

## LASERSCANNING IN REVITALIZATION PROJECTS FOR HISTORICAL STREETS

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### ABSTRACT:

Cities have always experienced changes and are being subjected to major revitalization operations including housing improvements, street scoping, infill and pedestrianization schemes. Especially historic districts of the cities are the areas affected mostly from these changes. The theme of the revitalization of the historical urban area is how to adjust the preservation of the traditional area and its identity to the needs of the modernization of the life style. These historic districts confront with the difficulty in the policy making in order to maintain the economic and cultural status. For the future renovation or revitalization projects, it should be done to take advantage of the value of the well-designed buildings and the historical and traditional resources in the area in order to develop the identity. The most of the historical parts of the cities now are undergoing the drastic change with high-rise buildings by losing their traditional environment. It is not the only way to maintain the historical environment, but it is more significant to control new implementations in these parts of the cities. In this context, for the future revitalization projects in historic parts of the cities, it would be extremely beneficial for the district to complete study in order to document the historic structures both remaining and those that still maintain their identities.

In recent years, modern technology in the field of architectural documentation makes it possible to create sensitive and digital documentation. With rapid developing technology, modern documentation techniques take the place of conventional documentation techniques and this has provided the improvement of contemporary documentation techniques rapidly. Today's technology gives possibility to documentation and transmitting of cultural heritage to new generations more sensitive and more rapidly.

Laser scanners are used more and more as surveying instruments for various applications including architecture. In this study, the advantages of laser scanners in the field of "Architectural Revitalization Projects for Historical Quarters" will be mentioned and the significance of documentation for historical streets will be defined in the context of restoration and revitalization. For case study, a historical street will be scanned with laser scanner and silhouette of street will be prepared. Then, the results will be compared with each other. Finally, both results will be evaluated in the context of historic preservation and urban policy making process.

### 1. INTRODUCTION

Cities have always experienced many changes during their history. Historic urban quarters have a special place in the city's history because of their cultural, historical and architectural value. They reflect the history of the city's culture and indigenous culture with their unique forms and patterns. They give message to us about the life style, economical degree, social condition and architectural style of the society with their special pattern. These features making historic urban quarters worthy also make them subject for preservation. After 1960's historic urban quarters have started to re-evaluate with their qualities and revitalization of these areas as functioning parts of their cities became popular (Doratlı et al.2004). However today, 'revitalization of historic urban quarters' is widely recognized and practiced in many historical cities because renovation- revitalization projects have important place in cultural and historical continuity. In order to achieve a success in maintaining this continuity, many works have to be done as

environmental improvement, preserving the city image, supporting the social and physical needs, preserving or renovating of façade and preserving the buildings and areas of importance (Çevik et al 2005).

Revitalization means bringing again into activity and prominence. In architecture, it means shortly revival of trade means. According to Doratlı 2000, 'revitalization' can be defined, in its simplest form, as a "process through which the deterioration and decay of a historic urban quarter can be addressed terminated or reversed". (Doratlı et al.2004)

This process needs to approach from many different perspectives because it includes social and economic dimensions besides only preservation especially in a long term period. In this process, economic vitality, physical quality, conservation aim, sustainability have to be considered and new solutions have to be acceptable in this frame. For achieving acceptable and successful solutions in revitalization projects, understanding the historic environment is the most important issue because all strategic approaches with the historic urban

quarter have to be done according to this understanding. In this stage, understanding the environment, sensitive and accurate determination is unavoidable.

With modern technology in the field of 'architectural determination' and 'architectural documentation' make easy to achieve sensitive documents which help to make proper intervention decisions about the historic quarter. The use of laser scanner to measure the shape and the geometry of historical buildings widely used in the field of preservation because of allowing instrument to obtain large quantities of data in very short time. What is not as much foreseen and simple is the utilization of this data according to the purpose of the study in architectural preservation frame and in urban scale. The aim of this paper is to evaluate the usage of Laser Scanner to get a sensitive street documentation for revitalization of an historical province of Konya.

## 2. REVITALIZATION IN HISTORIC URBAN QUARTERS

Three of the most important issues facing planning at the beginning of the 21 century are how to accommodate substantial growth in the number of households, how to revitalize cities and how to create more sustainable urban areas (Hetah, T.). If we study the past and learn from it, we need to know how cities have been able to adapt and to accept change as well as what they were like during their respective 'Golden Eras' (Ford, R.L., 1978). If a city seeks to keep its entire heritage, change becomes impossible while obsolescence is inevitable. Contrary to this, if a city erases its past, it may lose its connection with its heritage and become placeless. Kevin Lynch maintains that the best environment is one in which there are new stimuli and familiar reinsurance, the chance to explore and the ability to return. To develop management policies, in the long process, we must develop preservation techniques and legislation with better understanding of the relationship between urban form and capacity of change (Ford, R.L., 1978).

One of the most important problems in the field of architectural preservation is to understand the meaning of 'preservation cultural heritage without aiming to return to the past life styles' (Dostoğulu, N., 2004). In developing countries cities lost their identity with urban development because in this development process many changes are applied to the city. Thus, it is necessary to preserve and revitalize historical buildings without destroying their special characteristic and physical features in revitalization process. This process helps to provide historical continuity, identity, sustainability and to improve the urban quality. Revitalization of historical quarters includes physical renewal of province, organization of buildings and spaces and producing long period solutions both economic and physical concept. Only Physical revitalization may be attractive and get a great approve of public but when it is thought in long period, it can be insufficient. Revitalization also should help city's and country's economic development. A successful revitalization project become a reality with

- Balanced economic development,
- Preserved environmental quality
- Applied suitable strategic approach.

Tiesdell's argument underpins three contextual attributes within this definition 'revitalization': place assets, obsolescence

and intensities of development pressures (Tiesdell, S, Oc, T and Heath, T, 1996).

According to SWOT analysis, Place quality, Cultural Identity, Resource, Obsolescence (Physical, Structural, Functional, Locational) would be a help to increase the chance of accurate determination of the most appropriate strategic approach (Doratlı et al. 2004). It is possible to reach appropriate approach with the sensitive analysis of existing environment conditions with strong and weak points. Hence it should be given special emphasis to analysis and documentation stage.

## 3. DOCUMENTATION FOR REVITALIZATION

Recording of historical quarters is needed in order to have a record of urban environments when entire settings damaged, important features of the area are lost or seriously damaged through fire, natural calamity or redevelopment.

Planning and design practitioners should view documentation as a first step for intervening process. However, documentation may sometimes be appropriate for historical purpose but documentary purposes may be insufficient in practice. Therefore, the results of documentation may be definition of design and development guidelines, legislations, the preparation of revitalization and economic strategies and also for tourism plans. So we can say that documentation must allow for the complex and comprehensive nature of the planning and design process (Jamieson, W, 2009). While documenting historical quarters, documentation process uses the same approaches with single building documentation process because buildings are components of the area and they give special character to historical area with their parameters and elements. One must be known all elements must be recorded in documentation of historical areas process with the following:

- Single and group of buildings in terms of scale, height, proportion, materials, colors, texture, silhouette
- All city objects like trees, lamps
- Physical environment and built environment.

According to number 5226 and 3386 laws and number 2863 of Conservation Council of Cultural and Natural Assets, the aims of street revitalization projects are to get the street façades of registered and unregistered immovable cultural assets with their courtyard wall, annex, fountain etc. to preserve the street with its original pattern and urban furniture and to keep them alive with revitalization in contemporary life. With the light of this aim, many things are needed to complete revitalization projects according to technical specification of street revitalization projects. They are following:

-Existing Situation Documentation and Analytical Research (evaluation of environmental factors, analytical studies, documentation of physical condition, group of buildings with existing and new buildings, silhouettes, historical and topological surveys)

-Survey (Measured Drawings) with street façades 1/50 scale, system details of building,

-Survey Analysis Report (all documents related with the building usage and social, economic, historical effects, building definition, construction technique, material use and information about the people living in the building)

-Problems (deformations, deteriorations, structural problems, physical effects, material problems)

Among these stages, preparing drawings and making existing situation documentation are the most important stages in order to get most appropriate strategic approach for historical quarter. As it is mentioned above, for a street revitalization, all the drawing should be prepared with all details. Many times it is difficult to get sensitive data from the streets because of the buildings conditions. When buildings are so high or have a detailed façades, it is sometimes very difficult to erect scaffolding in front of the façade and measure details from on it besides its difficulty. With recent developments in the field of photogrammetry, preparing these projects has become easier.

#### 4. LASER SCANNING IN ARCHITECTURAL DATA INTEGRATION FOR REVITALIZATION

The use of laser scanner to measure historical buildings is now diffused because of allowing the instrument large quantities of data in a short time. In the last years laser scanner has become attractive reality in the field of architectural documentation especially with photo-texturing 3D surface models. However, it depends on object morphology and cost issues. This modern technology can provide highly valuable elements of solution for monitoring and preservation.

Historical buildings and sites suffer from natural and artificial effects through time. It is important to monitor the level and the rate of deterioration to which the buildings are submitted. They can be destroyed naturally or artificially in different times and they need to be restored. At this point, the importance of handing precise and accurate 3D digital recording of the original site can be felt. This virtual model can be used as a reference model to restore, revitalize or reconstruct the buildings or group of buildings. The reference model gives information about the shape, deformation, colour distribution, material deformations of current time or of a certain time. To have a digital model of the area at a larger stage helps to compare the situation. Besides, the level of resolution and accuracy of the virtual copy must be faithful with the original (Paquet,E., Viktor,L.H.2005).

Integration of architectural information in urban practice requires studying different levels of details depending on the purpose. Thus it is necessary to get different inputs and outputs which can be arise from 2D and 3D laser scanning in different frameworks. For architectural and urban surveying, a coarse visualization of buildings or quarters is benefited by the lowest level generation of subjacent solid geometry to the scanned urban space which can be interactively superimposed to the ordinary planimetric information(Finat at all,2005)

Laser scanning has shown many advantageous in 3D information with high resolution in cultural heritage. It digitizes coordinates of the objects which means it is easier to acquire 3D model from point cloud.

### 5. THE CASE STUDY: SILLE

#### 5.1. Definition of the Area

Sille where the first rock carved monasteries of the world were built is located on 8 km far from north-west of Konya in the Middle of Anatolia. Though it has a long and old history, it

difficultly tries to preserve its original character. Economic difficulties in business-life, lack of investment has caused to immigration to the city centre that's why many people from Sille has to immigrate this province. However, in recent years, people, municipality, civil society organizations has intensively started to work in this province in order to preserve its cultural identity and special pattern.

Sille is an ancient village which Rome people and Orthodox Turks lived in the past. Today it is a neighborhood of Konya Selçuklu Municipality and Dam Lake. Archeological data shows that this settlement was formed 6000 years ago. It was an important religion centre because of that it was located on the Rome, Byzantine and Jerusalem road. It did not lose its importance both in Seljukian and Ottoman Period because of that it was on Silk Road. In this neighborhood, there are many small churches, Ottoman tombstones and Aya Elena Church which succeeded to become today. The church was constructed in A.D. 371. Today the whole area of historical pattern which is 33 ha, is under a conservation scheme as "Urban Conservation Area". Sille was announced as an Archaeological Conservation Area of Urban and 1<sup>st</sup> Grade approved by the Konya Conservation Council of Cultural and Natural Assets with a decision dated of 19.06.1995 and registered of no.2292. The area was kept out of the urban development in the Master Development Plan of Konya with the scale of 1/25000 (Konplan2020) and defined as "Urban Conservation Area". (Erdem 2003).

#### 5.2. Determining the present situation

In the past, statistical surveys were made and measured drawings of many buildings of this street were prepared with traditional methods. In addition to these surveys, photogrammetric silhouette of the Cumhuriyet Street was prepared with photogrammetric software Photomodeler 5.0. In this study, to evaluate the usability of Laser Scanner for street silhouette, only measurements taken with Laser Scanner were used. Street buildings were scanned with 5 mm precision. Scanning of this street was executed by Optech's ILRIS-3D terrestrial laser scanner. Optech's ILRIS-3D Laser imaging system provides the means to reduce the time and cost significantly.

Features of the Laser Scanner:

- High resolution and high accuracy
- Highest dynamic range available on the market:from 3m to 1 km
- Class II laser rating: completely eye safe
- On-Board 6 megapixel digital camera and large format LCD viewfinder
- Ruggedly designed for demanding field applications
- Battery operated
- No levelling, retro-reflectors or mirrors required
- Compact and easy to use
- Easily hand-carried and deployed by a single operator

The street was scanned 10 stations. The building was scanned approximately 10-15 minutes. To get 3D images to 3D polygonal model, PolyWorks Version 10.0 InnovMetric software was used. Firstly, the binary data provided by Optech ILRIS-3D were parsed using Optech Parser 4.2.7.2. to get point cloud in .IXF format processed by Innovmetric PolyWorks 10.0.

Secondly the translated images were imported into PloyWorks InnovMetric software and then merged into one polygonal model. Because of the narrow street and difficulty in finding a location for laser scanner, street was scanned part by part and then the projects merged in PolyWorks Software.

Performance	
Dynamic scanning range	3 m-1,500 m to an 80%target 3 m-800 m to an 20% target 3 m- 350 m to an 4% target
Data sampling rate (actual measurement rate)	2,500 points per second
Beam divergence	0.00974°
Minimum spot step (X and Y axis)	0.00115°
Raw range accuracy*	7 mm @100m
Raw positional accuracy*	8mm@100m
Laser wavelength	1500 nm
Laser class (IEC 600825-1)	Class 1 **
Digital Camera	Integrated digital camera ;(CMOS sensor) optional external camera
Scanner field of view (ILRIS-3D)	40° x 40°

Table 1. ILRIS-3D features



Figure 1. Priest House of Aya Elena Church (Scanner photo)

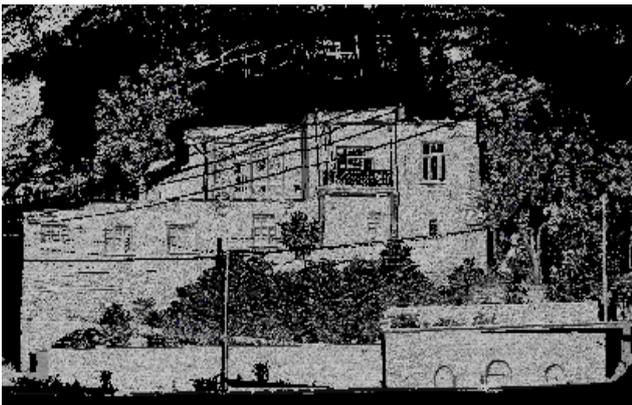


Figure 2. 3D point cloud of the house



Figure 3. A part of Cumhuriyet Street (Scanner photo)



Figure 4. 3D point cloud model



Figure 5. A part of Cumhuriyet street( Scanner photo)



Figure 6. 3D Point cloud model

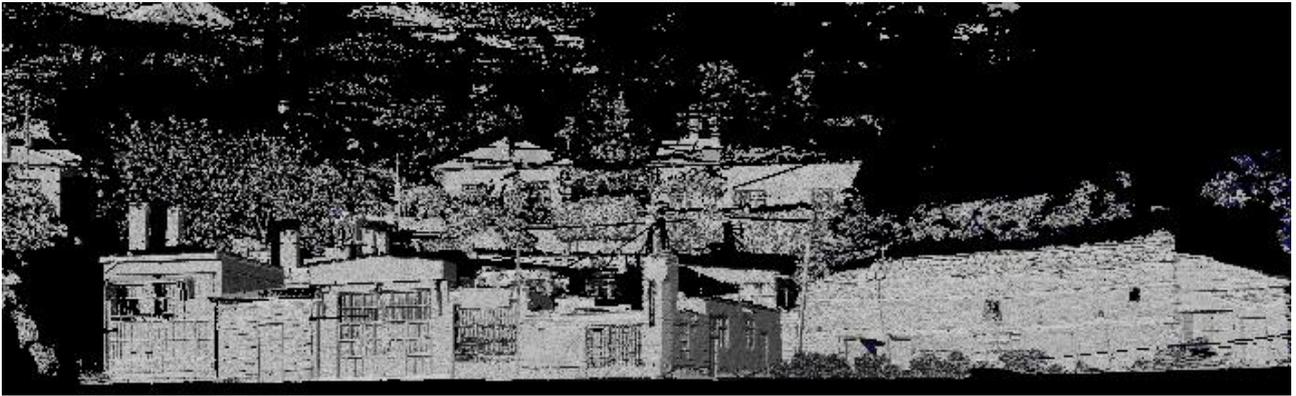


Figure 7. A Part of Cumhuriyet street silhouette



Figure 8-9. View from a part of street (Scan photos)

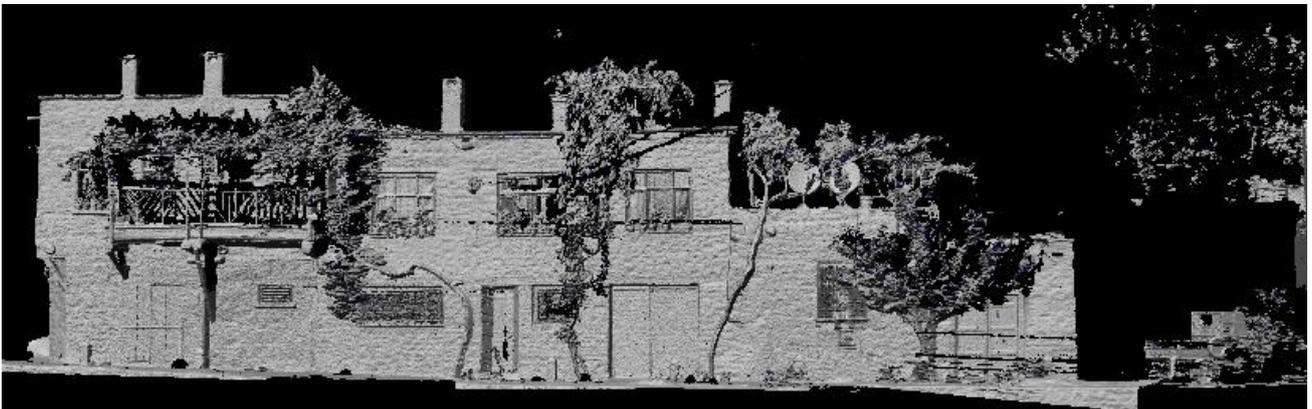


Figure 10. 3D point cloud of merged scans of the street

## 6. CONCLUSION

Laser-based technologies provide 3D support in architectural and urban surveying and documentation with different levels of detail. This support simplifies to get realistic and virtual environments around the buildings or in historical urban zones. In this study, it was observed that metric information is precise enough for general urban surveying. In addition, other parameters can be chosen in PolyWorks software. To be able to

create 3D model provides an additional reading for historical urban quarter analysis. All these things help to reach an appropriate strategic approach for revitalization of historic urban quarters and to evaluate the results with 3D virtual environments. So we can say that laser scanner survey could be the fastest solution in order to get geometry of buildings or group of buildings, to extract plans, cross sections and façades. These all affect the interventions in revitalization process. The integration of different geometrical data provides unavoidable support for preservation, restoration, reconstruction and revitalization projects.

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