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RESTORATION APPLICATIONS OF WOODEN STRUCTURES IN TURKEY

Cevdet SÖĞÜTLÜ[1], Kemal YILDIRIM [1], Abdullah TOGAY [2], Nihat DÖNGEL [1], Derya SÖYLEMEZ ÖZKÖSE [3]*

[1]Department of Wood Products Industrial Engineering / Technology Faculty / Gazi University, 06500, Ankara, Turkey
cevdet@gazi.edu.tr, kemaly@gazi.edu.tr, ndongel@gazi.edu.tr
[2]Department of Industrial Design/ Architecture Faculty / Gazi University, Ankara, Turkey
atogay@gazi.edu.tr
[3]Turkish Airlines, Sabiha Gökçen Airport, Kurtköy, Istanbul, Turkey
deryasoylemez@thy.com

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*Corresponding author

Abstract

This study determines application problems of restoration for wooden structures and puts suggestions for the identified problems. A questionnaire was developed in accordance with the aim of the study to determine of the application problems in the restoration of wooden structures and structural elements in various cities of Turkey. According to the results, 80% of small-scale, 78% of medium scale and 89% of large scale enterprises state that they operate in the field of restoration because of their interest in cultural assets. 63% of businesses have difficulties to get the qualified staff for restoration works. The highest challenge (51%) was to find qualified staff who has the knowledge and skills on carving, inlaying and kündekari. 55% of enterprises has difficulties in supplying suitable size, type and moisture content of wooden materials. It is stated that the problems of decay 40%, crack 55%, discoloration 30%, dimensional changes 36%, distortions 30%, and protective layer deformation 47% of wooden constructions and artifacts were occurred. According to the data obtained by those enterprises, the rate of protection methods applied to historical structure/artifact unconsciously is %92. The applications of 21% of user applications are non-recoverable, 43% of them cause significant financial losses and 13% of them can be helpful for protection of structure/artifact. In conclusion, unforeseen problems occur in 62% of applications of wooden construction restorations.

Keywords: *Restoration, Enterprise, Wood material, Wooden construction*

TÜRKİYE'DE AHŞAP YAPI RESTORASYONU UYGULAMALARI

Özet

Bu çalışmada, ahşap yapı restorasyonu uygulamalarında mevcut olan sorunlarının belirlenerek bu sorunların çözümüne yönelik önerilerinin geliştirilmesi amaçlanmıştır. Bu amaca uygun olarak geliştirilen kapsamlı bir anket yardımı ile Türkiye'nin farklı illerinde ahşap yapı ve yapı elemanları restorasyonu alanında faaliyet gösteren 47 adet işletmenin uygulamada karşılaştıkları sorunlar belirlenmiştir. Araştırma sonuçlarına göre, küçük ölçekli işletmenin %80'i, orta ölçekli işletmenin %78'i ve büyük ölçekli işletmenin %89'u kültür varlıklarına ilgi duydukları için restorasyon alanında faaliyet göstermekte olduklarını bildirmişlerdir. İşletmelerin %63'ü restorasyon işlerinin niteliğine uygun personel bulamada zorluk yaşamakta olup, en yüksek düzeyde (%51) oyma, kakma, kündekari bilgi ve becerisine sahip kalifiye iş gücüne ihtiyaç duymaktadırlar. İşletmelerin %55'i restorasyonda kullanılan istenilen boyut, tür ve rutubette ahşap malzeme temininde zorluk yaşamaktadır. Ahşap yapıların/eserlerin %40'ında çürüme, %55'inde çatlama, %30'unda renk değişimi, %36'sında boyutsal değişim, %30'unda çarpılma ve %47'sinde ise koruyucu katman deformasyonu meydana geldiği belirlenmiştir. Ankete katılan işletmelerin vermiş olduğu bilgilere göre, tarihi yapıya/esere kullanıcısı tarafından bilinçsiz uygulanan koruma yöntemlerinin oranı %92 olup, bu uygulamalarının %21'i telafisi mümkün olmayan, %43'ü telafisi mümkün ama önemli maddi kayıplara yol açan, %13'ü ise yapının/eserin korunmasına bir süre yardımcı olabilecek niteliktedir. Restorasyon uygulamalarının %61,7'sinde öngörülemeyen sorunlar ile karşılaşıldığı tespit edilmiştir.

Anahtar Kelimeler: *Restorasyon, İşletme, Ahşap malzeme, Ahşap yapı*

1 Introduction

Repairing or taking under protection, by sticking to the structures, of the movable or immovable cultural heritages which last from past to today and dug up or already on the ground, is called restoration [1]. All technical and architectural interventions which prolong the life of an artistic structure keeping its all original characteristics as a cultural and historical reference, form the restoration activity [2].

At past, the purpose of restoration was to keep the structure steady, to keep the integrity by reconstructing the collapsed parts and provide the operability of the structure with some additions according to variable demands. But today, monuments and the historical environment are considered as a reference which explains the municipal and architectural order, construction techniques and social life of a specific period [3].

As the most important pictures of cultural heritage, historical structures are built as important references of building materials technology, construction technology and design history, considering aesthetical and functional demands and they reflect the social, cultural, economic, political and religious structure of their time [4,5].

Although the conservation activities which are applied successfully based upon the international knowledge and experience in developed countries, unfortunately this knowledge and experience is not formed sufficiently in our country and some basic problems are not solved yet [6]. In scope of legal procedures about conservation; Law of Conserving Cultural and Natural Assets, Country Planning, Regional Planning and Development Plans, Convention for the Protection of the Architectural Heritage of Europe, Conventions for the Protection of Cultural and Natural Heritage of the World take place in our country. In this sense, rules applied by High

Commission of Preservation of Cultural and Natural Heritage, governorships and local administrations have active role in protection [3,7].

Wooden materials have an extend application area in the Turkish civil architecture in terms of construction procedures and designing [8]. Wooden materials are used as construction materials even today because of their useful features such as having less load on structural bearings as they a lighter material compared to concrete and steel construction materials, being capable of integration, being easy to mount and being more economic, being elastic, and being easy to convey [9,10].

On the wooden materials having been exposed to environmental impact, changes on the shape and dimensions of the material may be seen on the process of reaching the equilibrium humidity in accordance with the relative humidity and temperature of their environment within the hygroscopic limits (0-28%); physical deformations may be seen because of the climatic factors such as sun, rain, snow and wind; chemical deformations may be seen in case of being exposed to acid, alkali, salt and suchlike chemical impacts and/or getting burnt; biological deformations may be seen caused by living organisms such as bacteria, fungi, insects, marine species, birds and mammals.

When the society's structure and aspect to heritages is considered, it can be seen that the antiquity and historical assets are basic measures of protective consciousness. It is important to consider the cultural heritage with the concept of "cultural asset" by getting beyond the concept of "antique artefact". There is a lot of factors that cause deformation on wooden structures and on their elements, as there is on most of historical structures. The role of a restorer in this scope is to investigate root causes of deformation's impacts and principally make the structure protected against those impacts. Protection should be done by fixing the areas which has problems, by bringing new usage or by improving the infrastructure, not by protecting the history as it is [11].

It may be possible to get lots of cultural and economic benefits, to protect the historical structure and to change the cultural aspect of the society in restoration in case different occupational groups unite on a common ground and cooperate in an interdisciplinary way. Even if the needed level hasn't been reached yet in protection, lots of regulations have been made to settle the culture of protection and principles of restoration have been designated with strict lines and contribution has been made to build a consciousness within the society.

The culture of protection should take place in the educational systems in such a manner that it should involve all segments of society [12]. When we take a look at the education levels of individuals of the highest decision maker to lowest level applier unit who contribute the protection and restoration processes we can see that those individuals haven't taken any "Restoration education" directly,. Some of them are architects, city planners, art historians, archeologists and some of them even have irrelevant occupations. It is known that at lower units, most of the applications are realized by personnel who don't have any relevant education about the issue [13]. In another words, the biggest problem is lack of technical staff, qualified workers and experts [14]. Projects of experts should be applied by educated members of the profession and commissions should become adequate in terms of restoration experts [15].

Restorations works of immovable cultural assets are generally considered as ordinary construction works. As the nature of the work, even the repairing of the smallest details which can last for days should be realized carefully by the experts. However, as all these are a team work, the cost gets higher. Considering all those factors, transfer to next generations of the immovable cultural assets in our country is getting more and more difficult because of the incorrect restoration processes [14]. No matter how much experienced the technical staff in their field of study is, as restoration processes need team works, it is important with respect to get a healthier result from the process that an adequately educated, experienced and capable personnel work in cooperation. Wooden structures have an important place in historical structures in our country. If wooden structures as well as decoration elements used on the details of architectural structures are restored complying with their original versions, they become local symbols and contribute the development of tourism.

Wooden structures play an important role in transferring the architectural structure, lifestyle of people and customs and traditions of societies to the future, but a great number of those artifacts cannot resist to climatic and environmental effects owing to characteristics of wooden materials and not being protected adequately and they collapse. And consequently they get lost in the pages of history with the mission they carry on.

As it is understood from literature knowledges, restoration is not to be considered as an ordinary repairing process It is an essential necessity to adopt restoration as a repairing process which is realized by the collaboration of experts, researchers and qualified labors who has the knowledge and skill on materials and construction techniques of artifacts considered as historical and cultural assets. Yet, today there are concerns about how much restoration works comply with that necessity. With this study, it is aimed to determine problems faced in restoration processes of wooden structures and construction elements and to offer solutions for those problems.

2 Research Method

Companies which operate in various cities of Turkey in the field of "Restoration Applications of Historical Wooden Structure" have been taken into the scope of a research. With regard to this research, directors or production managers of 47 different companies have been surveyed. With the help of surveys which had been developed by many researchers [16-22] earlier for similar objects and considered applicable and trustful, a new survey which complies with the object of this research was developed. The survey had been realized by interviewing with company authorities face to face for 30 minutes each.

2.1 Statistical Evaluation

Dependent and independent variables which form research hypothesizes were tested with statistical methods. Information of those variables, acquired with this research was introduced by summarizing in order to be understood and compare with information which is acquired with the same method. Relationship between variables were tested with Chi-Square if they are statistically at the level of $p<0.05$ or not. The difference between variables was determined with single variance analysis (ANOVA). As there are three different methods to read the Chi-square method, all of them were tried separately during the evaluation. The first method is combination, the second method is neutralization. The third method was applied when two solutions were not proper and comments were made by using only frequencies and percentages over the cross table. Comments were evaluated by using SPSS.

3 Findings

The information of the survey which had been realized in order to determine the present situations of 47 various small, medium and large scaled company's which operate in the field of wooden structure restoration and the problems faced in restoration has been analyzed below in a systematic order.

10.6% of the companies in scope of the research operates with the status of ownership, 63.8% are limited companies, 14.9% are incorporated companies, and 10.6% of them operate in other legal statuses. Reasons of operating in the field of restoration and results in terms of experiences, of companies were indicated in the Table 1.

Table 1. Reasons for restoration of business operations

Reasons of business operations	Scale of the Enterprise						Business Experience					
	Small		Medium		Large		1-10		11-20		21 +	
	fi	%	fi	%	fi	%	fi	%	fi	%	fi	%
Interest in cultural assets	12	80	7	77.7	8	88.8	15	83.3	11	84.6	8	72.7
Profitable Field of Business	2	13.3	1	11.1	2	22.2	5	27.7	2	15.3	-	-
Family Profession	2	13.3	1	11.1	3	33.3	1	5.5	2	15.3	4	36.3
Rising interest in restoration	1	6.6	4	44.4	-	-	2	11.1	2	15.3	3	27.2

fi: Number of enterprise

According to the results indicated in the Table 1, among the enterprises which were surveyed, 80% of small scaled enterprises, 77.7% of medium scaled enterprises and 88.8% of large scaled enterprises operates in the field of restoration because of the interest in cultural assets. Besides 83.3% of enterprises which have experience of 1-10 years, 84.6% of enterprises which have experience of 11-20 and 72.7% of enterprises which have experience of 21 years or more seem to prefer this activity field because of the same reason. Restoration works ratio to total business volume was given in the Table 2. Experiences and profitability assessments of enterprises are given in the Table 3.

Table 2. Restoration works ratio to total business volume

Restoration works	Scale of the Enterprise						Business Experience					
	Small		Medium		Large		1-10		11-20		21 +	
	fi	%	fi	%	fi	%	fi	%	fi	%	fi	%
10-25%	6	10	-	-	1	11.1	4	22.2	1	7.7	2	18.2
26-50%	-	-	3	33.3	-	-	-	-	1	7.7	2	18.2
51-75%	8	53.3	3	33.3	4	44.4	11	61.1	7	53.8	4	36.4
76-100%	1	6.7	3	33.3	4	44.4	3	16.7	4	30.8	3	27.3

Note : *Scale of the enterprise: X^2: 17.069, sd:6, level of importance: 0.0009, Business experience: X^2: 5.656, sd:6 level of importance: 0.463*

Table 3. Experiences and profitability assessments of enterprises

Restoration	Scale of the Company						Business Experience					
	Small		Medium		Large		1-10		11-20		21 +	
	fi	%	fi	%	fi	%	fi	%	fi	%	fi	%
Profitable business	10	66.7	4	44.4	3	33.3	15	83.3	4	30.8	4	36.4
Unprofitable business	5	33.3	5	55.6	6	66.7	3	16.7	9	69.2	7	63.6

Note : *Scale of the company, X^2: 2.750, sd:2 , level of importance: 0.253, business experience:X^2: 10.455, sd:2, level of importance 0.005 X^2: Chi-square, sd: degree of freedom, fi: number of enterprise, %: percentage*

According to the Table 2, 53.3% of small scaled enterprises, 33.3% of medium scaled enterprises and 44.4% of large scaled enterprises and 61.1% of enterprises which have experience of 1-10 years, 53.8% of enterprises which have experience of 11-20 and 36.4% of enterprises which have experience of 21 years or more seem to operate mostly (51-75%) in the field of restoration. According to the Chi-square test, despite there is a meaningful difference statistically between the ratios of realization of restoration works within total business volumes of enterprises according to their scales in a level of $p<0.01$, no difference can be found according to their business experiences. As a result, it seems that there is difference between the ratios of realization of restoration works according to scales of enterprises. According to Table 3, 66,7% of small scaled enterprises, 44,4% of medium scaled enterprises and 33,3% of large scaled enterprises and 83,3% of enterprises which have experience of 1-10 years, 30,8% of enterprises which have experience of 11-20 and 36,4% of

enterprises which have experience of 21 years or more, consider restoration as a profitable field of activity. According to the Chi-square test, despite there isn't any meaningful difference statistically if restoration is profitable or not according to scales of enterprises in a level of $p<0.01$, there is a considerable difference according to their business experiences. As a result, it seems that the more the business experience enterprises have, the more they consider restoration as an unprofitable business. On the other hand according to Table 3 there is a considerable amount of enterprise which considers restoration as an unprofitable business. Reasons of not being seen as a profitable field of activity of restoration by enterprises are given in Table 4.

Table 4. Reasons of not being seen as a profitable field of activity of restoration

Reasons of not being seen as a profitable field of activity of restoration works	Scale of the Company						Business Experience					
	Small		Medium		Large		1-10		11-20		21 +	
	fi	%	fi	%	fi	%	fi	%	fi	%	fi	%
Negative impacts during restoration	3	20	3	33.3	1	11.1	3	16.7	4	30.8	3	27.3
Cost of qualified personnel	5	33.3	5	55.5	5	55.5	2	11.1	6	46.1	5	45.4
High prices of materials	4	26.7	3	33.3	4	44.4	2	11.1	6	46.1	5	45.4
Costs of tender, permissions, license etc.	2	13.3	3	33.3	1	11.1	2	11.1	4	30.8	2	18.2
Reputation more important than profitability	2	13.3	3	33.3	6	66.7	1	5.5	6	46.1	4	36.4

According to the information given in Table 4, 33.3% of small scaled enterprises, 55.5% of medium scaled enterprises and 11.1% of enterprises which have experience of 1-10 years, 46.1% of enterprises which have experience of 11-20 and 45.4% of enterprises which have experience of 21 years or more, put forward the cost of qualified personnel. Enterprises notify that they encounter problems about various issues in the process of getting permission for restoration. Numbers about those problems are given in Table 5.

Table 5. The problems in the process of getting permission for restoration

Encountered difficulties for permission	fi	%
Deficiencies of regulation	20	42.6
Being long of process	30	63.8
High costs	6	12.8
Bureaucratic obstacles	3	6.4

According to Table 5, length of process (63.8%) and deficiencies of regulations (42.6%) are seen as primary problems in the process of getting permission for restoration. On the other hand, 63.8% of managers of enterprises express their opinions in direction of taking incentive precautions for protection of the original situations of monuments. Institutions that enterprises receive restoration works are given in Table 6.

Table 6. Institutions that enterprises receive restoration works

Restoration employers	fi	%
Property owners	49	33.6
Ministry of Culture and Tourism	37	25.3
Municipality	29	19.9
General Directorate for Foundations	22	15.1
Provincial Special Administration	9	6.1
TOTAL	***146***	***100***

According to Table 6, 146 restoration works which were realized by enterprises had been respectively taken from property owners (33.6%), Ministry of Culture and Tourism (25.3%), municipalities (19.9%), General Directorate for Foundations (15.1) and Provincial Special Administration (6.1%). Deformation frequencies on the monuments which were restored is given in Table 7.

Table 7. Deformations of wooden structure and artifacts

Deformations	fi	%
Corrosion	19	40.4
Cracking	26	55.3
Change of color	14	29.8
Change of size	17	36.2
Distortion	14	29.8
Deformation on the facing	22	46.8

According to Table 7 deformation frequencies of wooden structure and artifacts are given as; 40.4% corrosion, 55.3% cracking, 29.8% change of color, 36.2% change of size, 29.8% distortion and 46.8% deformation on the facing. 68.1% of enterprises noticed that they couldn't find proper personnel for restoration works. Their responses for required qualifications of the personnel they are looking for are given in Table 8.

Table 8. Required qualifications for qualified staff

Required qualifications for staff	fi	%
Carving, inlaying and kündekari	24	51.1
Coordination skills	12	25.5
Top surface processes	11	23.4
Construction knowledge	10	21.3
Technical drawing knowledge	6	12.8

The most required qualifications are carving, inlaying and kündekari which require handcraft. Other required qualifications are, coordination with other profession members (25.5%), top surface processes (23.4%) knowledge of construction (21.3%) and technical drawing (12.8%). As 49% of enterprises notice that they don't have any trouble supplying materials used at wooden structure restoration, 51% of them notice that they experience difficulties on supplying materials. Values of supplying difficulties of materials are given in Table 9.

Table 9. Supply of shortage materials

Material property	fi	%
Wood material in proper type	30	63.8
Wood material in proper sizes	27	57.4
Wood material in proper moisture	22	46.8
Protective material	7	14.9
Cleaning materials for surfaces	5	10.6
Fixing elements and fasteners	3	6.4
Paint, varnish etc.	1	2.1

According to Table 9, 63.8% of enterprises experience difficulties in supplying required types of wood, 57.4% experience difficulties in supplying wooden materials in proper sizes and 46.8% experience difficulties in supplying wooden materials in proper moistures. Situation of encountering with the unconscious conservation methods are given Table 10.

Table 10. Situation of encountering with the unconscious conservation methods

Frequency of unconscious conservation applications of users							
Very Often		Often		Sometimes		Rarely	
fi	%	fi	%	fi	%	fi	%
18	38.3	19	40.4	4	8.5	2	4.3

According to Table 10, possibilities of encountering with the unconscious conservation methods applied by users quite likely (91.5%) and this situation is noticed as very often (38.3%) and as often (40.4%). Values of the effects of unconscious conservation applications to the current condition of historical structure/artifact are given in the Table 11.

Table 11. The effect of the users' application on the existing condition of the structure and artifacts

Possible effects of unconscious applications	fi	%
Causes irreversible damages	10	21.3
Causes financial damages which are reversible	20	42.6
Applications which may protect the structure/artifact for a while	6	12.8

According to Table 11, 21.3% of user applications cause irreversible damages to wooden structures and artifacts, 42.6% cause financial damages which are reversible, and 12.8% of those applications may protect structures/artifacts for a while. Situations encountered with the unforeseen problems in the restoration applications are given in Table 12.

Table 12. Encountered situations with the unforeseen problems in the restoration applications

Encountering with unforeseen problems	fi	%
Yes	29	61.7
No	12	25.5

It is determined that problems are occurred at 61.7% of restoration applications and no problems are encountered at 25.5% of them. The frequency of encountering with a problem caused by processing mistakes or with a deformation after delivery of the restored wooden structure/artifact is noticed as; 8.5% very often, 17% often, 29.8% sometimes, 38.3% rarely and 1% no problems. On the other hand 80.9% of enterprise authorities noticed that conservation of structures'/ artifacts' original versions should have been encouraged.

4 Conclusions and Recommendations

According to results 21% of companies which operate in the field of restoration in various cities of Turkey, operate with the status of ownership and other legal statuses, 63.8% are limited companies, 14.9% are incorporated companies and 80% of small scaled enterprises, 77.7% of medium scaled enterprises and 88.8% of large scaled enterprises operates in the field of restoration because of the interest in cultural assets. On the other hand 66.7% of small scaled enterprises, 44.4% of medium scaled enterprises and 33.3% of large scaled enterprises consider restoration as a profitable field of activity yet the more experience they have the more they likely consider restoration as unprofitable business and costs of qualified staff are high. This situation shows that enterprises operate in this field of business because of the effect of their interests in cultural assets despite they consider restoration as an unprofitable business.

There are various proportion of problems encountered in various issues. Length of process (63.8%) and deficiencies of regulations (42.6%) are seen as primary problems in the process of getting permission for restoration by enterprises.

63.1% of enterprises encounter problems finding proper staff for concerned works and staff requirement with handcraft for works such as carving, inlaying and kündekari is considered as the biggest problem with the proportion of 51.1%. On the other hand, even if with a small proportion, staff with knowledge of technical drawing and ability to coordinate with other profession's members is required. This situation can be evaluated as an obstacle for realization of restoration works by qualified labor. It is important not only for realization of restoration works by qualified labor but also providing employment to take incentive precautions for restoration divisions at educational institutions, especially at the level of secondary schools.

Difficulties are being experienced in the process of supplying required materials for restoration applications. Lack of required qualified wooden materials is one of those difficulties which take the lead (63.8%). Especially it is hard to find materials of required size, type and moist. Within this scope, it is considered that to encourage entrepreneurs who present various and qualified wooden materials as dried to the market would solve the problem.

The most common deformations in wooden structures /artifacts are cracking and corrosion, changes in size, color change, and distortions follow that respectively. On the other hand, according to the information given by enterprises which were surveyed, the ratio of unconscious conservation methods applied to historical structure/artifact is 91.5%, and those applications are being encountered very often (38.3%) and often (40.4%). 21.3% of user applications cause irreversible damages to wooden structures and artifacts, 42.6% cause financial damages which are reversible, and 12.8% of those applications may protect structures/artifacts for a while. This situation should be taken into consideration as a significant problem, and also it is vital for both wooden structure users and restorers which operate in this field to recognize well the characteristics of wooden materials against climatic and environmental factors and to take into consideration the

structural characteristics of materials to be able to make a selection of sustainable conservation method.

Problems are occurred at 61.7% of restoration applications and no problems are encountered at 25.5% of them. The ratio of frequency of encountering problems within a year after the completion of any work alters between 8.5% and 38.3%. As a result, restoration works require an extensive preliminary study in light of scientific and technological developments throughout the whole process. Restoration applications should be realized by educated and qualified personnel in respect to qualifications and requirements of the work to be done. Today there is a large variety of material, tool, machine, equipment and application method offered for use to executives. As material and method selection according to details of the restoration work to be realized can be done by qualified personnel, the choice of qualified labor should be considered as the most vital factor to able to sustain restoration works without any problems. In Restoration works, it is possible to provide many cultural and economic benefits, to conserve the historical pattern and to change the cultural sense of public in case many various groups of profession experts find a common ground and collaborate interdisciplinary.

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