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Evaluation of users' responses for 3D urban model in urban conservation model

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Abstract
Throughout the urban conservation process, evaluation of the townscape and physical environment of urban historic sites are significantly important to be examined in an analytical paradigm. Accordingly urban conservation studies require utilization of three-dimensional (3D) representation techniques. Most common planning studies have been developed with two-dimensional (2D) analysis, but such techniques may not be sufficient to evaluate townscape quality. This paper was held on a case study of the Zeyrek urban historic site which was accomplished with an innovative analysis procedure based on 2D and 3D visualization techniques in order to evaluate townscape quality. The case study was then examined to determine the efficiency of visualization techniques with subjective responses from graduate students in a questionnaire.

The most common response found in the questionnaire is that a 3D urban model of Zeyrek urban historic site is more helpful for evaluating the townscape quality. Therefore, parameters related to urban structure, visual characteristics, accessibility, and harmony can be better defined through the utilization of a 3D urban model compared to traditional 2D mapping techniques. In regard to the opportunities for utilization of 3D urban models, this study demonstrates the appropriateness with which key components in the urban conservation process—topographical features, conventional analyses, townscape analyses, and descriptions of historical evolution—are efficiently represented with 3D urban model.

***Keywords**: Urban conservation, townscape quality, Computer Aided Design (CAD), 3D urban model, users' evaluation*

Introduction

As an innovative representation media, 3D evaluation is vital to gain better understanding of the physical environment of an urban historic site. Even today most of the design works in urban planning and design are done in conventional media such as 2D mapping, sketches, photographs and such drawings. But these conventional media are not much enabling the developing ideas and improving proposals for historic townscape.

The most common application of 3D urban models is still design reviews that are last visualization tools in an aesthetic consideration of modeling physical structure and landscaping of urban environment. With its broad applications, a 3D urban model that is improved by means of computer aided design (CAD) increases the abilities and opportunities to deliver information to both the planning and urban conservation process. So the abilities of 3D models, (accuracy, realism and abstraction) should be discussed within their purpose and content. It is a fact that in evaluating urban historic environments it is more vital to progress and use these 3D representation tools because of the variety of spatial data related to physical environment of urban historic pattern.

As an urban planning field, urban conservation is constituted of the studies and interventions that preserve cultural and civil heritage on different scale and level of urban space; facilitates the current uses; evaluate the cases within contemporary approaches in the urban system (Gülersoy-Zeren and Koramaz, 2002). In this context, the main tasks of spatial information systems are documenting, surveying and modeling to preserve and evaluate urban historic sites. These innovative tools can offer detailed consideration of morphological and visual characteristics, circulation pattern, and architectural 3D evaluation. As design and planning professions work in spatial context, CAD should evolve with models that are more integrated with various data types, such as qualitative and quantitative data.

This paper tries to assess the utilities of computer-aided 3D urban model to attain well-defined representation and visualization techniques in urban conservation process. The purpose of this paper is to improve the tasks of computer-aided 3D models as an evaluative tool that is integrated with urban conservation and to investigate how graduate students in the Faculty of Architecture department, experienced the 3D model and 2D mapping techniques of the Zeyrek Urban Historic site. In this paper 3D evaluation, which supplants the traditional 2D mapping and surveying techniques, has been generated with townscape analysis that offers innovative approaches to define the characteristics of physical environment in urban context by means of CAD. Through this process, data about townscape characteristics and historic potential of the case area, Zeyrek, was gathered, evaluated and visualized within this model. Then finally it was examined by architectural and planning professions while they assess the efficiency of this method in a questionnaire study.

Theoretical background was comprised with consideration third dimension in urban design, design theories that determined the townscape parameters and technological tools to represent and visualize in 3D. These townscape parameters were outlined as structural parameters, visual parameters, parameters related to accessibility and harmony with traditional architectural character. Then computer-aided documentation and representation tools were briefly described to investigate 3D data in spatial information systems.

For the case study, analyses and proposals for Zeyrek historic townscape have been mapped in 2D and modeled in 3D representation tools with its structural, visual and architectural characteristics. The case study consisted of documentation of visual data, townscape modeling, surveying on 3D urban model and, finally, developing proposals. In the evaluation and proposal steps, townscape parameters were used that were explained in the following chapter. Within the examination of 3D urban model by graduate

students, results of this study were intended to contribute to the determination and representation of townscape quality in urban historic sites by means of 3D urban models.

Computer-Aided 3D Models in Urban Sites

CAD, assembling an exact mathematical input of object and environment geometry, creates a 2D visualization construction document and 3D physical models to visualize and interpret data as a presentation tool with powerful visual simulation (Bertol, 1997). Through the urban conservation process, in the stages of documentation and inventory, analyzing and evaluation, and developing a proposal, use of technology is required to improve the capacity of work and time. In the urban conservation process, 3D evaluation encourages innovative visualization tools to be developed with digital technologies. For all planning and design processes, digital information and software tools are adding significance to evaluation of spatial information for its purpose of design occasionally (Batty et al., 2000). One of the most common visualization tools is CAD generated 3D urban models that enable volumetric and manual measurement with high geometric content. For instance, analyzing and representing the visual details of environmental pattern can be generated with low cost, time and performance, encouraging the communication in design process (Levy, 1995).

Communication in design and planning process is another function of computer generated 3D urban model that enhance the information sharing among community participants and professions at large (Al-Kodmany, 2002). CAD creates 3D models that define the geometry of composition. 3D CAD model is already a good start for design exploration (Bertol, 1997). Serving as a design tool, 3D urban models are more powerful to show and evaluate the characteristics of urban pattern in urban design and planning process. To illustrate the relationship between 3D modeling and its purpose, innovative 3D models are more prevailing tools than the conventional renderings or animations which are improved to gain impressive and 'realistic' presentations. 3D modeling demonstrates what can be achieved in a useful and practical sense with existing limited resources in the context of relative abstraction (Pietsch, 2000).

3D urban models tend to approach with its applications in any of three ways. First, 3D urban and architectural models apply architectural photogrammetry to define and document the historic characteristics of the site (Gruen and Wang, 1998). The main purpose of these applications in photogrammetry is documenting and surveying the cultural heritage in automate systems with high accuracy. The second is virtual urban models that offer an interactive database in the design and management processes, Sheffield Urban Contextual Database (Peng and Blundell, 2004) and Virtual Bath Model (Batty et al., 2000) are the explicit examples of interactive 3D urban models. These applications are designed to sustain web-based and user-oriented dynamic recovery of urban contextual information from an architectural and urban design viewpoint. The third and the last set of these studies are 3D urban models that are built for the purpose of comprehensive spatial analysis. Environment Simulation Center (ESC) and U-Data Solution develop such spatial analyses on 3D urban models. U-Data Solution has the

cases in Chicago, New York, Washington D.C., and Boston that are modeled for the purposes of client-based information integration in the areas of media, urban services, real estate and other economic activities (http://www.u-data.com). Environment Simulation Center uses this kind of model for building coverage and density for each storey of its New York, Manhattan application (http://www.simcenter.org).

Interactive 3D urban models are formed within a structural and visual point of view in documentation and surveying. Accuracy and functionality are the main criteria for such applications. But there is less opportunity for comprehensive utilities to analyze physical environment and characteristics. They are mostly produced with a perfect consideration of accurate and functional uses of information technologies, which may generate a "dizziness of technological success" (Salzano, 1999). There should be perfect models for documentation and surveying of historic monuments and sites that are lost or in danger to be lost. But also utilities and purposes of 3D models' should be considered besides.

3D urban models that are generated for comprehensive spatial analysis are used in city centers for economic purposes. Real estate and economic developers use these analyses that achieve only quantitative data such as urban services, infrastructure, and land and rent prices, building stocks etc… As it is mentioned above (in American cases of Boston and New York) there is no consideration of qualitative evaluation in environmental analysis of townscape quality. Besides, 3D urban models of an urban historic site that has no exact case, generated within evaluation of townscape quality, should be created with not only conventional mapping techniques but also with 3D evaluation.

Investigation of 3D visualization techniques are vital in design and planning studies devoted to sustaining communication and collaboration by means of these techniques. There have been many different evaluation methodologies to investigate user responses for visualization techniques such as cognitive evaluation, comparative experiments, and observational studies to compare the efficiency levels of challenging tools and techniques (Kerren et al., 2007). Efficiency levels of visualization techniques may affect learning skills (Hamilton et al., 2001) cognition processes with design choices of users (Westerdahl et al., 2006) in planning and design processes. Then examination of negative and positive aspects of visualization techniques has been anticipated to provide contributions directly to communication and interaction between professions and other stakeholders.

Townscape Quality and 3D Evaluation

Townscape, demonstrating the main theme in this paper, is defined as physical environment that is perceived on the third dimension of urban space. Townscape expresses the composition of urban landscape, environment and genius loci (sense of place) rather than the simple description of the built space (Burke, 1976). It defines the layout of visual unity and organization of buildings, streets and spaces in urban environment (Cullen, 1971). To analyze the physical characteristics of urban space, quality of townscape should be examined in an analytical and systemic framework.

Theoretical background about evaluating and analyzing the physical environment of urban pattern help to determine townscape quality as well. Lynch (1971) described the image of the city in legibility context with user

perception of urban identity. To define main elements of the city, he acclaims nodes, edges, paths, districts and landmarks. But Bacon (1978) focuses on townscape and the space that covers the built environment and his theoretical findings are mainly based on just the physical elements in relation with time, space and user. Just ten years later, in Responsive Environment Design, Bentley et al. (1985) define consideration of physical environment of cities with permeability, variety, legibility, robustness, visual appropriateness, richness and personalization. They explain these criteria in a guide for analyzing and designing urban physical environment. In Urban Design: Method and Techniques, Moughtin, et al. (1999) describe townscape with the comprehensive approaches of perceptual structure, permeability, privacy, accessibility, and visual studies.

As the first concern of townscape quality, legibility studies express mental mapping of common image of perceptual urban environments. The second concern of townscape quality is permeability studies that ensure the safe use of public places in different levels of privacy demanded by citizens and culture. Accessibility is also an important aspect of permeability studies that analyze the public and private interfaces at all. The third concern in quality of townscape can be defined as conventional visual analysis as firstly used by Sitte (1889) and then Cullen in a comprehensive method. A fundamental aspect of visual analysis approach is definition, analysis and treatment of urban façade and its element of complexity with visual detail that engage the place to its authenticity.

Townscape Quality of Zeyrek Urban Historic Site

This paper discusses Zeyrek urban historic site as the case area with its physical environment and quality of townscape devoted to comparing efficiency of 2D mapping technique and 3D urban model. As included in the World Heritage List, Zeyrek urban historic site was chosen as case area because of reflecting a variety of cultural structures in its urban space. The most important monument of the site is Mosque of Zeyrek which had been Monastery of Christ Pantokrator in the Byzantium Period. Zeyrek has a traditional organic pattern consisting of authentic, wooden, Turkish houses (Gülersoy-Zeren et al., 2001 and 2008).

After the preparation of the base map as traditional visualization technique and 3D urban model, a survey and physical analysis were held in firstly conventional analysis which contains common analysis of building use, condition, construction material, built-up and inbuilt-up areas, and listed buildings. Next stage was evaluation of townscape quality in both visualization techniques in order to evaluate the quality of townscape and conservation potential of the urban historic site, in parameters titled as structure, façade, accessibility – privacy, and harmony with local architectural characteristics. All these evaluations and physical analyses were first constructed in 2D maps and then 3D urban model with the same titles. The last stage was developing a proposal for the conservation of townscape of Zeyrek Urban Historic Site.

The case study which was developed to evaluate the townscape quality of Zeyrek was mainly based on the Conservation Development Plan of Zeyrek

that was prepared by Gülersoy-Zeren (2001). With the help of this Conservation Development Plan of Zeyrek, cultural monuments and the present townscape were documented by gathering facade plans, photographs, drawings, and other visual materials that are vitally important.

The computer that was used in order to produce 3D urban model and maps, was an Intel Centrino Duo that was running at 1,66 GHz ,contained 1 GB RAM and supported the GeForce 8400M GS. 3D modeling of existing townscape was achieved by AutoCAD 2004©. By block modeling in the CAD system, a 3D urban model was transformed into VRML format using Cortona VRML Client Version 5.1© in order to produce an animated model for immersive virtual environment. Being the aim of this study 3D model and 2D mapping techniques constituted the base of survey and application studies in urban conservation of Zeyrek. Both 2D mapping technique and 3D model had the same physical elements which were formed with buildings, tombs and religious buildings as monumental buildings and finally streets (Figure 1).

Figure 1: *Base map and 3D urban model in CAD interface (colored in original)*

Conventional Analyses of Zeyrek Urban Historic Site

In the conventional analyses of Zeyrek Urban Historic Site, parameters were described in general consideration of urban analysis. These analyses can be conventionally generated in 2D mapping in most of the urban planning and conservation studies and projects. But each analysis was improved by having both visualization techniques; 2D mapping technique and 3D urban model. The conventional analyses of Zeyrek urban historic site consisted of building use, building condition, building construction material, built and inbuilt-up areas, and listed buildings.

Building Use: In Zeyrek urban historic site, traditional houses are the typical use for buildings. As for monumental structures, the most important is Molla Zeyrek Mosque. The site also contains a Fatih Municipality health service and an educational facility by “Foundation of Turkish Education Volunteers” (Figure 2)

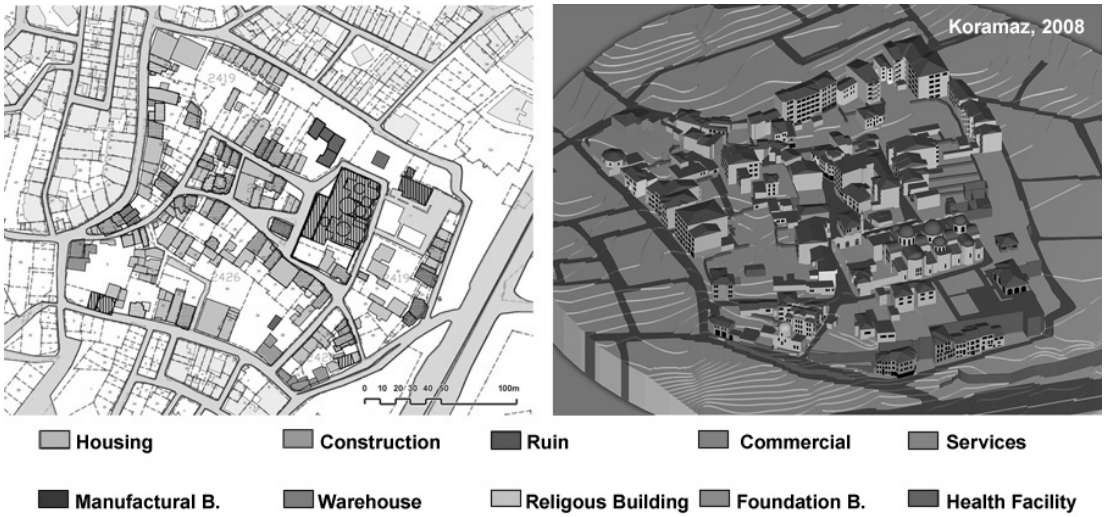

Figure 2: *Building uses in Zeyrek urban historic site (colored in original)*

Building Condition: The buildings in Zeyrek urban historic site are mostly in average condition. A large number of traditional houses are damaged. These authentic building units need maintenance. But there are some buildings that are restored or reconstructed but have disharmonious changes. The majority of the concrete structures are in good condition.

Building Construction Material: Buildings in the urban conservation site mostly have timber and masonry type of construction material. Types of concrete buildings are recently preferred as a main change in the area. In this analysis it is also observed that infill applications in listed lots are constructed as timber dressed concrete type.

Built and Inbuilt-Up Areas: Not only are the built and vacant areas represented, but also the voids of the building façades. So this analysis has the advantage of representing the gaps and masses by means of both 2D representation and 3D perspective.

Listed Buildings: This analysis classifies the listed buildings as, lots with the original listed building, lots with the restored listed building, lots where the listed building demolished and an identical or similar structure form or dimension is constructed in its place, lots where the listed building demolished and a new structure with a different form or dimension is constructed in its place, empty lots with the listed building demolished.

Townscape Analyses of Zeyrek Urban Historic Site

3D evaluation of townscape quality is important while defining the urban historic site in conservation applications. Organic growth of urban space should be considered with evidences from the past and cultural heritages in mind. Designing 3D components of this urban historic site is required for creation of cities that can continue to live its own potential.

This paper tries to develop a townscape analysis and evaluation method by improving 3D evaluation of urban historic site. Theoretical background examined in “Quality of Townscape and 3D Evaluation” expresses that all the concerns about quality of townscape cannot be described in only 2D visualization techniques. Hence this context should be distinguished with a systematic consideration to maintain an innovative analysis and evaluation method. This consideration is generated with these parameters described in Table 1.

Table 1: *Parameters related to townscape quality*

	Parameters	Contexts of Townscape Quality
Structural parameters	Building length	LEGIBILITY VARIETY FUNCTIONAL FLEXIBILITY HARMONY
	Building depth	
	Building height	
	Relationship of building and scale	
	Relationship of building and proportion	
Visual parameters	Material of the façade	VISUAL APPROPRIATENESS VISUAL RICHNESS, HARMONY
	Color of the façade	
	Texture of the façade	
	Details of the façade	
	Relationship between voids on façade	
	Rhythm between voids on façade	
	Visual unity	
	Visual harmony	
	Visual contrast	
Parameters related to accessibility	Privacy levels	LEGIBILITY PERMEABILITY HARMONY
	Street pattern	
	Characteristics of entrances	
	Length of building’s front façade	
Parameters related to harmony	Visual relationship between the component and urban identity	LEGIBILITY PERMEABILITY VARIETY FUNCTIONAL FLEXIBILITY VISUAL APPROPRIATENESS VISUAL RICHNESS, HARMONY
	Visual appropriateness between the component and traditional architectural characteristic	

Townscape Analysis of Structural Condition: The relationship between each component’s geometric form and structural condition was identified. Building proportions and building height were also evaluated in both visualization techniques. Townscape analysis of structural condition indicated the buildings as was, buildings with original structural form, buildings with additions on structural form, inharmonious buildings with structural form.

Townscape Analysis of Visual Quality: Façade characteristics of Zeyrek urban historic site were evaluated with visual relations in urban space as visual unity, appropriateness and contrast. Rhythm and proportion relations have been structured on voids of the façade. Within this analysis the visual parameters were evaluated with comparison of buildings with their façade

characteristics whether they have original façade or not, preservation of original material, color, texture and details, defining the voids of the façade, proportion and rhythm of the voids on the façade (Figure 3).

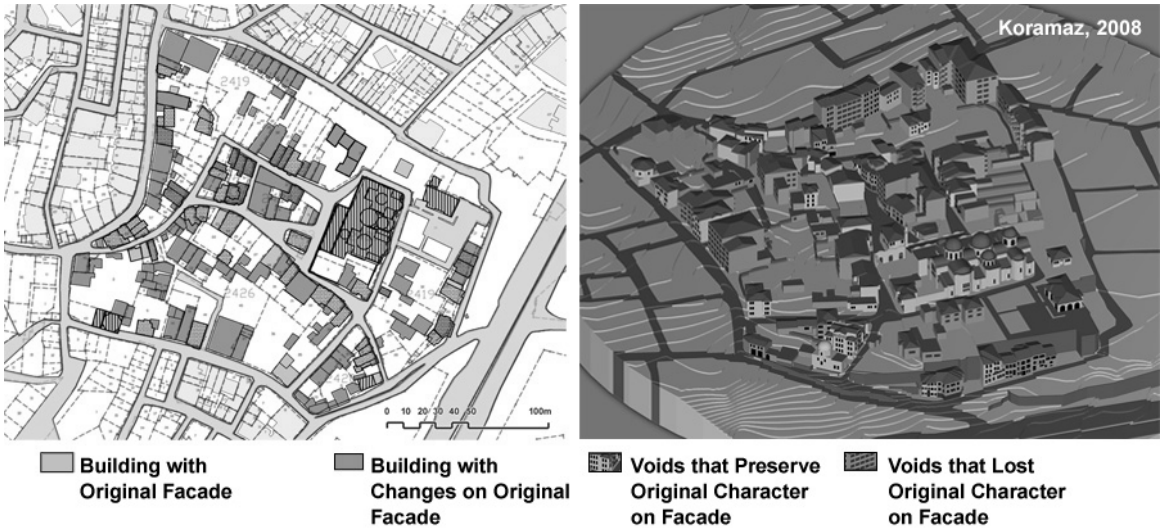

Figure 3: *Townscape analysis of visual quality (colored in original)*

Townscape Analysis of Accessibility: To better visualize the 3D urban model, townscape analysis of accessibility used circulation parameters such as privacy and permeability levels, street pattern, building entrances and front façades. The relationship between ownership pattern and street pattern was also evaluated in this analysis.

Townscape Analysis of Harmony: Analysis of harmony with identity defined the characteristics of components in urban pattern and appropriateness as an urban historic site. In this analysis buildings were indicated by their appropriateness with traditional architectural characteristics. The classification was made respectively as monumental buildings, building in harmony, building disharmony.

Proposal for Townscape in Zeyrek Urban Historic Site

Proposal for townscape in Zeyrek urban historic site was prepared with both 2D mapping and 3D visualization techniques. The main headlines through urban design and conservation decisions were as follow:

After the evaluation of structural condition, building forms are proposed as in harmony with historic urban pattern.

- After the evaluation of visual quality, infill applications have been considered as in harmony with the traditional architectural and façade characteristics.
- After the evaluation of circulation and accessibility, open public spaces have been arranged with their locational strategies.

- Proposals for conservation applications and building uses with civil and monumental architecture are evaluated through the urban identity and local architectural characteristics.

While improving proposals for building forms, disharmonious structural additions were firstly cleaned in urban structure. Additions such as plan extension and story heights made the urban pattern less legible. Infill applications on building forms have been proposed as structural conditions and harmony with the urban pattern. These additions and changes to the urban structure have been eliminated and the proposed building forms are structured on both visualization techniques (Figure 4).

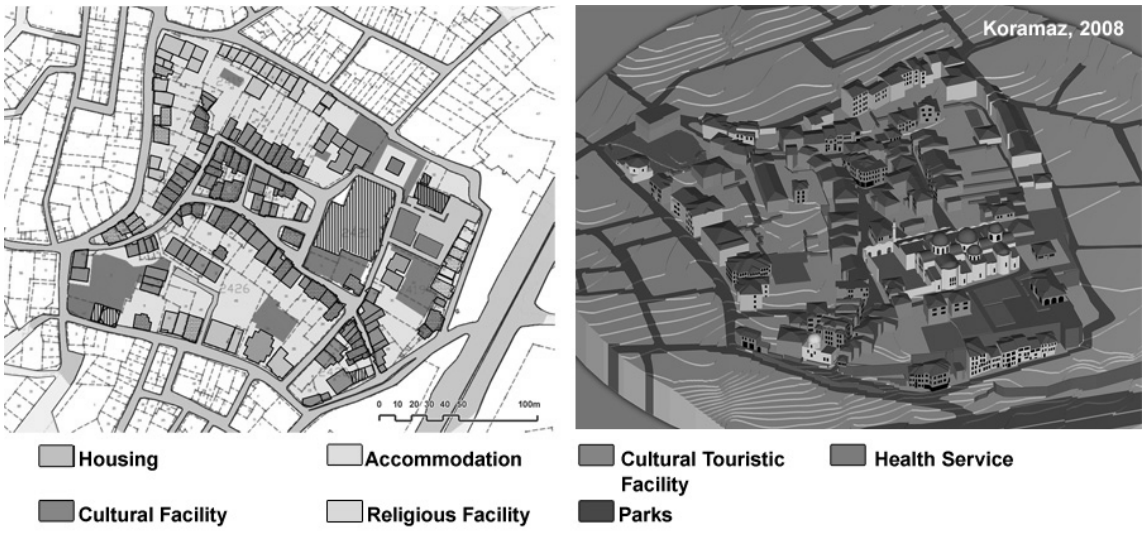

Figure 4: *Proposal for townscape in Zeyrek urban historic site (colored in original)*

Questionnaire Study for Assessment of the 3D Urban Model

In the questionnaire, held within this study in 2008, graduate students in the ITU Faculty of Architecture, have been examined with their responses in two different groups with two separate presentations; 2D mapping as traditional visualization technique and 3D urban model as an innovative tool. Respondents have assessed the efficiency of these visualization techniques in separate groups after separate presentations prepared by these techniques.

Materials and Procedure

In these presentations, prepared with these 2D and 3D visualization techniques, "Zeyrek Urban Conservation and Design Project" has been revised within the purpose of the questionnaire (Koramaz, 2009). The presentation of Zeyrek Urban Conservation and Design Project was approximately ten minutes long and has three main stages. The first stage was preparation of a base map and 3D urban model. All the maps and figures in both presentations used the same data, based on digital maps from the municipality, an on-site survey, and previous conservation and design studies and inventories prepared for Zeyrek urban historic site.

Both of the questionnaires concerning the evaluation of users' responses for 3D models and 2D mapping technique were conducted after the presentations. The presentations and questionnaires were held in a meeting

room in the faculty building. Presentations were made by projecting the models and VR applications onto the wall. After the presentations respondent groups completed the same questionnaire form in order to evaluate the static 3D model and the VR application they were presented.

The questionnaire actually consisted of comprehension and perception level of site characteristics in the urban conservation project and efficiency of visualization and representation technique. This paper investigates only the responses to open-ended questions to characterize efficiency of visualization and representation technique. The questions are:

Q1) Identify the spatial content or information that this visualization technique does not represent efficiently,

Q2) Identify the spatial content or information that this visualization technique represents well and efficiently,

Q3) Identify the technical attributes that this visualization technique does not express efficiently,

Q4) Identify the technical attributes that this visualization technique expresses well and efficiently.

Respondents

Sixty graduate students, studying at ITU, Faculty of Architecture (22 urban planners, 23 architects, 15 landscape designers), took part in the questionnaire. As first group of 30 (7 PhD and 23 master students) were asked to evaluate the 2D mapping representation technique, and the second group of 30 students (4 PhD and 26 master students) were asked to evaluate the 3D urban model.

Computer experience in the sample groups has been taken into consideration as the profile of respondents. Thirty-six respondents have been using computers for less than nine years; 21 respondents between 10-14 years and 3 respondents between 15-19 years. Another indicator for computer experience was the use of CAD software. Of all respondents, only 2 graduate students do not use any CAD software in their professional and educational occupations or studies. But fewer respondents (32 respondents) use 3D modeling software. Of respondents in the first group, who evaluated the 2D mapping technique, only 13 respondents use 3D modeling software such as 3D Max©, 3D Viz©. In the other group who evaluated 3D urban model, 19 persons use this software.

Results

Graduate students had different responses for the efficiency of 2D and 3D visualization techniques. Responses from the first group who were presented 2D visualization technique highlight that location, topography, relationship with surrounding and urban structure were less represented in spatial content and information. On the contrary, the second group's responses that were reported after the presentation of 3D visualization techniques highlight location, relationship with surrounding, street pattern, open spaces and plot (lot) pattern (Table 2).

Table 2: *Graduate students' responds for the efficiency of visualization techniques*

Questions	Graduate students' responds	First group 2d (n:30)	Second group 3d (n:30)
Q1) Problems Rel Spatial Content or	Location	12	7
	Topography	9	0
	Relationship with surrounding	3	10
	Urban structure	3	0
	Conventional analyses	4	0
	Proposal for architectural characteristics	3	7
	Street pattern	0	5
	Open spaces	0	3
	Plot (lot) pattern	0	2
Q2) Well-Represe or Information	Topography	0	9
	Conventional analyses	11	20
	Townscape analyses	7	12
	Proposal for architectural characteristics	3	4
	Historical evolution	7	7
	Distinction among building floors	0	3
Q3) Inadequacy of Technique	Absence of images and photographs	12	2
	Problems related to perception of colors	9	11
	Lack of 3D model	5	0
	Lack of diagram	2	2
	Lack of text or script	0	1
	Insufficient lighting	0	1
	Absence of close-range views	0	4
	Absence of material or texture modeling	0	7
Q4) Success of Vi	General success of visualization	10	10
	Colors	0	3
	Usage of animated modeling	0	7

In order to measure the representation level of location and surrounding relations, each presentation did not contain any upper scale graphic or map, and each visualization technique was given the same defined borders and size. Then it was possible to investigate which visualization technique generates the cognition of location and surrounding relationship more. 2D mapping technique had more reported problems (12 responses in the first group and 7 responses in the second group) related to cognition of location of the site. But in contrast the 3D urban model had more reported problems (3 responses in the first group and 10 responses in the second group) related to cognition of relationship with the surroundings according to the responses of graduate students (Table 2).

To clarify the problems related to representing the spatial content in the use of 3D urban models, graduate students responded street pattern, open spaces and plot (lot) pattern. This means that 3D model itself was not capable of representing the street or plot layout even though it has streets or walls which divide the land units or plots. In summary professionals might need 2D mapping techniques to represent and describe street or plot layout.
An interesting discovery was that responses to topography were vastly different between two visualization techniques. The 2D mapping technique had a definite problem in representing topography as 9 graduate students, in the first group, responded. As responses to the second question (well-

represented spatial content) report, 9 graduate students in the second group stated that topography was one of the elements that 3D urban model represented efficiently.

Another discriminative finding in favor of 3D urban model was its being capable of expressing the distinction among building floors. For instance, in the analysis of building uses, the 2D mapping technique is used only to represent the building uses in common, but the 3D urban model better represented the different uses in all the floors. Not only building uses, but also townscape characteristics may also need representations with changes on different floors in 3D.

As the content of this paper, the efficiency of visualization techniques in the evaluation of townscape quality in Zeyrek urban historic site was investigated with the responses for representation performance of conventional and townscape analyses. According to responses for the second question, about well-represented spatial content or information, 20 respondents in the second group who were presented 3D urban model stated that conventional analyses have been efficiently represented by means of 3D urban model. But only 11 respondents who were presented 2D mapping technique in the first group stated that these analyses were efficient. The same responses have been reported for townscape analyses, also. Twelve respondents in the second group stated that townscape analyses have been well-represented but only 7 respondents in the first group agreed for 2D mapping techniques. Consequently, in the evaluation of townscape quality in urban historic site, conventional and townscape analyses should be developed by means of not only 2D mapping techniques but also 3D urban models (Table 2).

But graduate students in the second group reported for the first question (problems related to representing spatial content) that visualization technique was not sufficient to represent proposal characteristics (3 respondents in the first group, 7 respondents in the second group). Graduate students are accustomed to using and representing the ideas of urban and architectural proposals with 2D mapping techniques. This fact will be discussed within the idea of 3D urban model usage as a last visualization tool in the conclusion/discussion part of this paper.

In the third question, inadequacy of visualization technique was asked to respondents and answers were gathered. Attributes that were not efficiently developed in 2D visualization technique were reported as absence of images and photographs, problems related to perception of colors, lack of 3D model and diagram. For 3D visualization technique, attributes that were not developed efficiently vary dominantly in the statements of problems related to perception of colors, absence of material or texture modeling, close-range views (Table 2).

In order to measure and compare the efficiency of both visualization techniques, each presentation did contain the same images and photographs in few numbers. Then it was possible to investigate which

visualization technique stimulated the cognition of visual characteristics as a parameter of townscape quality. Twelve respondents in the first group who were presented the 2D mapping technique distinctively reported the absence of images and photographs, but only 2 respondents in the second group who were presented the 3D urban model reported this statement. This clarifies that when using traditional 2D visualization techniques in urban conservation and planning studies, projects should contain more images and photographs, characterizing the townscape quality of the site. But an innovative visualization technique's utilization of 3D urban model can better represent townscape quality than images and photographs.

Another important response in comparing the efficiency levels of both visualization techniques is stating the lack of 3D urban model in the presentation which was prepared with the 2D mapping technique. Five graduate students in this first group responded that there was a need to use 3D urban model in any urban conservation and design project.

Other responses to the third question give facilities to investigate the efficiency of 3D urban model that was prepared for this case, Zeyrek Urban Conservation Study. The inadequacies of the 3D urban model were reported as problems related to perception of colors, absence of material or texture modeling, close-range views and insufficient lighting.

In the case study, to evaluate the townscape quality, color was used to visualize townscape characteristics defined by a representative legend. If choice of colors in 3D urban model varies, their perceptive or cognitive effect to the profession and other users may vary or not, hence this assumption should be investigated in another study as color effect and perception in visualization. In this case study, no material or texture modeling was developed within the 3D urban model. But 7 graduate students (5 architect and 2 landscape designer) responded to the absence of material of texture modeling as an inadequate attribute of 3D urban model.

Four graduate students in the second group responded that there was an absence of close-range views. They wished for close, macro views from the sites, to perceive the urban historic site in detail. Especially in architectural modeling, such close-range 3D views are vital. But in this case, VRML application has been used to meet such demands. Hence, usage of animated modeling was reported as a success of the 3D visualization technique by 7 respondents in the second group (Table 2). In the concluding remarks, 3D urban modeling in urban planning will be suggested to aide other visualization tools, especially when used in urban conservation.

Conclusion / Discussion

As the first finding of this paper, 3D urban model can create opportunities to define parameters of both townscape quality and urban pattern. Contrary to conventional survey and analysis techniques, spatial data related to townscape quality cannot be efficiently evaluated in 2D mapping technique, as responses from this questionnaire reported. Thus 3D urban models should be comprised, with their purpose and content, to define the abstraction and reality levels that generate the ability of comprehensive analysis and evaluation of townscape quality.

As a result of the case study it is concluded that using computer based 3D models provide more efficient evaluation of townscape quality, like topography, conventional analyses, townscape analyses, proposal for architectural characteristics and historical evolution etc., than traditional 2D

mapping techniques. The 3D urban model of Zeyrek urban historic site also improves the understanding of architectural and urban characteristics by exploring not only conventional survey but also townscape analyses such as structural, visual, accessibility and harmony characteristics of urban historic site. Preservation of cultural monuments with their surrounding in urban space, evaluation of townscape quality and rehabilitation of urban historic site requires a comprehensive and innovative survey and analysis techniques for conservation of urban identity and traditional architectural characteristics. A main remark is that 3D evaluation of townscape quality facilitates the description of urban pattern better than traditional 2D mapping techniques. The 3D urban model and evaluation method can define more parameters with its expressions. Such an implementation also presents the capabilities of evaluation in urban conservation potential. This paper demonstrates that the CAD expresses flexibility and convenience in 3D evaluation of townscape quality.

Despite most common uses of computer based 3D models as last visualization media in design or planning projects, 3D techniques should be involved in whole process of urban design and planning. 3D evaluations in such innovative computer based techniques have the ability of containing more parameters, such in representing townscape quality. This paper deduces that in any urban design and conservation project, various visualization techniques should be used together. As the questionnaire in this paper reports, each technique has its own positive aspects. To describe these aspects comprehensively in detail, this questionnaire should be examined by other interested groups, such as non-professionals; inhabitants, and decision-makers, professions working in planning and conservation institutions.

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Kentsel koruma sürecinde üç boyutlu kentsel modele yönelik kullanıcı görüşlerinin değerlendirilmesi

Görselleştirme ve sunum tekniklerinin etkinliğinin ölçülmesinde, kullanılan tekniğin kent planlaması sürecinde kapsamlı mekansal içerikte bilgiyi sunabilmesi önem taşımaktadır. Geleneksel iki boyutlu görselleştirme

tekniklerine kıyasla, yenilikçi görselleştirme tekniklerinden olan, bilgisayar destekli üç boyutlu kentsel modellerin üzerinde daha kapsamlı mekansal bilginin görüntülenebileceği savunulmaktadır. Bu modeller özellikle tasarım projelerinde kentsel dokunun değerlendirilmesi ile planlama ve tasarım kararları uygulanmadan önce öneri yapının görüntülendirilmesi için kullanılabilmektedir.

Görselleştirme teknikleri teknolojinin gelişimiyle etkinlik düzeyi gelişerek farklı amaçlara hizmet edebilecek şekilde kullanılmaktadır. Tarihi kentsel alanda yapılacak inceleme ve mekansal değerlendirmelerde, kullanılan görselleştirme tekniklerinin olumlu ve olumsuz yanlarının tespit edilmesi, kentsel koruma sürecinde meslek adamları ve diğer aktörler arasında iletişimin geliştirilmesine yönelik doğrudan katkılar sağlayacaktır.

Mekansal bilgi sistemleri yardımıyla üretilen üç boyutlu model uygulamalarında yaygın olarak belli parametrelerin ve özelliklerin geliştirildiği ancak farklı işlevlerin bütüncül olarak birarada geliştirilmediği tespit edilmiştir. Bu nedenle planlama, kentsel tasarım ve kentsel koruma çalışmalarında kullanılan üç boyutlu model uygulamalarının, kentsel alanların farklı özelliklerini değerlendirmesi ve kapsamlı mekansal analiz yöntemlerindeki kullanımları geliştirilmelidir.

Bu çalışma, kentsel koruma sürecinde bilgisayar destekli üç boyutlu kentsel modellerin kullanımlarını değerlendirmekte ve görselleştirme ve sunum tekniği olarak etkinliğini incelemektedir. Çalışmanın temel amacı, mekansal inceleme aracı olarak kullanılabilecek bu modellerin kentsel koruma uygulamalarındaki rolünü geliştirmek ve lisansüstü öğrencilerinin üç boyutlu kentsel model ile iki boyutlu haritalama tekniğini hangi düzeylerde deneyimlediklerini incelemektir. Çalışmada geleneksel iki boyutlu haritalama tekniğinin yerini alabilecek üç boyutlu değerlendirme ve incelemeleri, kentsel görünüm analizi başlığına geliştirilmekte ve yenilikçi bir yaklaşım olarak bu değerlendirmeler, çalışma alanı olarak seçilen Zeyrek tarihi kentsel alanının yapılaşmış çevre özelliklerini tanımlamak için kullanılmaktadır. Böylelikle kentsel görünüm özellikleri ve tarihi çevrede koruma potansiyeli Zeyrek tarihi kentsel alanında incelenmiş ve her iki teknik yardımıyla görselleştirilmiştir. Son olarak mimarlık, şehir planlama ve peyzaj planlama konu alanlarında lisansüstü eğitimlerine devam eden meslek adamlarının görüşleri ile bu görselleştirme tekniklerinin etkinliği değerlendirilmiştir.

Çalışma alanı olan Zeyrek, İstanbul'un tarihi çekirdeği olan Tarihi Yarımadanın kuzeyinde, Haliç yamacında yer alan ve tarihi kentsel potansiyelini hala koruyan önemli kültürel miras alanlarından biridir. Anıtsal ve sivil mimarlık örnekleriyle taşıdığı tarihi, estetik ve mimari özellikleriyle 1983 yılında UNESCO tarafından Dünya Mimari Miras Listesi kapsamına alınmıştır.

Anket çalışması öncesinde görüşmecilere toplu olarak bulunduğu gruba göre iki boyutlu haritalama tekniğiyle hazırlanan sunum ya da üç boyutlu kentsel model ile hazırlanan model gösterilmiştir. Görüşmecilere aynı anket föyü verilerek kendilerine gösterilen görselleştirme ve sunum tekniğini

değerlendirmeleri beklenmiştir. Yaklaşık 10 dakika süren sunum aynı içerikte hazırlanmış ve görüşmecilere sunulmuştur.

Sunum çerçevesinde kullanılan görselleştirme teknikleri, Zeyrek tarihi kentsel alanının fiziksel çevresine ait niteliksel verileri, fiziksel yapı analizi, tarihi kentsel dokunun özgünlüğünün değerlendirilmesi ve önerilerin geliştirilmesi adımlarının bütününde kullanılmıştır. Tarihi dokunun özgünlüğünün incelenmesi kapsamında tarihi eski belgeler ile kayıtlar kullanılarak fiziksel yapının değişimi konusunda da incelemeler tamamlanmıştır.

Bu çalışmada tarihi çevrenin özgünlük niteliklerinin değerlendirilmesi kapsamında kentsel görünüm ile ilgili parametreler belirli başlıklarda incelenmiştir. Kentsel görünüm parametreleri tarihi çevrede yapıların yapısal, görsel, erişime ve yerel mimari karaktere uyum ilişkileri başlıklarında incelenmiş ve görselleştirilmiştir.

Sunumun ardından görüşmecilerden öncelikle Zeyrek tarihi kentsel koruma projesinde tanımlanan özelliklerin hangi düzeyde algılanabildiği ve kavranabildiğini değerlendirmeleri ve görselleştirme tekniklerinin etkinliğini değerlendirmeleri beklenmiştir. Ancak bu çalışmada görselleştirme ve sunum tekniklerinin etkinliğinin değerlendirilmesi için sorulan açık uçlu soruların yanıtları değerlendirilmektedir. Görüşmecilere sorulan açık uçlu sorular aşağıda belirtilmektedir:

S1. Kullanılan görselleştirme ve sunum teknikleriyle Zeyrek tarihi kentsel çevresine ait tanımlanan hangi içerik ve/veya bilgi yeterli biçimde sunulamamıştır?
S2. Kullanılan görselleştirme ve sunum teknikleriyle Zeyrek tarihi kentsel çevresine ait tanımlanan hangi içerik ve/veya bilgi doğru biçimde sunulabilmiştir?
S3. Görselleştirme ve sunum tekniklerindeki hangi özellikler yeterli biçimde geliştirilememiştir?
S4. Görselleştirme ve sunum tekniklerindeki hangi özellikler yeterli ve doğru biçimde geliştirilebilmiştir?

İki boyutlu görselleştirme tekniklerinde hazırlanan sunumda tanımlanamayan mekansal bilgi ve içerik sorusuna verilen yanıtlar en çok konum bilgisinin yetersizliği, yakın çevre bilgisinin yetersizliği ve topografya bilgisinin yetersizliği başlıklarında toplanmış durumdadır. Üç boyutlu kentsel model ile tanımlanamayan mekansal bilgi ve içerik sorusuna verilen yanıtlar, çoğunlukla konum bilgisinin yetersizliği ile yakın çevre bilgisinin yetersizliği şeklinde açıklanmaktadır. Aynı içeriğe sahip ancak farklı görselleştirme teknikleri ile hazırlanan iki sunumun ardından görüşmecilerin yanıtlarında ilk ayırt edici özelliğin konum ve yakın çevre ilişkisine dayalı olduğu ortaya çıkmıştır.

Bu sonuç, üç boyutlu kentsel modelin kullanıcının kendini konumlandırma becerisi konusunda daha olumlu olduğunu göstermektedir. Halihazır harita üzerinde sınırlı da olsa yakın çevre bilgisinin sunulabildiği, oysa sanal boşlukta modellenen üç boyutlu kentsel modelin yakın çevrenin algılanmasında yetersizlikler yarattığı düşünülmektedir

İki ve üç boyutlu görselleştirme tekniklerinde belirgin bir diğer ayırımın topografyanın algılanmasında ortaya çıktığı görülmektedir. Üç boyutlu

kentsel model üzerinde arazinin modellendirilmesi sırasında topografyanın üçüncü boyuta taşınması, kullanıcıların topografyayı daha yüksek düzeyde algılayabilmeleri ve kavrayabilmelerini sağlamıştır.

Açık alan özelliklerinin modellenmesi gerektiğini belirten görüşmeciler, üçüncü boyutta peyzaj etkisine dikkat çekmektedirler. Ulaşım ve sokak dokusu ile mülkiyet ilişkisinin önemini belirten görüşmeciler ise perspektif görüntülerinde arazi bölümlenmelerinin ve organik kent formunda kimi dar sokakların algılanmasında zorluklar olduğunu ifade etmişlerdir. Anket çalışmasındaki bu yanıtlar, iki boyutlu haritalama tekniği kullanımıyla, alanın özelliklerinin tanımlanmasında imaj ve fotoğraf gibi diğer sunum tekniklerine daha fazla gereksinim duyulacağını ortaya koymaktadır.

Kentsel tasarım ve planlama uygulamalarının çoğunda bilgisayar destekli üç boyutlu modellerin son görselleştirme aracı olarak kullanılmasına rağmen, bu teknikler planlama ve tasarım sürecinin bütününde kullanılabilecek biçimde geliştirilmelidir. Üç boyutlu kentsel model üzerinde geliştirilen mekansal incelemeler ve değerlendirmelerin özellikle kentsel görünümün sunum ve ifade tekniklerinde görselleştirmesinde önemli katkılar sağladığı görülmektedir. Ancak tarihi çevrenin farklı özelliklerini ifade edebilmeleri bakımından iki boyutlu haritalama tekniği ile üç boyutlu kentsel modelin farklı açılardan daha etkin oldukları sonucu ortaya çıkmıştır. Bu çalışma, özellikle kentsel koruma uygulamalarında farklı görselleştirme tekniklerinin birarada kullanılması gerektiğini sonucunu ortaya koymaktadır.