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Determination of Occupational Health and Safety Risks in the Restoration of Historical Buildings*

Abstract

Restoration practices, which are one of the methods of preserving cultural heritage buildings in historical environments that have become inactive and lost their function due to various reasons, aim to ensure structural and urban continuity. Restoration practices, which also include some construction items, contain unique hazards and risks due to their unique structure and construction techniques. Identifying these hazards and risks in advance is of great importance for the long-term sustainability of the health and safety of workers working in this field. In this study, the hazards that may be encountered in restoration works and the risks that these hazards may cause will be examined. As a result of the studies on regulations

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and field applications, it is of great importance to correctly identify the risks in restoration works in order to obtain more reliable working spaces for those working in this field and users. The main purpose of this study is to contribute to the elimination of these application risks by identifying them at the beginning of the application.

Keywords: *Restoration, Reconstruction, Historical Environment, Hazard, Risks*

Tarihi Yapıların Restorasyonunda İş Sağlığı ve Güvenliği Risklerinin Belirlenmesi

Öz

Çeşitli nedenlerle atıl hale gelmiş ve işlevini yitirmiş tarihi çevrelerdeki kültürel miras yapılarını koruma yöntemlerinden biri olan restorasyon uygulamaları, yapısal ve kentsel sürekliliğin sağlanmasını amaçlıyor. Bazı yapı öğelerini de içeren restorasyon uygulamaları, özgün yapısı ve yapım teknikleri nedeniyle kendine özgü tehlike ve riskler barındırır. Bu tehlike ve risklerin önceden tespit edilmesi, bu alanda çalışan işçilerin sağlık ve güvenliklerinin uzun vadede sürdürülebilirliği açısından büyük önem taşımaktadır. Bu çalışmada restorasyon çalışmalarında karşılaşılabilecek tehlikeler ve bu tehlikelerin yol açabileceği riskler incelenecektir. Yönetmelikler ve saha uygulamaları ile ilgili yapılan çalışmalar sonucunda bu alanda çalışanlar ve kullanıcılar için daha güvenilir çalışma alanlarının elde edilmesi için restorasyon çalışmalarındaki risklerin doğru tespit edilmesi büyük önem taşımaktadır. Bu çalışmanın temel amacı, bu uygulama risklerinin uygulamanın başında tespit edilerek ortadan kaldırılmasına katkı sağlamaktır.

Anahtar Kelimeler: *Restorasyon, Rekonstrüksiyon, Tarihi Çevre, Tehlike, Riskler*

Introduction

Historical buildings are achievements that are historical artifacts that transfer the sociological, cultural and economic conditions of the period to which they belong to the present day (Güngördü, 2021). For this reason, the preservation and transfer of cultural heritage period buildings to the present day is of great importance for the sustainability of urban memory. Structural wear and tear occurs as a result of historical buildings losing their function over time, losing their users or remaining idle for various reasons. There are various methods of renovation and integration of these cultural heritage buildings into the present day. According to Feilden (2003), restoration practices are also a conservation method that refers to the stages of renovation or repair of the historical building (Feilden, 2003). In accordance with the legislation in our country, the restoration work item is considered as a part of the construction sector (Uzun et al., 2020). Construction works are among the sectors with the highest number of occupational accidents. According to the 2024

SSI Statistical Yearbook, it is the sector where fatal work accidents are the most common after the industrial sector with a rate of 26% (İş Sağlığı ve Güvenliği Yönetmeliği, 2024).

Figure 1: Sectoral distribution of mortality rates due to occupational accidents in the first 6 months of 2024
(İş Sağlığı ve Güvenliği Yönetmeliği, 2024).

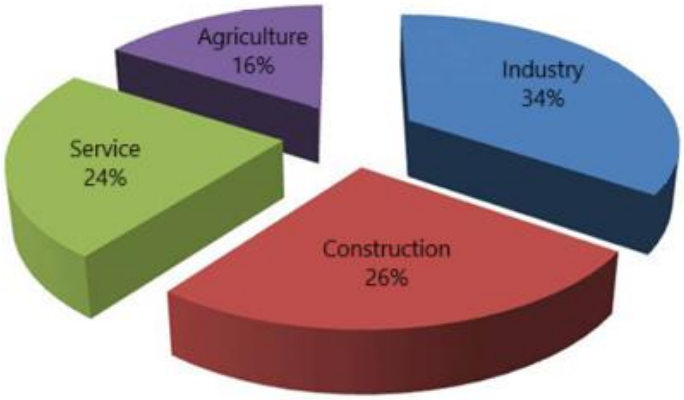
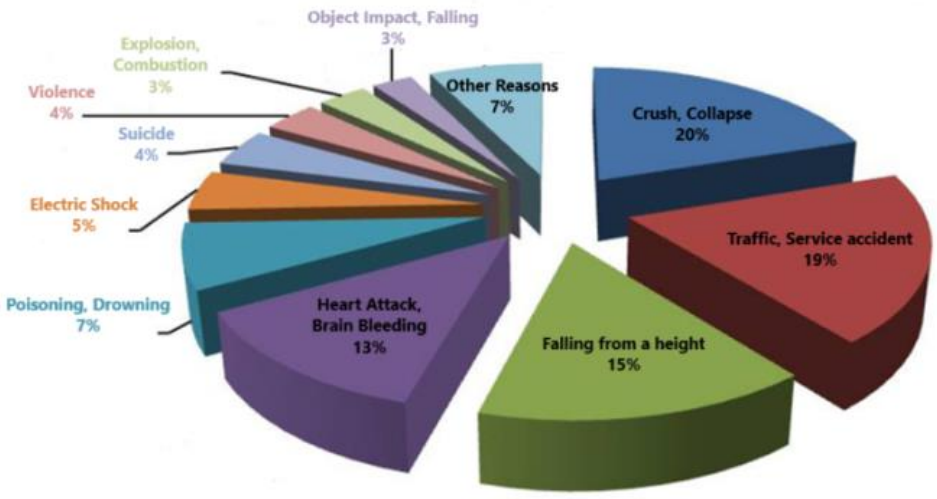


Figure 2 shows the distribution of occupational accidents in the construction sector in the first 6 months of 2024 according to the causes of death. Restoration works in historical buildings include all work items that can be encountered in construction works. In addition, it also has its own specific work items. For this reason, workers in this field also face different hazards and potential risks.

Figure 2: Distribution of fatalities due to occupational accidents in the construction sector in the first 6 months of 2024 by causes
(İş Sağlığı ve Güvenliği Yönetmeliği, 2024).



Although restoration works are considered as construction works, in order to continue successfully within the scope of occupational health and safety measures, it is necessary to determine the hazard and risk distinctions correctly, to analyze the existing risks correctly and to

determine how often the risks will be encountered (Özkılıç, 2005). In this way, it is aimed to prevent accidents and fatal accidents that employees are exposed to in this field.

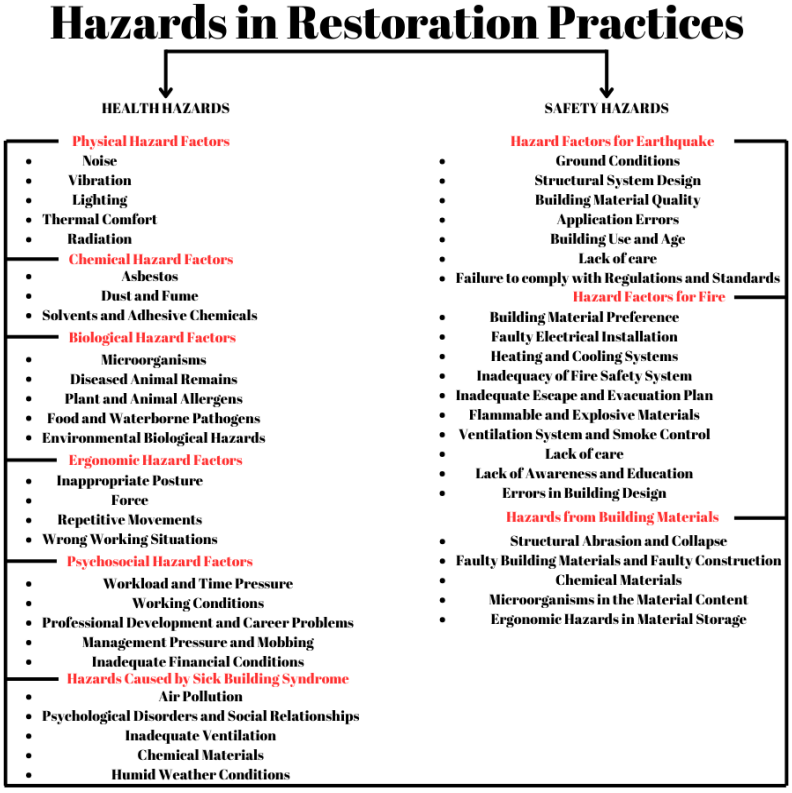
1. Material and Methods

In this study, terms, concepts and methods related to the subject are examined using the literature review method. Hazards and risks in restoration works are analyzed and tabulated. In order to develop the most accurate and applicable risk analysis in restoration practices in future studies, it is of great importance to distinguish between hazard analysis and health and safety risks in restoration practices. For this reason, the risks identified in the study are listed using check-list and job hazard analysis methods.

2. Detection of Hazards in the Restoration Process of Historic Buildings

Hazards are situations that may directly affect a person's health, may cause great harm or loss, and are likely to occur but undesirable (Özkılıç, 2005). During restoration works carried out for the protection of historical buildings, there are some hazards that employees, employers and visitors may encounter. Article 8, paragraph 1 of the *Occupational Health and Safety Risk Assessment Regulation* specifies the sources of information required to identify the hazards (Çalışma ve Sosyal Güvenlik Bakanlığı Yapı Yönetmeliği, 2013). In order to identify Occupational Health and Safety hazards, first macro information and then micro information should be analyzed and a detailed plan should be prepared based on this data and detailed according to the type, size and special determinants of the construction works (Güngördü et al., 2024). Based on the regulation, it is possible to classify the dangers we will encounter in restoration practices under two main headings on a macro scale. The main headings of *Health Hazards and Safety Hazards* will facilitate the hazard analysis in determining the risks we will encounter during restorations.

Figure 3: Classification of Hazards in Restoration Work
(Güngördü, 2024).



According to the *Building Regulation of the Çalışma ve Sosyal Güvenlik Bakanlığı Yapı Yönetmeliği of Turkey*, construction and implementation works should be evaluated together with construction works and other related legislations in order to be applicable in our country. Accordingly, annex 3 of the *Building Inspection Implementation Regulation* should include control forms for architectural, elevator, thermal insulation, plumbing and electrical projects. In the annexes of these control forms, the architectural project should include details such as site plan, floor plans, sections and elevations (Çalışma ve Sosyal Güvenlik Bakanlığı Yapı Yönetmeliği, 2013). These forms and projects show the techniques with which the building was constructed or revised, which is important for OHS. Especially restoration projects differ from construction projects in terms of special needs. And in our country, there is no rule or regulation that determines the method and order of construction of these construction works. For this reason, while making a project-based evaluation, implementation details gain importance. For example, when evaluating building gaps such as a lighting or elevator shaft in the project, it is of great importance to determine the risk of falling from height that may occur here and the measures that can be taken to eliminate this risk during the application. For this reason, these designs should be continuously reviewed in terms of occupational health and safety during the detailed design process of the project. All data

obtained from the application projects and the work site should be evaluated with hazard analysis and a safe design should be created (Çalışma ve Sosyal Güvenlik Bakanlığı Yapı Yönetmeliği, 2013). Analyzing the hazard depends on factors such as the size of the construction work, the dimensions and complexity of the project. According to the aforementioned regulation hazard analysis is respectively;

A. All architectural, electrical, insulation, elevator and installation projects must be drawn in detail.

B. Identify the planned business activities and their sub-activities and the estimated duration of these activities.

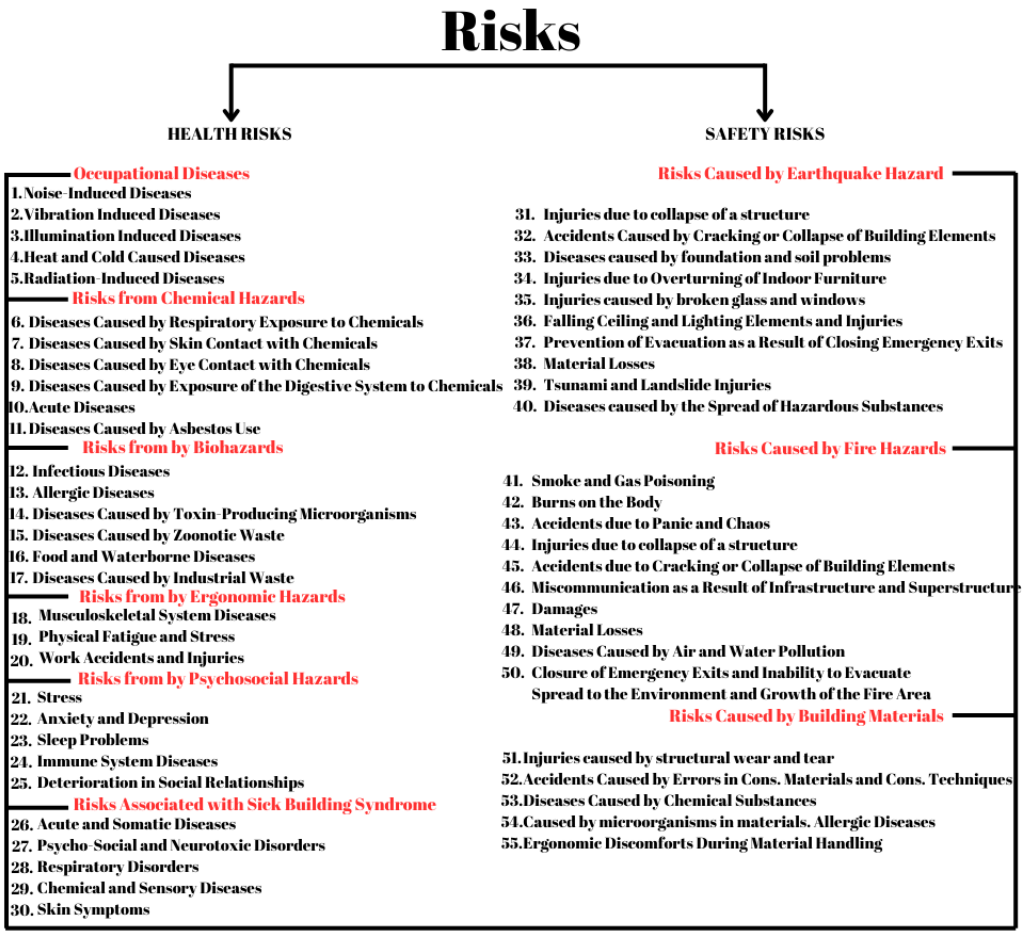
C. Sources of danger and relevant information should be compiled (Çalışma ve Sosyal Güvenlik Bakanlığı Yapı Yönetmeliği, 2013).

In particular work activities to be carried out, planned application methods and techniques, equipment to be used, material safety data sheets, hazards that may arise as a result of the processing, use, transportation, storage or disposal of materials with the risk of combustion, flash or explosion, the condition of the construction site and its surroundings, soil structure, seasonal weather conditions, hazards that may arise from equipment such as drainage, treatment, fire prevention and intervention equipment, hazards that may arise as a result of the hygiene conditions of the working environment and personal hygiene habits of employees, hazards that may arise from the use of transportation routes within the workplace are factors that should not be ignored. Based on these factors, the hazard factors in *Figure 3* were customized for restoration practices with a micro-scale approach.

3. Risks Related to Hazards in the Restoration Process of Historical Buildings

Risk is the combination of the probability of hazards occurring and the consequences when the hazard occurs (United States Environmental Protection Agency, 1991). Risk considers the potential effects of hazards and the likelihood of these effects. If necessary, precautions are not taken against hazards during restoration works, there are risks that these hazards may cause (Figure 4).

Figure 4: Grouping of Risks in Restoration Works
(Güngördü, 2024).



Risk is defined as the combination of the probability of an event or situation occurring and the potential consequences of that occurrence. Risk assessment involves identifying hazards and analyzing the probability and impact of these hazards (Aven, 2016). Analyzing the risks encountered in restoration practices is of great importance in terms of occupational health and safety. A detailed assessment of these risks is necessary to ensure the safety of workers and prevent occupational accidents. It is essential to create a risk management plan taking into account the likelihood of the identified risks and the negative consequences that may arise if these risks materialize. In this process, potential hazards should be identified at each stage of work activities and the risk levels of these hazards should be rated.

Figure 5: Risk Management Diagram
(Güngördü, 2024).

4. Risk Assessment Methodologies

Risk assessment can be briefly defined as the use of information and knowledge to guide decision-makers using various scientific methods (Aven, 2016). The risk assessment process aims to identify and analyze the significant hazards that a business or institution may encounter in its working life. The identified hazards are evaluated and then the control measures to be taken are determined. These measures are implemented within a plan and the ultimate goal is to eliminate the hazards. We can examine risk assessment methods under three main headings (National Institute for Occupational Safety and Health, 2023).

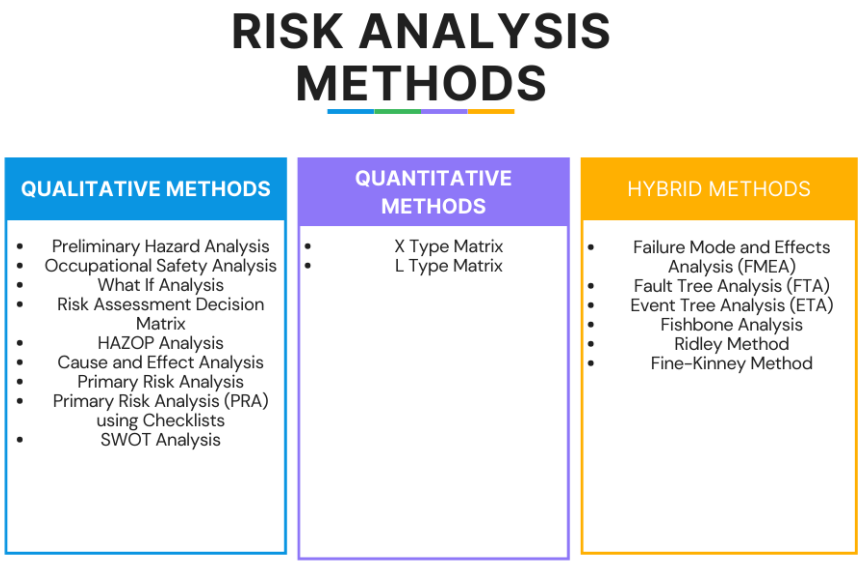
1. Qualitative Methods: It covers all assessment methods that focus on the qualitative assessment of risks.

2. Quantitative Methods: It is a method that aims to analyze risks with numerical data and covers all quantitative assessment methods.

3. Mixed (Hybrid) Methods: It is a risk assessment method that includes qualitative and quantitative methods and utilizes the advantages of both approaches.

The methods and strategies to be used in the risk assessment and management process may vary depending on the scope and complexity of the work. For example, in large-scale restoration projects, more detailed analyses can be performed using advanced clouding methods or simulation software. In small-scale projects, simpler and classical methods may be preferred. The main purpose of all these preferred methods is to minimize occupational health and safety risks and provide a safe working environment.

Figure 6: Risk Analysis Methods
(Güngördü, 2024).



The greater the capacity to manage risks in a restoration works and the more we can control risks, the more we can minimize losses.

5. Some Risk Analysis Methods that We Can Use in Restoration Works

In this section, practical, applicable and accurate risk analysis methods that we can use in restoration works, among the risk analysis methods specified in Figure 6, will be examined.

5.1.Job Safety Analysis

It aims to identify hazards before starting work and to prevent these hazards before they occur by focusing on work tasks. The focus is on the employee, work, tools and workplace. After the identification of hazards, it is based on bringing these hazards to an acceptable risk level or eliminating them completely (İş Güvenliği Analizi Nedir? , 2023).

For job hazard analysis;

-Workers should be included in the risk identification process.

-Previous accidents and near misses in the workplace should be examined and taken into consideration.

- Previous analyzes in the work area should be examined.

-Hazardous work items should be identified and graded.

-The identified hazards should be prioritized and the stages of the work should be established (Gümürçinler, 2023).

5.2. Primary Risk Analysis Using Checklist (PRA)

The Check-List method is a qualitative risk analysis method used especially in the construction and restoration sector to determine the compliance of the building with standards and codes. It can be used in inspections and approval processes starting from the design process (Meacham et al., 2021). The Check-List method consists of lists of hazards related to the special characteristics of a building or building class and is usually made more effective by using it in combination with different analysis methods (Ganah et al., 2015). Check-lists provide a basis for non-specialists to identify potential risks. They can be simple or, if necessary, detailed. Since the check-list method, which is a practical method, is not based on a mathematical formula, it is difficult to determine the severity of each hazard in the lists (Meacham et al., 2016). In construction and restoration work, it is important to determine the importance of each hazard and make it measurable. Therefore, using it together with *Fine-Kinney method* or *Matrix method* gives more precise results.

5.3. L Type Matrix

According to this method, also called 5X5 L-type matrix, the main objective is to analyze the relationship between two or more variables. The L-type matrix is used to determine a risk or the degree of impact of that risk. This method is very simple, understandable, easy and fast to apply and is a deterministic and quantitative risk assessment method (Karaelmas, 2019). It aims to find the risk level with the probability of realization of the risk (r) and the severity of the risk (s). Its formulation is Risk Level: I X S. In the L-type matrix method, the degree of risk is determined by multiplying the degrees of importance corresponding to each of the risk elements in the system. The decision matrix methods used in risk assessment are as follows;

- 5 x 5 (L-type) Decision Matrix
- 3 x 3 Decision Matrix
- Type X Decision Matrix

When applying this risk analysis method, a list of hazards is created by carefully examining the entire operation and workflow in the workplace and identifying every source of hazard that is likely to pose a risk, regardless of whether it is small or large. Probability and severity values are determined to determine the risk score of each hazard.

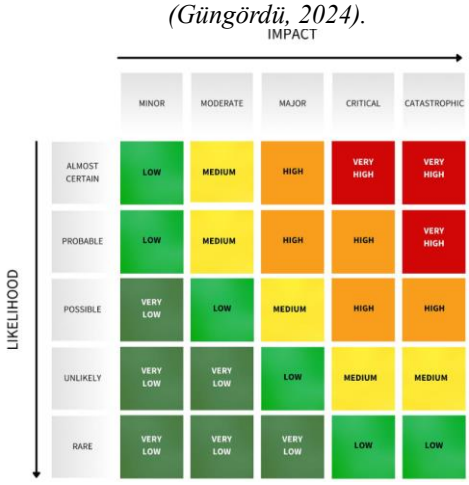
Figure 7: Probability of Hazard Realization
(Güngördü, 2024).

POSSIBILITY	SCORE
Very small (Almost never)	1
Small (Very few - once a year)	2
Middle (Less - several times a year)	3
High (Frequently - once a month)	4
Very High (Very often - once a week, every day)	5

Figure 8: Degree of Severity
(Güngördü, 2024).

SEVERITY / IMPACT	SCORE
Very Light (No loss of working hours, requiring first aid)	1
Lightweight (Loss of working hours, no loss of working days, requiring first aid)	2
Middle (Minor injury, requiring inpatient treatment)	3
Serious (Death or serious injury, long-term treatment or occupational disease)	4
Very Serious (Multiple deaths, permanent incapacity)	5

Figure 9: Risk Score according to type L matrix
(Güngördü, 2024).



5.4. Fine Kinney Risk Analysis Method

The 'Mathematical Evaluations for Controlling Hazards' method developed by W.T. Fine was revised by Kinney and Wiruth in 1976 and published under the title 'Practical Risk Analysis for Safety Managment' and is now practiced as the Fine-Kinney method (Şimşek et al., 2019). The Fine-Kinney method is a method that determines the prioritization of risks and where resources should be allocated, so it is a method that we frequently encounter in construction works. This

method, which decides the necessity of the measures to be taken by calculating the weight ratios of the risks, provides more realistic results by using workplace statistics (Oturakçı et al., 2015).

According to the *Fine-Kinney method*, severity (s), frequency (f) and probability (p) are needed to calculate the degree of risk. Probability is the likelihood that harm or damage will occur over time. Frequency refers to the frequency of exposure to the hazard. Severity is the estimated harm that the hazard will cause to humans or the environment (Erzurumluoğlu et al., 2015) *.RS is formulated as I x f x p.* It makes the risk assessment process more understandable as it provides mathematical data.

Figure 10: Fine-Kinney Method Severity Value
(Şimşek, 2020).

Severity	Significance
1	To be taken into account (insignificant, harmless or mild)
3	Important (minor damage, low work loss, first aid required)
7	Serious (loss of workforce, treatment, significant damage)
15	Very serious (environmental impact, loss of limb, disability)
40	Very bad (severe environmental impact, total disability, death)
100	Disaster (major environmental disaster, multiple deaths)

Figure 11: Fine-Kinney Method Frequency Value
(Şimşek,2020).

Frequency	Significance
0,5	Very rarely (once a year or less)
1	Extremely rare (once or a few times per year)
2	Rare (once or a few times per month)
3	Occasionally (once or several times a week)
6	Frequently (once or several times a day)
10	Continuous (continuously or more than once per hour)

Figure 12: Fine-Kinney Method Probability Value
(Şimşek,2020).

Probability	Significance
0,2	Practically pointless
0,5	Weak probability
1	Extremely low probability
3	Rare but possible
6	Highly probable
10	Very strong probability

In the *Fine-Kinney formula*, the severity, frequency and probability values and their meanings are selected from Figures 10-11 and Figures 12, while the value resulting from the multiplication reveals the risk assessment result.

Figure 13: Fine-Kinney Method Risk Value Chart
(Şimşek,2020).

Risk Score	Results
R < 20	Acceptable Risk (no immediate intervention required)
20≤R<70	Definite Risk (action plan required)
70<R<200	Significant Risk (should be included in the annual action plan and attention should be paid)
200<R<400	High Risk (should be included in short-term action plan)
R<400	Very High Risk (work must be stopped, immediate action must be taken)

In the risk assessment process, the degree of each risk is calculated using the frequency, probability and severity values shown in the charts. These values are compared with other risks and ranked in descending order. The risk with the highest score should be considered first in the scope of risk prevention and control activities. For this reason, the Fine-Kinney method primarily aims to manage the most serious and probable risks. The greater the capacities to manage and control risks, the more the damages are minimized.

6. Identification of Risks in Restoration Works

Restoration works, which are the renewal of buildings and building groups in historical environments and which have value in urban memory, seem to carry the same dangers and risks as construction works in some basic features so they have their own unique risks. If we classify all the risks that occur in restoration practices by blending check-list and job hazard analysis methods;

Figure 14: Risks identified in restoration works, precautions to be taken and risk values according to Fine Kinney Method *(Güngördü,2024)*

	No	**Risk Factor**	**Identified Risks**	**Risk Prevention Measures**	**Violence**	**Frequency**	**Possibility**	**Risk Score**
HEALTH RISKS	1	OCCUPATIONAL DISEASES	Hearing loss that may occur on employees due to noise sources resulting from the use of machinery such as hammers and drills.	-Noise measurements should be made during machine use.-Employees must use PPE	15 (Very Serious-Limb Loss)	6 (Frequency - Once or Several Times a Day)	6 (Highly Possible)	540
	2		Diseases caused by vibration exposure during restoration work	-Vibration measurements should be made	7 (Serious Signific	6 (Frequency -	3 (Rare but possible)	126

			when workers use crushing, drilling and mixing machines (such as hand-arm vibration syndrome, osteoarthritis and muscle diseases)	during machine use.-Employees should work in accordance with the 2-4 second waiting period.-Use of PPE by employees	ant damage external treatment)	Once or Several Times a Day)		
	3		Eye and dermatological diseases caused by direct exposure to natural lighting sources in the work area (especially in exterior and roof works)	-Revise working hours according to the times when the sun's rays are at their strongest.-Use of PPE	3 (Important - minor damage requiring first aid)	3 (Now and again)	3 (Rare but possible)	9
	4		Diseases such as dizziness and vomiting that occur as a result of heat and cold to which workers are exposed in exterior works.	Programming working hours to avoid very hot and very cold hours-Using protective equipment and clothing against heat and cold-Employees should take breaks at regular intervals in protected rest areas.	3 (Important - minor damage requiring first aid)	2 (Rare)	0.5 (Weak probability)	3

	5		Lung diseases caused by worker exposure to radiation	-Use of dosimeters to control radiation levels of employees - Regular control of the health status of employees- Implementation of safety protocols regarding the safe use and protection of radiation sources.	100 (Disaster - Major environmental disaster multiple disabilities or death)	1 (Very Rare)	1 (Very low probability)	100
	6	RISKS CAUSED BY CHEMICAL HAZARDS	Employees are exposed to various chemicals found in insulation materials such as concrete mixtures, paints, and adhesives through inhalation.	-Employees must use advanced filter masks.- Providing air circulation in the work area- Regular control of insulation materials	15 (Very Serious- Limb Loss)	6 (Frequency - Once or Several Times a Day)	6 (Highly possible)	540
	7		Injuries, skin diseases or toxic disorders that may occur as a result of contact with chemical particles produced during work such as	- Use of N95 or P3 type mask to prevent chemical from passing through the respiratory tract.-	15 (Very Serious- Limb Loss)	6 (Frequency - Once or Several	6 (Highly possible)	540

			grinding, drilling and cutting.	Use gloves to avoid skin contact		Times a Day)		
	8		Eye irritation, temporary and permanent vision disorders caused by contact of chemical gases with the eyes during welding and spray painting operations.	-Use of glasses during work to protect eye health -Preventing the spread of particles by using local suction systems in welding work areas.	15 (Very Serious-Limb Loss)	6 (Frequency - Once or Several Times a Day)	6 (Highly possible)	540
	9		Poisoning that may occur as a result of contact of cleaning chemicals used on construction sites with food and subsequent consumption by the worker.	-Correct storage of food and chemicals on site-Planning of cleaning works-Use of PPE by those working with chemicals	3 (Important - minor damage requiring first aid)	0.5 (Very Rare)	0.5 (Weak probability)	0,75
	10		Acute diseases that may occur as a result of continuous exposure of the worker to dust at the construction site	-Optimization of stone processing to reduce dust generation and protection against dust falling from heights-Use of PPE-Employee's personal hygiene,	3 (Important - minor damage requiring first aid)	6 (Frequency - Once or Several Times a Day)	10 (Very strong possibility)	180

				change of clothes after work				
	11		Since historical buildings were built with old construction techniques, the use of asbestos as insulation material and exposure to asbestos	Asbestos must be removed by professionals.Working a small number of elements in a controlled and rotating manner during this removal.-Use of PPE	100 (Disaster - Major environmental disaster - multiple disabilities or death)	1 (Very Rare)	3 (Rare but possible)	300
	12	RISKS CAUSED BY BIOLOGICAL	Infectious diseases such as flu, cold and tuberculosis are seen among the workers who work in closed environments.	-Regular cleaning of construction sites-Vaccination of employees and regular health -Employees must comply with social distancing rules	3 (Important - minor damage requiring first aid)	3 (Now and again)	6 (Strong probability)	54
	13		Allergies and irritations on the skin caused by toxins originating from plants such as ivy, oak, sumac, nettle in buildings that have lost their user base and have	-Employees must avoid contact with unknown plants. -Choosing appropriate clothing and PPE	3 (Important - minor damage requirin	2 (Rare)	3 (Rare but possible)	18

			been neglected in natural environments.	-Regular allergen testing of employees	g first aid)			
	14		Skin and immune system disorders that will occur as a result of the wastewater accumulated on the ground or the rusting and chemical substance accumulation in the iron fittings in the working environment and the occurrence of infectious microorganisms as a result of the historical environments remaining idle for a long time.	- Regular checks of iron reinforcement for rust -Performing necessary disinfections to prevent the spread of microorganisms -Regular cleaning of waste water on the ground	3 (Minor damage requirin g first aid)	1 (Very Rare)	1 (Very Low Probabilit y)	3
	15		Since the study area is far from the city campus and has long been abandoned structures and environments, animal waste and residues can be encountered. This can cause diseases such as parasites, e.coli, salmonella and leptospirosis.	Proper collection and disposal of animal waste -Cleaning the work area with disinfectants- Regular ventilation of the work area and removal of waste gases	3 (Importa nt - minor damage requirin g first aid)	1 (Very Rare)	3 (Rare but possible)	9

				- Regular health checks and vaccinations of employees.				
	16		Poisoning caused by foods consumed in the work environment	-Hand cleaning before preparing food -Cleaning and proper storage of nutritional foods- Cleaning of the kitchen where meals are prepared- Cooking temperature of foods-Health checks of food preparation workers- Regular food inspections	3 (Important - minor damage requiring first aid)	0.5 (Very Rare)	3 (Rare but possible)	4,5

	17		Hearing disorders and psychological disorders caused by air pollution or high noise in the working environment.	-Use of ventilation systems, air purifiers and masks -Regular measurement of noise levels, use of noise reduction panels and use of PPE -Preventing the employee from working in the same position for a long time	3 (Important - minor damage requiring first aid)	0.5 (Very Rare)	3 (Rare but possible)	4,5
	18	RISKS CAUSED BY ERGONOMIC HAZARDS	Musculoskeletal disorders such as tendon disorders and spinal disorders that may occur as a result of the employee not paying attention to the required waiting time (2-4 seconds) during material handling and	Informing the employee about lifting heavy loads with correct lifting techniques. -Use of ergonomic equipment for transportation	7 (Serious - Significant damage external treatment)	6 (Frequency - Once or Several Times a Day)	6 (Highly possible)	252

			lifting or vibrator work during construction site work.	(wheelbarrow, forklift) -Providing physiotherapy support to employees suffering from muscular system disorders				
	19		Physical fatigue and stress caused by reasons such as employees working in narrow spaces without proper body posture, which is caused by the dimensions of old buildings not being up to today's standards.	-Providing support to employees with seminars on stress management and regular health checks -Use of adjustable and ergonomic equipment for use in narrow spaces -Workers working in confined spaces should take more frequent breaks.	1 (Insignificant, harmless - light)	0.5 (Very Rare)	3 (Rare but possible)	1,5
			Accidents and injuries resulting from	-Employees must use PPE items	7 (Serious -	6 (Frequency -	6 (Highly possible)	252

	20		employees working at heights	such as seat belts and helmets. -High working platforms or scaffolding must have appropriate guardrails and these platforms must be checked regularly. -Employees should receive safety training on working at heights and emergency situations.	Significant damage external treatment)	Once or Several Times a Day)		
	21	PSYCHOSOCIAL HAZARDS	Employees are stressed due to reasons such as working conditions, not taking regular breaks, salary dissatisfaction, et al.	-Working conditions should be improved, regular breaks should be provided, salaries and job satisfaction, stress management and support should be provided.	1 (Insignificant, harmless - light)	0.5 (Very Rare)	3 (Rare but possible)	1,5

	22		Anxiety attacks and related depression caused by the person's living and working conditions	-Provision of psychological support, regular breathing exercises, improvement of the employee's sleep pattern should be ensured.	3 (Important - minor damage requiring first aid)	0.5 (Very Rare)	3 (Rare but possible)	4,5
	23		Reasons such as noise, physical fatigue, work pressure, et al. that the employee is exposed to in the working environment cause insomnia.	-Taking measures to reduce noise in the construction site -To prevent physical fatigue of the employee, give regular breaks, do physical exercises and stretching movements, -To manage and control the workload among employees correctly -Sleep hours should be regularized, the	3 (Important - minor damage requiring first aid)	0.5 (Very Rare)	3 (Rare but possible)	4,5

				sleep environment should be improved and relaxing activities should be done before sleep.				
	24		Immune system disorders occur as a result of exposure of the worker to substances such as solvent vapors, oxidation of metals, solder or welding fumes, silica dust, lead particles and the sun.	-Employees use appropriate PPE-Regularly checking the air quality of the environment and keeping it clean with air purifiers-Employees should have regular health checks and receive treatment in case of any illness.	7 (Serious - Significant damage external treatment)	6 (Frequency - Once or Several Times a Day)	6 (Highly possible)	252
	25		Deterioration of social relationships as a result of working in a stressful work environment	-Social activities taking place in the workplace and full participation of employees in them should be ensured.	1 (Insignificant, harmless - light)	2 (Rare)	3 (Rare but possible)	6

				-Maintaining the balance between work and time management among employees -Regular breaks and activities can be motivating				
	26	RISKS CAUSED BY SICK BUILDING SYNDROME	All of the symptoms that are experienced specifically and regularly while working in a building but disappear when the building is left are called 'sick building syndrome' (9). Sick building syndrome occurs when triggered by factors such as the person's gender , atopy and history of disease. The most common discomforts that occur as a result of the historical building showing sick building syndrome on the	-Keeping the air quality of the work environment healthy, regularly monitoring the cleanliness of the ventilation - The chemical paints and adhesives used in the work area for a long time should not contain air pollutants and masks should be used when working with these materials.	7 (Serious - Significant damage external treatment)	6 (Frequency - Once or Several Times a Day)	6 (Highly possible)	252

			employee are; irritated throat and runny nose , itchy eyes, burning eyes and upper respiratory tract, itching and skin irritation.	- Evacuating stale and polluted air indoors by using plants indoors				
	27		Sick building syndrome can cause headaches, irritability, nervous breakdowns and distractions in the employee.	-If there are devices emitting radiation in the building, they should be detected and removed from the building. -If regular maintenance of electronic devices within the building is required, all devices should be gathered in one room and only used for short periods of time.	3 (Important - minor damage requiring first aid)	0.5 (Very Rare)	3 (Rare but possible)	4,5
	28		As a result of sick building syndrome, employees may experience shortness of breath, cough, allergic asthma and wheezing.	-Keeping the air quality of the work environment healthy, regularly monitoring the	7 (Serious - Significant damage	6 (Frequency - Once or Several	6 (Highly possible)	252

				cleanliness of the ventilation - The chemical paints and adhesives used in the work area for a long time should not contain air pollutants and masks should be used when working with these materials. - Evacuating stale and polluted air indoors by using plants indoors	external treatment)	Times a Day)		
	29		Sick building syndrome can cause odor sensitivity, hearing impairment, and vision problems.	-The interior should be illuminated correctly and maximum efficiency should be obtained from the natural light source. -Employees should perform eye resting	3 (Significant damage external treatment)	6 (Frequency - Once or Several Times a Day)	6 (Highly possible)	108

				movements at certain intervals. computers, cameras or monitors to use a screen filter or glasses if they need to balance the screen brightness.				
	30		It can cause skin problems, allergies, rashes, redness, dryness and itching in the employee.	-Regular cleaning is required to prevent the formation of organisms such as mold, fungus and dust that cause skin irritation. -Employees must use preventive PPE such as gloves.	3 (Important - minor damage requiring first aid)	6 (Frequency - Once or Several Times a Day)	6 (Highly possible)	108
SECURITY RISKS	31	RISKS CAUSED BY EARTHQUAKE HAZARDS	Injuries and disabilities that may be caused by partial or total collapses as a result of the weakening of the load-bearing system in the structure.	- Early detection of construction-related weaknesses-New construction design, both reinforcement and	15 (Very Serious – environmental impact loss of	2 (Rare)	3 (Rare but possible)	90

				reconstruction- Regular control, protection and maintenance of reconstructed sections	limbs or disability)			
	32		Injuries and injuries due to damage, cracking or collapse of structural elements such as columns, pillars and vaults due to earthquakes and landslides caused by these earthquakes.	-Regular monitoring of load-bearing structural elements -Strengthening of columns and pillars with chemical or physical elements -Control and maintenance of carrier elements -Connecting the load-bearing structural elements with flexible connections that will absorb the earthquake.	15 (Very Serious – environmental impact loss of limbs or disability)	2 (Rare)	3 (Rare but possible)	90
	33		Accidents and injuries that may occur as a result of damage to the building foundation and	-Soil stabilization -Strengthening the foundation with methods	15 (Very Serious –	2 (Rare)	3 (Rare but possible)	90

			damage to the integrity of the building as a result of ground slides after an earthquake.	such as reinforced concrete sheathing and fiber polymer. -Supporting the ground using earthquake shields and reducing damage by distributing the earthquake load.	environ mental impact loss of limbs or disabilit y)			
	34		Damages that may occur as a result of the collapse of unfixed interior elements within the structure as a result of an earthquake.	- Simulating potential damage from an earthquake with dynamic analysis and modeling -Fixing unfixed interior elements -Making interior elements durable and dynamic	3 (Importa nt - minor damage requirin g first aid)	3 (Now and again)	6 (Highly possible)	54
	35		Injuries to the skin caused by the explosion and breakage of	-During the design, the reinforcement of	7 (Serious -	1 (Very Rare)	3 (Rare but possible)	21

			weakened glass in windows during an earthquake	the glass should be planned (an additional glass layer can be added inside or outside the glass.) -Regular checks on glass surfaces for cracking or weakening and reinforcement is carried out. -Increasing the load-bearing capacity of glass surfaces	Significant damage external treatment)			
	36		Falling of roof elements such as domes and gargoyles of old buildings or lighting elements on the ceiling as a result of earthquakes or earthquake-related ground damages and injuring workers.	-First, the structure analysis is done and the damaged areas are listed as a detailed inventory.- Repairing damaged areas with materials such as wood and stone in accordance with the construction technique.Strengt	3 (Important - minor damage requiring first aid)	1 (Very Rare)	3 (Rare but possible)	9

				hening the weak point by adding modern architectural carrier or supporting elements to the design.				
	37		Partial collapse during an earthquake resulting in the closure of building exits and the inability to evacuate employees	-Design and strengthen the carriers in the emergency exit line using durable and flexible materials. - Planning exit axes and doors that provide easy access to multiple open areas within the building -Preparation and updating of comprehensive emergency plans in the construction site	15 (Very Serious – environmental impact loss of limbs or disability)	1 (Very Rare)	3 (Rare but possible)	45
			Material loss due to damages caused by the earthquake	-Providing safety training to employees-Use of PPE by	1 (Insignificant,	0.5 (Very Rare)	3 (Rare but possible)	1,5

	38			employees reduces the risk of injury-Regular control of the structure, detection of potential damage and precautionary measures-Correct storage, regular maintenance and repair of construction materials	harmless - light)			
	39		Earthquake aftershocks causing other major disasters such as landslides and tsunamis	-Detecting dangerous points where landslides may occur and establishing settlements at these points using bridges or tube systems.-In areas with tsunami risk, risky points can be identified through topographic studies and prevention dams	15 (Very Serious – environmental impact loss of limbs or disability)	1 (Very Rare)	3 (Rare but possible)	45

				or dams can be established at these points. -Alarm systems can ensure that employees are informed at the same time and evacuation can be accelerated.				
	40		Damage to workers caused by the spread of hazardous substances that may occur from falling/broken structures or interior materials after an earthquake.	-During the preparation of emergency plans, the material content of the building and interior elements and hazardous material determinations should be made. -Preventing the spread of hazardous substances indoors with air purification systems -Employees should be provided with	7 (Serious - Significant damage external treatment)	1 (Very Rare)	3 (Rare but possible)	21

				emergency and intervention training and contingency planning in case of exposure to hazardous substances.				
	41	RISKS CAUSED BY FIRE HAZARDS	The employee may experience respiratory problems as a result of the spread of gases such as smoke, carbon dioxide, nitrogen and carbon monoxide after the fire.	-Gas management systems keep the gas spread under control after the fire in the structure and prevent it from spreading into the atmosphere. -Post-fire monitoring limits the spread of gases	7 (Serious - Significant damage external treatment)	1 (Very Rare)	3 (Rare but possible)	21
	42		Burns occurring on the employee's body	-Employees should receive	7	1	3	21

				first aid training and provide quick and correct first aid in case of burns. -In burn cases, medical support should be sought immediately and injured workers should be taken to the hospital.	(Serious - Significant damage external treatment)	(Very Rare)	(Rare but possible)	
	43		Chaos that occurs after the panic experienced by employees during the fire makes evacuation difficult.	-Providing fire safety training to employees and conducting regular drills-Emergency evacuation plans should be prepared and evacuation axes should be established during training. Employees should be trained in preventing the spread of fire and extinguishing it, thus ensuring	15 (Very Serious – environmental impact loss of limbs or disability)	1 (Very Rare)	3 (Rare but possible)	45

				rapid evacuation without chaos.				
	44		Difficulty in evacuation and injuries due to partial or total collapse of the structure after a fire	-During the restoration, material choices such as fire-resistant concrete, composite and steel can be added to the design. -Covering of building carriers with fire insulation -Use of fire extinguishing and sprinkler systems	15 (Very Serious – environmental impact loss of limbs or disability)	1 (Very Rare)	3 (Rare but possible)	45
	45		Injuries and disabilities, especially as a result of damage, cracking or collapse of structural elements such as wooden columns, pillars and vaults, as a result of fire.	-Preferring materials with high fire tolerance during design -If wooden material is to be used due to design, it must be insulated.	7 (Serious - Significant damage external treatment)	1 (Very Rare)	3 (Rare but possible)	21
	46		Lack of communication following damage to the	Emergency plans should be	15	1	3	45

			infrastructure and superstructure system due to fire	prepared and employees should be trained Considering the possibility of the main communication system being cut off, a backup communication system such as radio and satellite phones should be considered. Emergency assembly areas should be determined on the construction site.	(Very Serious – environmental impact loss of limbs or disability)	(Very Rare)	(Rare but possible)	
	47		Material loss due to damages caused by fire	-Employees receive fire safety training-There should be a sufficient number of fire extinguishers on the site and their regular maintenance and inspection should	3 (Significant damage external treatment)	1 (Very Rare)	3 (Rare but possible)	9

				be carried out.- Installation of fire detection and warning systems in the construction site- Fire insurance for the construction site				
	48		Health problems such as poisoning and burns that employees and the surroundings will experience as a result of air and water pollution caused by the fire.	-Establishing effective ventilation systems that can quickly evacuate smoke and toxic gases generated during a fire.- Appropriate gas masks and respiratory protection must be provided for employees. Storage of chemical materials to prevent chemicals from mixing with water resources	7 (Serious - Significant damage external treatment)	1 (Very Rare)	3 (Rare but possible)	21

				in the event of a fire. Employees should receive first aid training and a first aid kit should be available at the construction site. Proper disposal of the generated waste.				
	49		Problems that may occur in evacuating employees as a result of damage to structural elements such as wooden stairs or blocking of exits during a fire.	-Adding fire-resistant doors and fire escapes to the structure Insulation of structural elements that are important for evacuation, such as stairs, with strong insulation materials. Developing alternative emergency evacuation routes to the closure of main exits and marking these	15 (Very Serious – environ mental impact loss of limbs or disabilit y)	1 (Very Rare)	3 (Rare but possible)	45

				plans on the construction site.				
	50		Chemical building materials such as paint and adhesives that should be used specific to the historical structure exacerbate the fire	- Using materials that prevent fire development instead of materials that accelerate fire development.Historical buildings should undergo regular checks to ensure the safety of electrical and gas installations.Correct storage of materials	15 (Very Serious – environmental impact loss of limbs or disability)	1 (Very Rare)	3 (Rare but possible)	45
	51	RISKS ARISING	Structural wear and tear resulting from the use of cheap, inadequate or unsuitable materials may cause accidents and injuries.	-Durable and reliable material selection -To procure materials from reliable, certified vendors. - Regular quality controls of building materials and building elements	7 (Serious - Significant damage external treatment)	2 (Rare)	3 (Rare but possible)	42

	52		The employee may experience spinal cord disorders, skin or vision disorders due to the construction material and application techniques.	-Making material choices according to the intended use of the building. -Employees are trained on the application of the material -The correct use of materials can be controlled by regular controls and inspections during the work.	3 (Significant damage external treatment)	2 (Rare)	3 (Rare but possible)	18
	53		The chemical materials used cause skin irritation and respiratory tract disorders.	-Employees must receive chemical substance training and pay attention to safety instructions. -Use of PPE -Preparing an emergency plan for possible discomfort caused by working with chemicals.	7 (Serious - Significant damage external treatment)	2 (Rare)	3 (Rare but possible)	42

	54		Redness and itching on the skin as a result of the microorganisms contained in the building materials having an allergic effect on the worker's body.	-Use of PPE - Regular cleaning of the work area -Regular ventilation of the work area	3 (Significant damage external treatment	2 (Rare)	3 (Rare but possible)	12
	55		Disorders such as joint and back pain, herniated disc, neck hernia may occur as a result of the employee carrying the material incorrectly while stacking.	-Training of employees on material use and storage in construction sites-Using auxiliary transport vehicles such as forklifts and wheelbarrows	7 (Serious - Significant damage external treatment	2 (Rare)	3 (Rare but possible)	42

7. Results and Discussions

Restoration activities, one of the methods of protecting historical buildings, are a reconstruction method that includes the general characteristics of construction work, but it is one of the specific activities with its own risks. As much as restoration practices are necessary for historical buildings, supervision of occupational health and safety practices in restoration works is just as necessary in terms of user, employee and workplace safety. Figure 14 shows the risk assessments together with their scores. As a result of the study, the results obtained by multiplying these scores are ranked from the largest to the smallest and the urgency of the measure is determined. According to Figure 14, No 1-6-7-8 risks are among the most prioritized risks that need to be taken precautions. Restoration works are unique projects. For this reason, the special situation of restoration activities was addressed in the study and hazards and risks specific to this field were identified. As a result of the study, it was emphasized that the measures to be taken for

those working in the field of restoration should be prioritized according to the risk scores and the necessary measures should be taken urgently.

Conclusion

The study draws attention to the hazards and risks that are specific to restoration work and highlights the similarities and differences between construction and restoration activities. Considering these, 55 risks were identified on the subject of the study and these risks were rated using the severity, frequency and probability values of the *Fine Kinney Method*, which has been proven to be accurate in the literature. The aim of the article is to prioritize the necessary measures to be taken according to the results obtained by enabling those who will work in this field to easily analyze the risk detection. As a result, it is evaluated that the hazards and risks identified in restoration activities and the selected risk analysis methods can pioneer and support new projects to be developed in this field and other academic studies to be included in the literature.

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