirengi noktaları önemli rol üstlendiği unutulmamalıdır. Bu bağlamda ülkemizde son yıllarda çarpık kentleşmeye karşı somut çözümler olarak önerilen kentsel dönüşüm projeleri, bir kentin tarihi dokusundaki nirengi noktalarının bütüncül bir yaklaşımla ele alınabileceği önemli fırsatlar olarak değerlendirilmelidir.

Coğrafi ve stratejik konumu itibarıyla Doğu Karadeniz Bölgesi'nin önemli kentlerinden olan Trabzon kenti, birçok uygarlığa ev sahipliği yapması nedeniyle de manastır, kilise, bedesten, han ve sivil mimari örnekleriyle bakımından zengin tarihi geçmişini yansıtan bir mimariye sahiptir. Kentin tarihi geçmişinde farklı dönemlere tanıklık etmiş olan Hagia Sophia kilisesi, günümüzdeki adıyla Ayasofya müzesi, kıyı çizgisindeki stratejik konumu nedeniyle kent silüetinde dolayısıyla kent kimliğinde önemli bir yere sahiptir. Özellikle 1960'lardan sonra gittikçe hızlanan yapılaşma ve altyapı işleri kilisenin kent imajı ve kent silüetindeki nirengi olma etkisini olumsuz yönde etkilemiştir. Geçmişte kentin yapılaşma sınırının dışında, deniz kenarında ve etrafı kırsal tarım alanlarıyla çevrelenmiş bir konumda yer alan Hagia Sophia, günümüzde yoğun yapılaşmanın içerisinde sıkışıp kalmış durumdadır. 1964'de tamamlanan 1. sahil yolu ve ardından yapılan Samsun-Sarp duble Karadeniz sahil yolu dolgu alanlarıyla birlikte Hagia Sophia kilisesi kuzey yönde de yoğun bir ulaşım aksıyla çevrelenerek kıyı çizgisinden giderek uzaklaşmıştır. Bu durum plansız ve yoğun bir yapılaşma içerisinde sıkışıp kalsa bile kilisenin görülebilirliğini arttıran yeni güzergâh olanakları sağlamak ve bu olanakların Hagia Sophia ve yakın çevresini ele alacak bir kentsel dönüşüm projesinde veri olarak kullanılabilmesi için araştırılmasının gerekliliğini ortaya koymaktadır.

Bu çalışmada kentin değişen fiziksel yapısı içinde Hagia Sophia'nun farklı yaya ulaşım aksları boyunca algılanabilirliği seri (ardışık) görünümler bağlamında tanımlanmaya ve görünebilirliğin maksimum olduğu nokta ve aralıklar belirlenmeye çalışılmıştır. Bu bağlamda yaya aksı boyunca belirli aralıklarla çekilen seri görünüm fotoğrafları, soyutlama yöntemi kullanılarak analiz edilmiş ve nasıl bir seri görünüm dizisi oluştuğu Autocad çizim programı kullanılarak grafik hale dönüştürülmüştür. Daha sonra bu seri görünüm dizisi içerisinde baskın olan görülebilirlik nokta veya aralıkları belirlenmiştir. Sonuçlar 'yakın mesafe (A Grubu)', 'yakın mesafe yükselen ve alçalan (B Grubu)', 'uzak mesafe (C Grubu)', 'uzak mesafe yükselen ve alçalan (D Grubu)' olmak üzere dört grup üzerinden değerlendirilmiştir. Uzak mesafe güzergâhlarının kesintisiz ve etkili silüetler sunduğu kilise, yakın mesafe güzergâhlarında parçalı ve algılanabilirliği düşük görüntü kareleri ortaya koymaktadır. Bu bağlamda araştırma, Trabzon kentinin yaşadığı hızlı ve yoğun yapılaşmanın bir nirengi noktası olan Hagia Sophia'nun algılanabilirliği üzerindeki olumsuz etkisini net bir şekilde ortaya koyması bakımından önemlidir. Ayrıca elde edilen sonuçların, söz konusu alanda gerçekleştirilmesi düşünülen kentsel dönüşüm, yenileme ve iyileştirme projesine uzak ve yakın silüet analizi bağlamında planlama kararı verisi oluşturması araştırmanın önemini artırmaktadır.

**ARZU KALIN, BLA LArch., MLA LArch., Ph. D.**

Assistant Professor of Landscape Architecture at Karadeniz Technical University. Received her BLA LArch., MLA LArch. and Ph. D. degrees from the Department of Landscape Architecture at Karadeniz Technical University in 1994, 1997 and 2004. Currently teaches landscape architecture and design, basic design, urban furniture and space, historical environment conservation, and landscape architecture design studios. Areas of interest are environmental behavior research mainly focused on landscape perception, symbolic meanings of environment, symbolic landscapes, semiology (semantics) (sign theory), visual-aesthetic quality of environment, environmental preference and evaluation methodologies-applications. [arzuk@ktu.edu.tr](mailto:arzuk@ktu.edu.tr), [arzukal@hotmail.com](mailto:arzukal@hotmail.com)

**DEMET YILMAZ, B.Arch., M.Arch., Ph. D.**

Assistant Professor of Architecture at Karadeniz Technical University. Received her B.Arch., M.Arch and Ph. D. degrees from the department of Architecture at Karadeniz Technical University in 2003, 2006 and 2011. Areas of interest are architectural design and urban design. She has been employed by the Karadeniz Technical University, Faculty of Architecture, Department of Architecture since 2005. [yilmazdemett@hotmail.com](mailto:yilmazdemett@hotmail.com), [yilmazdemett@ktu.edu.tr](mailto:yilmazdemett@ktu.edu.tr)