

## DOCUMENTATION OF TRADITIONAL WOODEN CEILING IN TRADITIONAL TURKISH ARCHITECTURE WITH PHOTOGRAMMETRIC METHOD

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### ABSTRACT:

Ceiling Veneers mostly used in traditional architecture are decorative exquisite elements enriching interior architecture with their laborious and effective visualization. In our country, for survey projects, drawing all plans, cross sections and details of the buildings as a piece of the project are necessity for documentation and restoration projects. This necessity has been a pre-condition for some historical buildings documentation projects. Transferring ceiling plan to architectural plan is very laborious and difficult process with conventional measurement methods. These ceiling plans are prepared either measuring one by one with scaffolds or transferring geometric projections of the ceiling to the ground with plumb-line. After this projection transfer, geometry of the ceiling is determined and drew with reference measurements obtained from the ground. In the situations when ceiling ornaments are complicated, dense or complex, it has seen that conventional methods are desperate and insufficient to document them. Especially when the ceiling lost its originality or when there is some deformations on its geometry, measuring the ceilings becomes very difficult. In such applications, beside the truth of the drawing, sensitive documentation is very necessary for the quantity surveying of the materials which will be used in restoration applications. In the scope of the study, architectural evaluations of a wooden ceiling plan of a traditional Turkish house prepared for a restoration project and drew in photogrammetric software will be evaluated. Orthoimages of the ceiling and 3D model obtained from Laser Scanner will both evaluated. These methods will be compared with traditional methods. It will be dwelled on measurement methodology, easiness and sensitivity of the photogrammetry in such projects. In addition, contribution of this application to conservation practices will be mentioned and evaluated.

### 1. INTRODUCTION

One of the most important structural elements of traditional Turkish architecture is the ceiling. Ceilings are an important decorative element in traditional Turkish house room design. Ceilings formed with the cultural experiences of centuries enrich and define its space. Not only we can generally experience ceiling coverings in Turkish Traditional Houses but also it has been a custom to be made of various, special, astonishing ceiling design in much worship (mosque) and public buildings. In the general sense, we can say that Traditional Turkish Residential Architecture of the façades has been designed with minimal design approaches. While Turkish Traditional Houses reflect their humbleness in the society with their simple shaped facades to the street, this simplicity might change to richness with ceiling and wall covering design inside of the houses. Wall coverings and ceilings especially have been highlighted as a demonstrated of wealthy, vision, art of pleasure of owner, skill of workmen in interior design of palaces, pavilions, waterside house (especially in the Bosphorus).

Ceilings due to their importance are shown special interest in restoration applications. But until today, original structure of the floor, wall and ceiling coverings have lost their original

character due to weather conditions and structural deteriorations in many historical monuments which are reached out to current time. Sensitive measurement and drawing of historical ceilings is very important step for construction and measured drawing projects which are base of restoration projects.

With awareness of sensitive documentation of historical ceilings, Culture and Tourism Ministry separate a special chapter about the preparation of ceiling plans in The Specification of Single Historical Building of Measured Drawing, Restoration and Restitution Projects. It is emphasized that ceiling is a part of measured drawings and except for floor plans, 1/50 scaled ceilings plans have to be drawn by restaurateur architect in this specification. Moreover, It is emphasized that 1 / 20 scaled detail must be prepared from the most important part of the structure as section, elevation and plan. In other words, although, ceiling geometry was drawn with general contour before this specification, ceiling plans will be much large part of the measured drawings project and will be important part of the project. In this study, it is given general information about ceilings which are in Traditional Turkish House Architecture and traditional and modern techniques which are used for preparation of ceilings plans like orthoimages and laser scanner.

## 2. CEILING TYPES IN TURKISH ARCHITECTURE

### 2.1 Ceiling Materials

Traditional Turkish House is full compliance with the geography where it is inside. Wood, cut stone, brick, and wood frame with brick filler (*hımış*) are used the major types of materials at the construction of Traditional Turkish House. The wood is most commonly used material in the ceiling construction. Ceiling with various geometries and construction techniques have been used in almost every region of Turkey. Although, it contains some diversities between the region of Turkey, metal plates, plaster, glass, and traditional tiles are used in the decoration of ceiling.

### 2.2 Construction Techniques of Wooden Ceilings:

Ceiling as a part of decoration element of Traditional Turkish Architecture has some diversity in the context of adorned techniques and construction techniques. Cause of diversity of construction and adorned techniques are financial strength of owner, talent of craftsman and function of room. With awareness of these factors appropriate ceiling type was preferred for the traditional buildings. While service sections of the buildings usually decorated with simple ceiling, the most important rooms (main room) and the main hall which are the most used spaces in the house have been decorated with adorned ceilings. Moreover, it can be come across with widespread example of semi-open seating room ceiling design integrated with outside of space, like pavilions. We can group type of ceiling in two parts as construction and adorned techniques (Yıldırım K., Hidayetoğlu L., 2006).

**Inverse Ceiling:** This type of ceiling constructed by structural wood beams which are placed with approximately 20-40 cm gaps and covered with wood sometimes stone or another material. This wood structure is seen by space users (Figure 1).



Figure 1. Two inverse ceiling from province of Gaziantep, Turkey.

**Flat Ceiling:** Ceiling structure is not seen by user. Structure of ceiling is covered with board. Joints between the boards and wall are veneered with lath (Figure 2).

**Caisson Ceiling:** This type of ceiling usually are preferred the top floor of historical buildings. Ceiling is not flat, and mid part of ceiling height is increased designed one or more crown mounding (corona). This type of ceilings faces are constructed by using shaped short laths and then this face is covered with gypsum plaster and architects call this technique as "*bağdadi*

(lattice)" in local name. This system is fixed under the floor structure and sometimes this system is bearing self weight thank to its construction in example of Gaziantep Houses (Figure 3).



Figure 2. Two flat ceiling from province of Konya, Turkey.



Figure 3. Two caisson ceiling from province of Gaziantep, Turkey.

**Corbelled Ceiling:** It is usually constructed for square spaces. Geometry of ceiling created by cross beams from a wall to adjacent wall and an octagonal geometry is obtained from these beams on the square plan. This similar octagonal shape consists on another level. Three or more level later ceiling shape is finished. This type of ceiling is constructed in different regions in Turkey (Figure 4).



Figure 4. A Corbelled ceiling from province of Kayseri, Turkey.

### 2.2 Techniques of Wooden Ceiling Adorned.

Traditional Turkish House Ceiling adornments can be group in the context of type of laths, type of joint of boards, techniques of adorned ceilings' cut and carve techniques, painting and picture techniques. (Yıldırım, Hidayetoğlu 2004):

- Adorned with Laths,
- Wood Jointing,
- Carved Woods,
- Curved Woodworking,

Lattice with Painting(*bağdadi*).

**Adorned with Laths:**

Desired pattern is obtained with thin lath in this type of ceiling decoration. "S" and "C" curved laths are fixed on flat ceiling surface. Flat roof on the ground is created with the ceiling decoration (Figure 5).



Figure 5. A Adornet with laths ceiling province of Karaman,Konya.

**Wood Jointing:**

It is a famous Turkish wooden decorative technique. Shaped as triangle, square, star, pentagon, hexagon wooden parts are jointed without any nails and large wooden surfaces are obtained. This technique is usually use traditional Turkish doors, mosque pulpits as a decorative and structural element. Variety of ceiling surface geometries are obtained with different gathered composite wooden parts(Figure 6).



Figure 6. Wood Jointing Ceiling from Konya Ince Minare Museum Konya.

**Carved Woods (Applique):**

A geometry drawn on the board is cut with a saw for obtaining a decorative wooden shape. And then this wooden geometry is nailed to the ceiling surface (Figure 7).



Figure 7. A Carved Wood Ceiling from province of Karaman, Turkey.

**Curved Woodworking:**

Wooden decorative elements are usually created by bending of thin sheets of woods. And these bended sheets are got together. This decorative technique is usually used in centre of ceiling c



(Figure 8).

Figure 8. A curvef working mid of ceiling from province Konya, Turkey.

**Lattice ceilings (*Bağdadi*)**

Lattice ceilings (*Bağdadi*) are designed as flat or curved surface. This surface usually is decorated by painting with different picture. Sometimes a beautiful scene and sometimes a fantastic building is theme of this decoration. This painting is very artistic value especially historic building and must be listed (Figure 9).

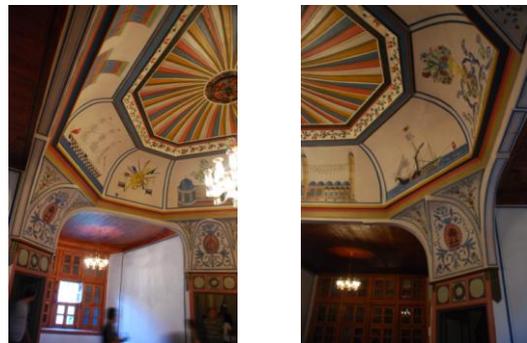


Figure 9. A Lattice ceiling with painting from province Karaman, Turkey.

**3. PREPERATION OF CEILING PLANS**

Turkey is a quite rich country in point of cultural heritage. Documentation and restoration of cultural heritage has become a current issue with history conscious especially in last years. Government has designated new fund for revitalization cultural heritage. Most of owner of the house who want to benefit from these funds get some grants for project and construction of cultural heritage. Number of the architect who will prepare project of these rapid restoration activities is few currently in our country. Many application projects are obtained by auction and it is not an obligation that measured drawing project had to prepare with photogrammetric techniques. Cultural Ministry doesn't have a technical specification about the qualification of photogrammetric measured drawing projects. A commission which was established collaboration with the Chamber of Architects is trying determining photogrammetric measurement and drawing standards nowadays in our country. Reason of this

situation, There are no enough technical equipment and personal who able to use photogrammetry on restoration project. Furthermore, there are no enough personal to give control and approve of photogrammetric measurement in relevant institution. Unfortunately, many architectural restoration office that they receive and prepare a lot of restoration project due to auction, describe photogrammetry as a measurement with totalstation. In this context, the using methods for measurement of ceilings can be listed like that:

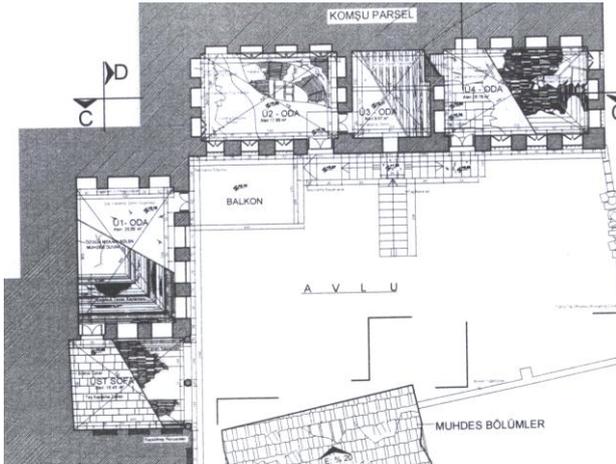


Figure 10. Ceiling and floor plan from province Gaziantep, Turkey. Hüseyin Enc House second floor plan.

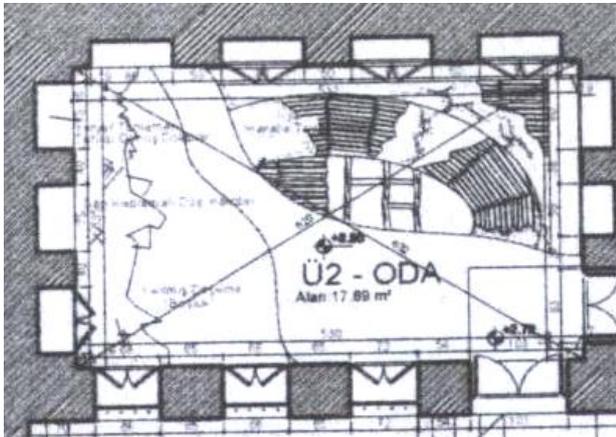


Figure 11. Detail from a Ceiling plan from province Gaziantep, Turkey

### 3.1 Documentation of the Ceilings with Traditional Methods

Even though measuring the ceilings with traditional methods has fairly difficulties, they are still used. These difficulties increase when the ceilings are much adorned or the inner height of the room is very high. In order to measure cross section of caisson ceilings are plumb line and meters are basic tools. In adorned ceilings, only one module of the ceiling is drawn and then it is copied to get whole drawing of the ceiling. For this reason, it can be said that the ceiling is not actually drawn; it is only idealized with multiplying one module. This means that the ceiling is not in its actual size because in copy and multiplying method, deformations and size differences between the modules are neglected. If the ceiling is very detailed, adorned, difficult to measure and to draw, software helping to arrange pictures like Photoshop are used. As result

of this process, it can be acquired only raw pictures but not in real size. Even though this method is known inappropriate and primitive in academic milieu and by control mechanisms, there is no any prohibitive decision related with this method to obstruct people in any specification. In addition to this, there is no inspection made by any institution about it (Figure 10-11).

### 2.2. Documentation of the Ceilings with Photogrammetric Method

Photogrammetric surveys are not widely used in all restoration projects, even though it became widespread in last five years in our country. It is certain that use of the photogrammetry in all documentation and restoration projects will become widespread by noticing its importance and easiness in this field. In our country, the field which the photogrammetry is mostly used is building façades. However it is being done different photogrammetric projects for plans, cross sections and different details of the buildings in order to document them.

Ceiling projects are prepared by taking geometric projection of the ceiling to a paper and drawing it in architectural plan. It is the best way in order to get ceiling plan is the orthophoto if the ceiling is flat. This method is very productive and gives sensitive outcomes. Ceiling plan can be acquired with matching orthophotos gotten from any ceiling of a space with plans. All ornaments and details can be acquired from these orthophotos and they can be easily transferred to plan drawings. Architects generally prefer to insert these orthophotos to AutoCAD and drawn from on it after they scaled them to actual size.

It is a kind of study requiring special attention and careful to get geometric projection of the ceiling if it is a caisson ceiling. It is needed to increase the time and attention to measure when there is ornaments or pictures on the curved surface of the ceiling. Drawings are generally imported to AutoCAD after the process of drawing 3D geometry models of the ceilings because to get geometric projection from imported model is easier with this method. In some caisson ceilings, to study the ceiling part by part and then to utilize these drawings is used as an easy method for getting ceiling plan (Figure 12,13,14,15).

While documentation of ceiling plans, the most significant problems are difficulties in taking photographs and measuring sourcing from space dimension and size. Especially in narrow and low spaces it is difficult to set Total Station and to take photos. However, it is easy to study in wide spaces.

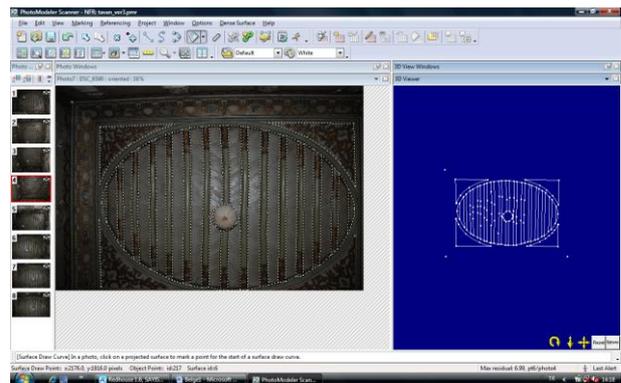


Figure 12. Photomoder drawing a ceiling from province Gaziantep, Turkey.

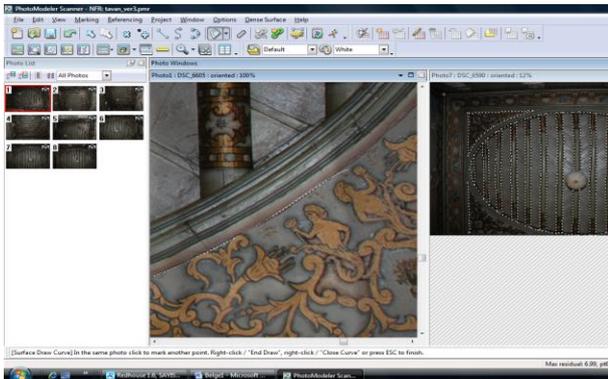


Figure 13. Photomoder drawing a ceiling detail province of Gaziantep, Turkey.



Figure 14. Orthophoto of a ceiling detail province of Gaziantep, Turkey.



Figure 15. Orthophoto of a ceiling province of Gaziantep, Turkey.

### 2.3. Contribution of Laser Scanning to Prepare Ceiling Plans

It is almost new to use Laser Scanner in architectural studies in our country. Because of the fact that using photogrammetric measurement is not obligatory in restoration projects, using and becoming widespread of modern technology in restoration and documentation projects is to be delayed. On the other hand it is commonly accepted that it is very difficult to measure of very high monumental buildings or architectural documentation of intensive building details or façades with pictures, writing or relief. This causes to research usage possibilities of new and modern technologies in architectural preservation and documentation process. A few university, municipality and private institution have Laser scanner because of its first investment cost. In private architectural restoration services,

especially private offices preparing many projects rent laser scanner for a day or a few days and utilize from productive measurement possibilities of scanner.



Figure 16. A Lazarscanner exapmle of Italy (Bonora V. at all,

It should be defined that laser scanner fairly gives good results in documentation of ceilings. This method quietly facilitates measurement obstacles in architectural restoration practice and reduces error ratios (Figure 16). In this manner, it becomes easy to get 3D inner space with actual size.

## 4. CONCLUSION

Ceilings are one of the most important structural elements of Traditional Turkish Architecture. Because of this importance, the necessity of preparing ceiling cover as a separate part of the Project is informed to Project control committees by Ministry of Culture and Tourism. To use photogrammetric documentation techniques and laser scanner in order to prepare ceiling projects like other documentation projects is necessary for sensitive documentation and decision making process. These applications determining existing situation best and 3D model will have better outcomes in the future in the field of cultural heritage preservation and documentation.

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