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## Conservation education techniques: the role and importance of modern technology

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### Abstract

Between all of the professional education disciplines, architectural education is an interdisciplinary model that acquires a different character due to the transfer of design consciousness process and necessity of being carried out in a coordinated manner with other disciplines. As a result of differentiation, education and teaching process is getting a difficult situation, intellectual background for implementation of training intensity causes time issue. According to this fact, different methods in different schools of architecture are being tried even every faculty members are developing strategies that can be called subjective. Developed in different ways from each other, the common point of all this training strategies should focused on modern technology based student-centered education to increase the quality of education.

Restoration is one of many major fields of science, located under the discipline of architecture that transfers past to the future by reflecting the characteristics of its age and maintaining cultural continuity in history. Owing to the fact that restoration defines multi-dimensional, multi-faceted and very problematic area it needs collaboration of different disciplines such as architecture, urban planning, sociology, art history, archeology and engineering.

A successful restoration practice can be achieved by group of experts, well educated in their fields. Thence, restoration education should be given in this context. Documentation and building survey works, is at the basis of restoration practice and in our country carried out by conventional methods. The mentioned systems' excess of workload and the high error margin reduces the reliability of the documentation and survey works. Conversely revealing accurate, reliable and fast data with modern methods increase necessity of preference of these methods require. Due to education of the target audience is the generation of the technology era that gave birth to modern methods, the use of technological equipment for students interested in the course will increase the susceptibility of the education will ensure successful.

Erciyes University Faculty of Architecture is improving its "restoration training" in the light of this approach. Technological surveying methods have been examined, most compatible program packages for student knowledge and architectural education have been investigated and Tachycad, Point Cloud and Photoplan programs were preferred. Necessary background produced by

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getting trained on pointed programs and purchased technical equipment. Educational strategy, supported by the established background, has been used primarily in the education of graduate students and has been applied on the sample American College Building which located within the Social Establishments region of Erciyes University. Our faculty aimed at improve technology-assisted learning strategies on behalf of achieving accurate and reliable restoration practices and implementing this method in undergraduate education. With this proceeding, the implementation process performed and the necessity and practicability of these methods will be described and be presented.

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## 1. Introduction

Historic surroundings in which cultures are built that identify a process, a way of life and the development of society as the most obvious example of the level of production and significant savings should be handled down to future generations. In a globalized world in which cities have quickly begun to resemble each other, the distinguishing depicting of the history of mankind that makes it special and historic buildings and environments are now recognized as world heritage sites the conservation of which is managed by international decisions.

We cannot deny the role of notion in architectural practice which goes beyond designing and building process. In renovation studies concerning the maintenance, repair and protection of existing buildings, notion is meaningful when it is fed by knowledge which comes from practice, because the most important point is to preserve structures for the future without damaging their unique features. Determining, describing and documentation of the historical structure's plan and façade schemes in their own ratio in an accurate way is the most important phase of the conservation process.

The importance of the renovation phase, which can be defined as establishing the present situation of a historical structure and transforming it to drawings, is very significant in the total process. The simplest mistake made during this phase can cause major problems like miscalculating building ratios which cannot be fixed even if all the other phases are performed correctly. In this point we can clearly see the importance of the measuring process which forms the basis of renovation. The simplest mistake made while taking measurements will affect all the whole process in a negative way and cause waste labor and money. As can be understood from the explanation, conducting renovation work according to international standards is directly related with minimizing the error margin in renovation. In order to achieve more accurate results it is essential to use modern methods instead of traditional methods.

However in this point, we must not forget that to improve the quality of work in keeping with international standards the problems faced should be solved with instant decisions, responsibility, sensitivity and knowledge because every structure has its own unique problems. In the process the renovator chooses or combines the hardware and methods he/she will use.

## 2. The importance of survey studies and the methods used

Structures need to be protected and their close surroundings, which is defined as cultural heritage, is a process which exemplifies the lifestyles, education, technological levels, social, political, physical and economical conditions of civilizations which are in cultural persistence in a concrete way. While reflecting the mission of the period in which they existed, at the same time these structures also give information about that period's building materials and techniques. The historical formations which need to be protected as the most important treasures of nations are today not able to resist the effect of time and are losing their unique features which have been spoiled, by serious corruptions, even some are even on the point of destruction. In this context we can clearly see the necessity of protecting the monuments and documentation.

Survey is not only a part of protection; at the same time, it is also done so it can be used by documentation and scientific researchers. Thus, lots of researchers like Alby, Grussenmeyer, Perrina (2005) and Erzun (1989) have

stressed on the importance of cultural continuity and protection, introduction, archiving, etc. for in the purposes of documentation. It is possible that, with the potential of the students they have, universities can achieve documentation and inventory formation steps in a rapid and reliable way and create an open database for the use of researchers. Because of the impossibility of providing protection in the short term to our rapidly perishing historical heritages and also because of the risk of losing unique features while the restorations are being done, universities which only focused on scientific concerns far removed from budget and commercial pressures have to take a role in this field in a more effective and active way. In this way it would be possible to form extensive archives which other disciplines could use.

The surveying methods used in survey studies are divided into two main categories, traditional methods and high technology supported methods, both of which are explained with their advantages and disadvantages below.

### 2.1. Traditional methods

Constructions built by using methods such as dividing in triangles, Cartesian coordinates methods and gridding, which are described as traditional methods, are measured by tape measure, plumb, compass, range rod, leveling rod, nivo, etc. The project planning is done by the drawing teams with these measurements. Because of problems like, working separately as surveying and drawing teams, processing the measurements taken on site to the plot, the coordination malfunction between the reader and writer while processing it on the plot, not stretching the steel measuring tapes enough on wide areas or shifting the zero point while stretching result in reducing the sensitivity of the work, and contribute to the error margin. We cannot talk about one hundred percent successes in the outcome in the measurements performed with these methods. A disadvantages of traditional methods, high error margin, the exponential increase in millimetric faults, damage to the accuracy of documents and generating a chain of problems by causing errors which are difficult to compensate in the outcome can be listed. However, despite of all these negative aspects, survey studies and training activities conducted at the universities in our country are mostly performed using traditional methods.

### 2.2. Advanced-technology assisted methods

Pakpen (2013) classified advanced-technology assisted methods as

- Tachometric and Laser Measuring Instruments
  - Laser meter
  - Line laser
  - Protractor
  - Advanced Nivos
  - Advanced Theodolites
  - Total Station
- GPS (Global Positioning System)
- Laser Scanning
  - Tellural Laser Scanning
- Geographical Information Systems and Photogrammetry
  - Sky photogrammetry
  - Tellural photogrammetry
  - Close up picture photogrammetry

In addition to this classification, Hanke and Grussenmeyer (2002) discussed architectural photogrammetry methods by classifying them in to basic theory, procedures and items. Turan (2004) however classified the architectural photogrammetry methods as,

- Single image (monoscopic) method
- Stereo image (stereoscopic) method
- Beam of rays (bundle) method

There are many methods, technical tools and equipments which named as advanced technological methods in today's terminology. However the program, hardware and methods which are used surveying structures will be mentioned. Advanced technology assisted methods are computer-aided methods which allow the progress of

surveying and drawing process together. Survey studies with conventional methods, consists of roughly measuring and drawing teams. However the fact that both the office team is far away from the works done on the site and the measuring team does not have the necessary details for drawing results in increasing error margin, thus damaging credibility. In the survey studies done with advanced-technology supported methods, these methods prevent the teams from being divided and provide site and office collaboration, bringing the site to the office venue.

The most important device to use with the advanced-technology based methods in survey studies, with positive properties like sensitivity, credibility and providing multiple purpose usage, is the laser scanner. The data obtained by this method, include documentation on the whole structure, provide the data like photographs, sections, plans and details which cannot be obtained with other methods.

Another advantage of using advanced-technology based methods is being able to position the devices which are going to survey at a definite distance to the area which is going to be measured and thus being able to take the measurements of places which are at risk of collapse or hard to reach in a correct and safe way. Using these methods also minimizes the error margin which is caused by taking measurements from a close distance with traditional methods and devices which have low sensitivity and they also protect the team from risky situations.

When the laser scan is completed with the laser measuring devices, with the gathered 3 dimensional data we can take positions from every point and create unlimited sections. Also in despite of their high initial investment costs, in documentation studies done with these methods less human power and time are required. Therefore in the long term there is a reduction in time and human effort however the most important thing that they provide information to scientists from different subjects with this real documentation. Gathering the documentation in a numeric way and which is digitized enables us to keep, store and update this information better when necessary and in an interdisciplinary context to utilize the documents in the most effective manner.

### 3. Restoration education at present

#### 3.1. Restoration education in the architecture faculties in Turkey

Architecture is a special profession which involves engineering, design, art and social studies. The architecture education given has to be multi-dimensional, dynamic, varied and connected with technology. This situation is causing problems, for the students, who have learned lots of things in a short time, as they become overwhelmed and very often cannot use the necessary information he/she has learned, at the required place and time. Renovation art is one of the various disciplines in architecture and has its own rules and terminology. Using technological methods in protection applications, which need multi-partnered study platforms, is unavoidable. In fact in this context researchers like Taşlı, Pektaş and Erkip (2006) declared the importance of using computers and programs in architecture education and their positive effect on productivity.

Table. 1. Restoration education programs of the top 10 government-run universities of Turkey.

University Name	Obligatory lessons (hours per week)	Obligatory lessons (total ECTS)	Elective lessons (total count)	Practical Training (total weeks)
İstanbul Technical University	6	8	8	0
Middle East Technical University	3	4	6	0
Mimar Sinan Fine Arts University	2	2	10	15
Yıldız Technical University	4	3	8	0
İzmir Institute of Technology	0	0	4	6
Dokuz Eylül University	6	7	11	6
Uludağ University	7	9	5	0
Eskişehir Osmangazi University	0	0	0	6
Abdullah Gül University	6	6	4	0

When renovation education in licensed degree courses in Turkey is inspected overall it is seen that the education is given in a traditional way but when the students graduate and started to work in this field it is seen that they

cannot use the knowledge they have learned in an effective way. The most important reason for this is that the professionals have forsaken traditional methods and continued their studies with advanced-technology supported methods.

When the education programs and lesson contents of the top 10 government-run universities are inspected we can clearly see that restoration disciplines are not an offer in their curricula. The reasons for this maybe budget cuts and not having the necessary equipment and correspondingly, not offering these disciplines in the lessons available.

### *3.2. Erciyes university architecture faculty and renovation education program*

The lessons on offer in Erciyes University Architecture Faculty's renovation departments include 9 hours of obligatory lessons and 23 elected lessons of 2 hours each. The first obligatory lesson, Protection and Documentation of Historical Environment I, involves 2 hours of theoretical and 3 hours of practical lessons making a total of 4 credits. Within this lesson framework students are given instruction in how to conduct renovation, survey, restitution, and classify monument types and to take measurements and make drawings in this context. The other obligatory lesson, Protection and Documentation of Historical Environment II, involves 2 hours of theoretical and 3 hours of practical lessons making a total of 3 credits. The content of the lesson involves taking measurements and making drawings of a structure or a whole street in a historical setting. Also there are 26 elected lessons offered at the renovation department which are in different subjects like New Functions for Old Structures, Design in Historical Textures, Architectural Elements in Traditional Textures, Material Protection in Traditional Textures and Protection Theory. In applications in this area, the targets are to protect cultural heritage, determine the historical structure stocks of Kayseri and its surroundings, make inventory studies, conduct archiving, protecting the present cultural heritages potential and bringing it to a more perceptible situation.

To avoid giving education in a traditional way in licensed degree renovation education, research has been conducted and funds provided. However, for reasons such as crowded classrooms, the equipment being expensive and the problem of providing this equipment to the students, instead of making it available to licensed degree students, it has been decided to use it with those who have architecture degrees, in graduate degree classes with fewer students. With the equipment and programs available, graduate students have the opportunity to learn advanced-technology supported methods using the example of the American College which is registered and used as the Erciyes University Social Facilities building. The training for reading the surveying data, program and survey devices is given by the "Kubit" company, from which the programs are obtained.

## **4. New searches in renovation, the american college experience**

### *4.1. American college structures*

At the present day, the structure complex used as the Erciyes University Social Facilities site is occurred from 7 buildings and is located in Kayseri's Talas district. The oldest structure of the campus, the dormitory building, was built in the 19th century and was used as a bond house until it was donated to the American Board foundation in 1889. The other buildings located on the campus were built after the agreement of the American Board Foundation and were used to meet of accommodation and sleeping needs of students. In the education break given because of World War I, the buildings were used as orphanage for children who lost their parents during the war and were returned to the foundation at the end of the war and used as a hospital. The complex continued as a hospital until the American Hospital was closed in 1972. In 1974 the structure complex was bought by Ankara Hacettepe University and transferred to Erciyes University in the same year.

With the feature of being the oldest structure on the campus, the dormitory building also gives an example of the traditional residences of the area. The structure, with its cross-like plan scheme, with additions on its left and right sides has a 480 m<sup>2</sup> area of usage. Unique components like the stones used in the exterior, the windows and top windows which form the façade, the wooden and stone ornaments in the structure, the dices, the marble basins and the 2 different caves which are entered from the basement are forming the characteristic features of the structure.

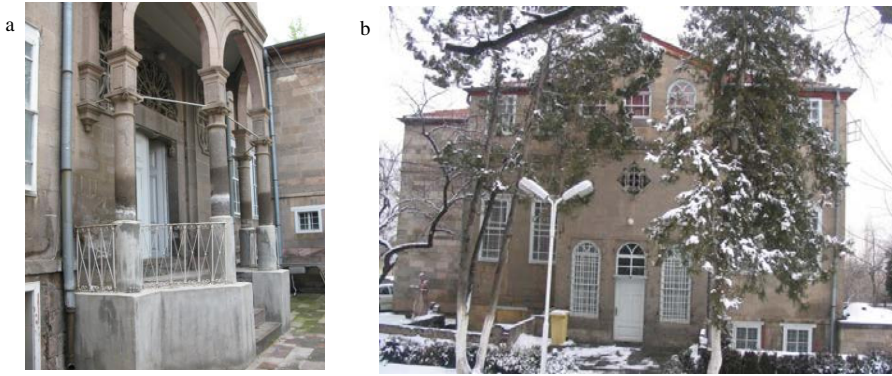


Fig. 1. (a) Entrance door from courtyard, (b) Main entrance

#### 4.2. Renovation studies

The campus and the structures on the campus are used to show the graduate students the difficulty of taking measurements with traditional methods due to the structure's physical features. The increase in error margin and concern for ruining the work quality necessitated the use of advanced-technology methods. Of the advanced-technology methods, the laser scan, laser measuring devices and photographic methods, called multiple methods, were chosen and for use in survey studies. With the support of the university, which owns the area, the necessary equipment was bought and this made scientific research project possible.

The project started with the overlays taken with traditional methods and measuring studies using in different methods have started.

#### 4.3. Laser scanner phase

With the laser scanner method, which was chosen to minimize the error margin in measurements because of the structure's unique details, a 3D model is prepared and transferred to digital media. Due to high prices of the devices we employ laser scanning services from a well-known and experienced firm. For 3D laser scanning a device, which can scan 360o horizontally and 320o vertically, is preferred and the sensitivity rate is set to 4mm-2mm. In the measurement process 360o panoramic photography is possible and dataset gathered from these photos is used. While applying the laser scanning method "Faro Focus 3D Laser Scanner" device and "Kubit Lupo Scan Pro" software to read the data are used. For the purpose of fitting the laser scan to a coordinate system on the campus "Focus 6 Total Station" is used. After accomplishing the measuring phase, the data are collected on computer with "Kubit Point Cloud Pro" software and "Kubit TachyCAD" software which works with the "Focus 6 Total Station" device.



Fig. 2. 3D digital model of the building

At the end of the applied method, a 3D model of the structure which can be read in AutoCAD and fits the satellite coordinates, in other words the “point cloud” data and the “ortho-image” images formed in dots of black and white, in the scan of the façade, are provided. The laser scanning data which provide the transfer of the project area to digital media are read by “Kubit Point Cloud Pro” software which is attached to “Autodesk AutoCAD 2013” and with the same software plan, section and detailed drawings are done.

The laser scanning method, because of its advantages, is used for the dormitory building and the exteriors of the other structures in the area and for the layout plans of the near surroundings. For the interior measurements of the other structures the Total Station measuring method is used.

#### 4.4. Surveying phase with laser devices (total station) method

“Kubit TachyCAD” software and “Focus 6 Total Station” are used to obtain the plan, sections, detailed surveys and its designated coordinates which are determined by laser scanning. In this phase of the renovation study, the team is supported by intern students of licensed degree level. During this phase the intern students are given training for the program and devices which will be used and have the opportunity to earn experience in using such a method.

With “Kubit TachyCAD” software, which allows the data to cultivate on “Autodesk AutoCAD 2013” software simultaneously, the distinction between the office and the site disappears. As a result all the team members participate in the measuring and drawing phase, the error margin which occurs while transforming information is avoided and at the same time drawing speed is increased, thus the time to achieve final product is reduced.

The measurements made with “Focus 6 Total Station” are done with the “Autodesk AutoCAD 2013” software where the “point cloud” is gathered by the laser scanning data of the structure. Documentation of the structure is done by studying 3D over one file and with this system both the plan and section data are gathered. However during the studies, in the measurement of organically formed caves traditional methods are applied because of the sensitivity of devices and the unsuitability of the working site for advanced-technology methods. This occasion shows us that traditional methods should not be discarded totally and there is need to use different methods together.

#### 4.5. Photographic method

“Kubit Photo Plan Pro” software, which is also used in renovation studies performed with traditional methods in documentation with photography, is preferred for documentating the points which cannot be determined by the laser scanning method in a sensitive and detailed way.

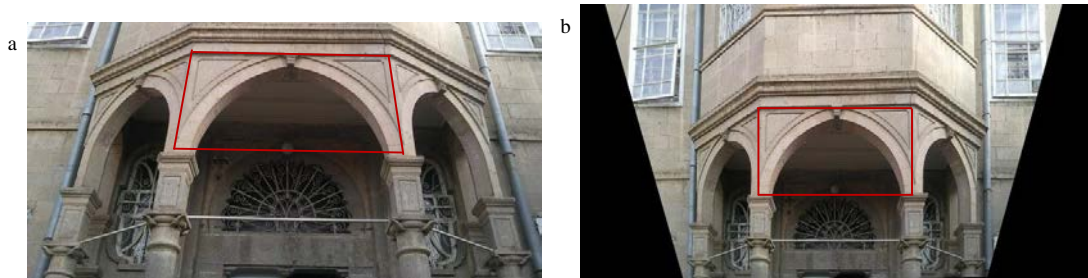


Fig. 3. (a) Original image , (b) Flatten image with Photoplan software

The photos, which are taken with a high resolution camera, with the mediation of “Kubit Photo Plan” software in AutoCAD media, are transformed into planes and with this method; details like doors, windows, ceiling ornaments, syrup holders, and quick and reliable drawings of other unique components are realized.

## 5. Result

The transition from one approach to another is always precarious and painful. It is possible to see people who affirming, object to or not embrace a measuring method and the programs related to this. At this point the most important thing is the editing of the chosen measuring methods which have a successor-premise relationship with

each other by a person who is specialized in protection and renovation studies. The method and the program which will be chosen may be varied according to each structure's own attributions. In this context recommending an approach which is suitable for all structures is not a good idea. We must not forget that every method has positive and negative sides and the method or methods, considering the structure's attributions, must be determined by a specialist.

However the main point to be discussed here is the position of universities, which need to be in touch with society in a more dynamic way and their qualifications. When the subject is protection and renovation programs it is obvious that the universities are looking in terms of both academic programs and technological hardware. On the subject of using up-to-date measuring techniques and technology, university renovation programs cannot compete with the private sector's speed while they continue to teach future architects with conventional methods. Universities, due to their autocratic approaches and temporal impossibilities, in terms of the new technologies and technologic hardware which are used and internalized by private sector have been, in application site can not compete with the private sector, nor they can achieve the same speed or success ratio. This situation has to be changed immediately and universities, which are created for producing knowledge and giving education, have to acquire the hardware to follow up-to-date developments.

A university which is not integrated with 21st century's instruments, methods, techniques and technologies, which does not claim responsibility for its own cultural heritage, which is lacking in the use of modern technology, techniques and methods, which cannot develop r&d studies and does not have a position between urban relations and have a active role in transformation and development decisions, may not perform its basic function and it cannot be considered as being in a successful position.

As understood from the arguments given above, protection the notion of and using technology connected to this notion in architectural education is an important area and our country has been unable to solve this problem completely. The main reason behind this is that notions like protection, urban identity and sustainability are not seen as problem of the community in general or as a priority. These notions, which are the concerns of a sensitive elit group, have a lack of support and substructure even in universities.

However, traditional structures, the symbol of social memories and local textures, are the most valuable assets of the countries which have to be protected as treasures. Until this fact will be understood and the norms become priority issues of the broad masses, built environments, which are away from notional background, non-creative and non-constructive, which can not use the possibilities of science and technology, which destroy, may be the most important feature of historical value, the originality, which do not pay respect to the past, will continue to be produced. The qualified historical environments and urban spaces which obtained by the centuries of experience and knowledge, will be enforced while compared with the world's leading conservation practices.

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