Islamic Republic of Iran

Iranian Ministry of Cultural Heritage, Tourism & Handicrafts

MCTH

State of Conservation report of Meidan Emam, Esfahan World Heritage Site

UNESCO

World Heritage Convention

Tehran 2020

In the name of God

3. **<u>Requests</u> the State Party, as a matter of high priority, to submit the completed Conservation and Management Plan of the property to the World Heritage Centre, for review by the Advisory Bodies prior to its adoption and implementation;**

   The 2nd phase of the Conservation and Management Plan is under development, the outline of which is presented in appendix 1. The final version of the plan will be provided as soon as completion and gaining required confirmation by MCTH in a few months.

4. **<u>Also requests</u> the State Party to submit to the World Heritage Centre the detailed plans and technical documents concerning the physical interventions with potential impacts on the Outstanding Universal Value (OUV) of the property, which are included or not included in the draft Conservation and Management Plan prior to its finalization or implementation, for review by the Advisory Bodies, ensuring that it includes an assessment of the property's vulnerability to disasters such as earthquakes or fires, and a systematic strategy for disaster risk reduction;**

   Hereby, the MCTH announces that any further interventions concerning the physical attributes of the site with major impacts on the site or its OUV will be provided as separate reports before any implementation. However, the final integrated conservation and management plan including Disaster management plan was supposed to be provided for consideration of the committee by the deadline of 1 December. Yet, due to the critical condition that the pandemic created, the field studies postponed for a while. Nevertheless, the final version will be submitted as soon as possible within a few months.

5. **<u>Further requests</u> the State Party to submit to the World Heritage Centre, for review by the Advisory Bodies, and before any further implementation of works is undertaken:**

   1. **Information on the development of the spatial structure for the motorized and pedestrian roadways for visitors to the property,**

   2. **Detailed information on further planned reorganization of the sewage system within the property and its buffer zone;**

   A Disaster Management Plan is currently underway for the whole heritage site and its built structures. The plan includes the evaluation of the spatial structure and the risks due to water and sewage systems, in addition to other existing risks, to the site.

   As part of the plan, the investigation and reorganization of the property's water system and sewage system has already been started.

   Different phases are envisaged in the reorganization plan of the water system and sewage system. In the first phase, the data and information available on the property's water system and sewerage system are collected from the organizations

responsible for water and wastewater. At the same time, a field study is ongoing to review the data and supplement the information.

The initial draft of the report entitled Disaster Management Plan for the World Heritage Site of the Emam Square including the Reorganization of the Water and Sewage Systems within the Emam Square and its Buffer zone is attached as the appendix 2. The plan is expected to be completed within the next few months.

6. **<u>Requests furthermore</u> the State Party to submit:**

    1. **Details of any planned anti-earthquake consolidation projects to the World Heritage Centre, for review by the Advisory Bodies, before their implementation,**

    2. **Architectural and photographic details of the anti-earthquake consolidation that is implemented to the Ali Qapu Pavilion and other built structures in the property;**

Ali Qapu edifice has undergone two major restoration works. The first and more comprehensive restoration was carried out in the 1960s and 1970s and focused on the main masonry building. The restoration work on the wooden columnar structure remained incomplete. The main purpose of the restoration work was to retrieve the integrity of the masonry part, which was in a non-stable condition. Therefore, the seismic rehabilitation of the building was not the objective of restoration.

The second restoration of Ali Qapu was undergone from 2005 to 2017 and it was concentrated on the wooden columnar structure and its supporting veranda. The main purpose of the work was to repair the damaged wooden part as well as the structural rehabilitation of the wooden structure.

Seismic rehabilitation was not the objective of restoration works of Ali Qapu in the 1960s and 2000s, therefore a separate seismic rehabilitation project must be carried out in the near future after a precise priority study within the risk management plan, not only on Ali Qapu but also other architectural monuments of the square.

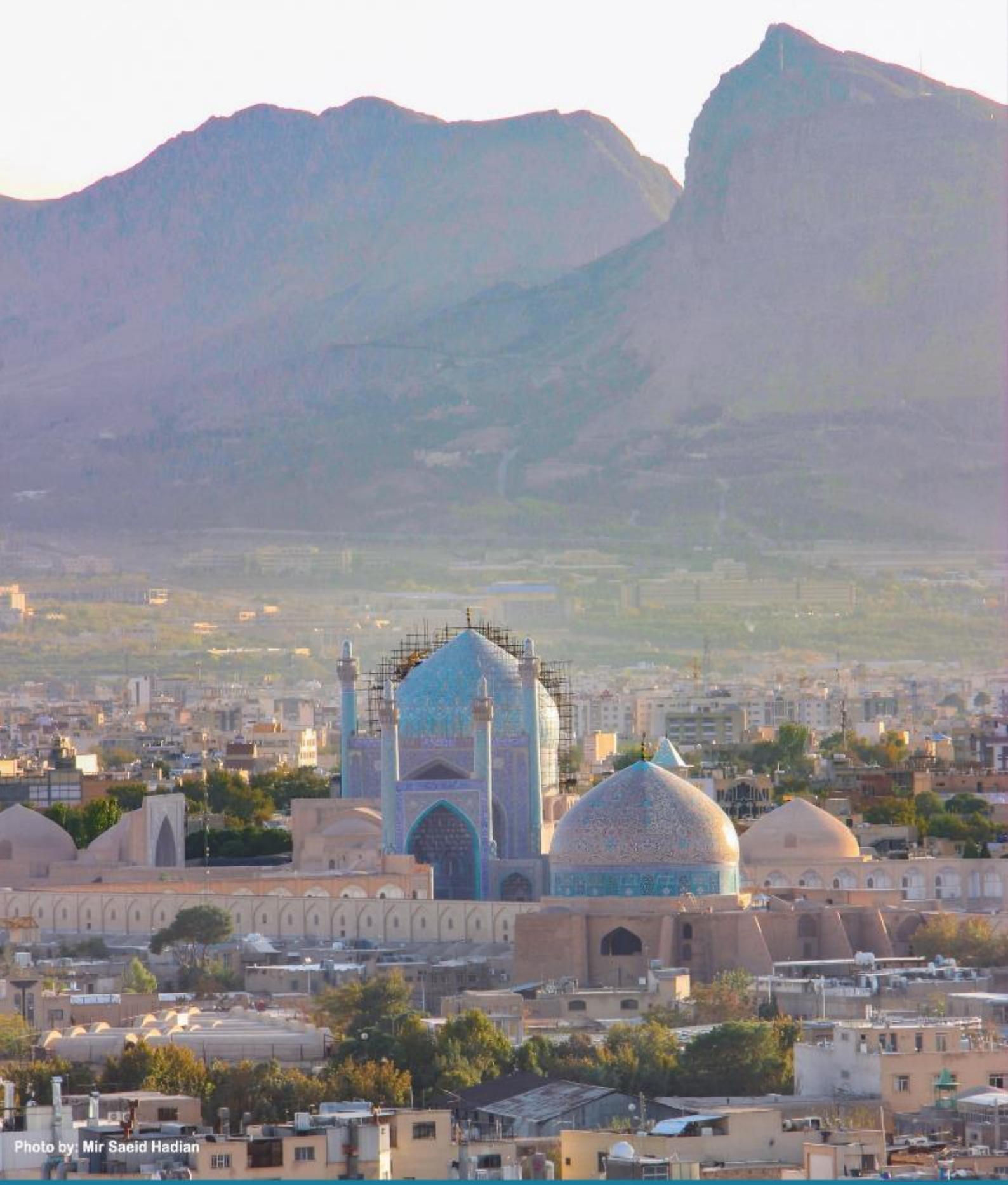
A Disaster Risk Management Plan (DRMP) is currently underway for the whole heritage site and its built structures. The DRMP includes the evaluation of earthquake risk, in addition to other existing risks, to the monuments. The geotechnical and seismotectonic studies have also been included.

After completion of the DRMP and the prioritization of the risks, a number of seismic rehabilitation projects will be proposed for the built area of the property within the framework of an action plan.

The report entitled “Disaster Risk Management Plan (DRMP) for the World Heritage Site of Emam Square, including mitigation Measures in the event of an earthquake for Ali Qapu pavilion and Other Built Structures of the square” is attached.

7. **<u>Reminds</u> the State Party of the requirement to submit to the World Heritage Centre, for review by the Advisory Bodies, detailed information, including Heritage Impact Assessments (HIAs), for any large tourism and/or development projects, which have a potential to impact the OUV of the property, in accordance with Paragraph 172 of the *Operational Guidelines* before works commence or any irreversible decision is made;**

   Hereby, MCTH announces that in case of any further interventions, large tourism activities and/ or development projects that may have major impacts on OUV of the site or its attributes, an HIA report will be developed and submitted as the matter of priority.



MEIDAN EMAM WORLD HERITAGE SITE

DRAFT MANAGEMENT PLAN

1400/2021 - 1405/2026

پایگاه میراث جهانی میدان امام اصفهان
MEIDAN EMAM WHS

Meidan Emam, Esfahan World Heritage Site

Property	**13 (ha)**
Buffer zone	**57 (ha)**
open space dimensions	**510×160 (m)**
Latitude	**51°40′49″E**
Longitude	**32°39′26″N**
Significant historic monuments	**4 monumental buildings**
Inscription	**1979**
Criteria	**Cultural: (i)(v)(vi)**

United Nations
Educational, Scientific and
Cultural Organization

World
Heritage
Convention

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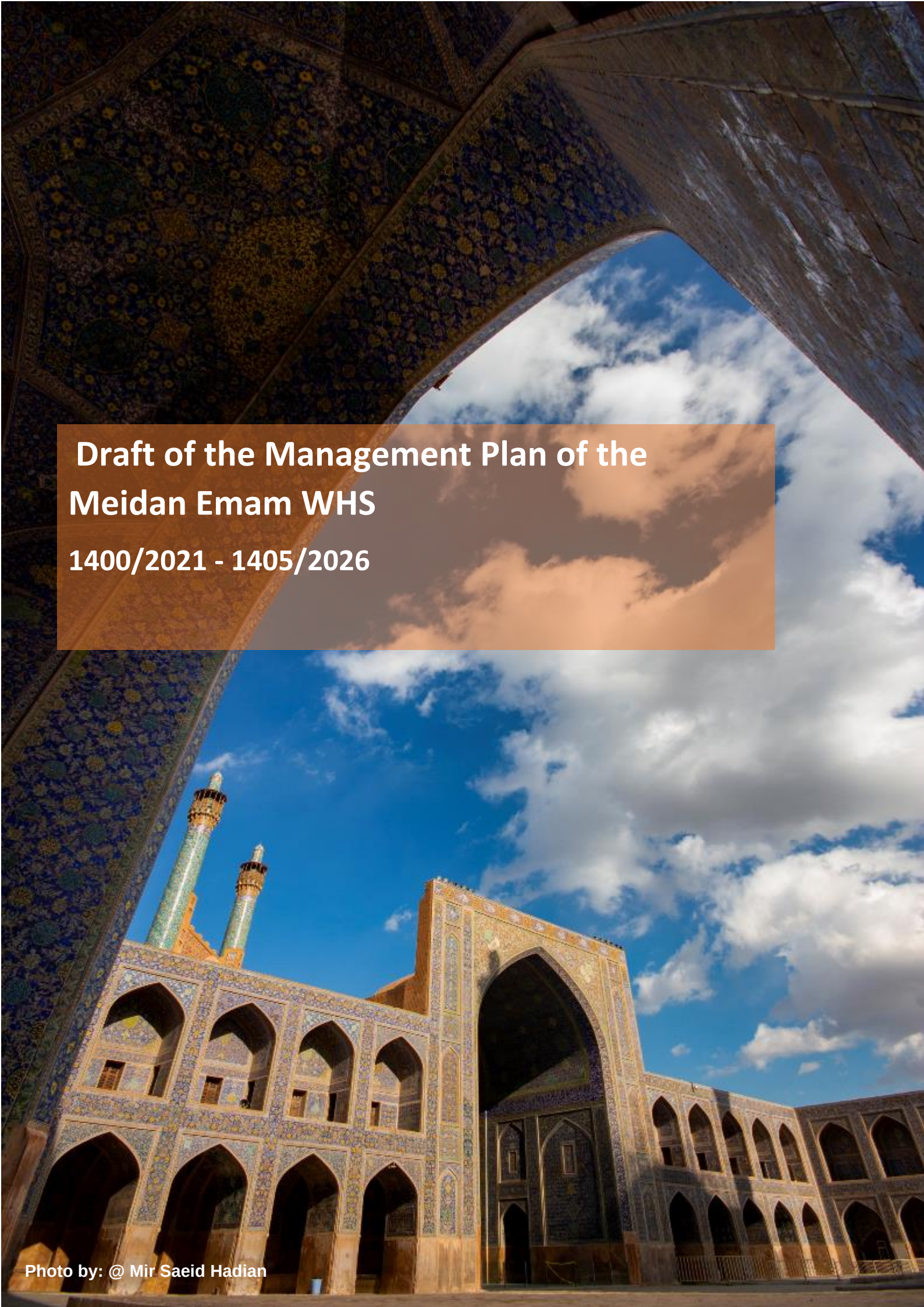


Draft of the Management Plan of the Meidan Emam WHS

1400/2021 - 1405/2026

Photo by: @ Mir Saeid Hadian

The necessity of a Management Plan

UNESCO's Operational Guidelines for the Implementation of the World Heritage Convention (2019), article 108 states, "each nominated property should have an appropriate management plan or other documented management system which must specify how the Outstanding Universal Value of a property should be preserved, preferably through participatory means."

On the basis of Guideline, the Iranian Ministry of Culture Heritage, Tourism and Handicrafts (MCTH) as the representative of I.R of Iran, considered all the sites to update their initial Management Plan.

Meidan Emam WHS is part of a dynamic historic urban environment at the center of Safavid planned development of the Esfahan city. However, the evolving city and its new development around the intact property and its buffer zone must be taken into consideration.

The very nature of the site, the multiple ownership, engaged parties, agencies and organizations that are involved in the management of the site provided a complex and interwoven situation. As such, it is essential to have a Management Plan to take a holistic and strategic approach and to establish a shared framework for the management of the site.

The purposed Management Plan

The primary purposed Management Plan is to guide all engaged parties in preservation and management of the WHS to sustain its Outstanding Universal Value, by ensuring the effective protection, conservation and presentation of the site and its transmission to future generations. To sustain the OUV of the site, it is important to have a systematic plan and have proactive approach in protecting and managing all the attributes of the site. Therefore, the MP identifies the source of problems and key issues and develop strategies and action plans to tackle such issues. Categorization of key issues, level of risks, and prioritization of strategies, actions, human and financial resources will be one of the outcomes of the updated Management Plan.

The status of the Plan

The final version of the management plan after its approval by the Ministry of Cultural Heritage, Tourism and Handicrafts, will be sent to UNESCO's World Heritage Center for validation before implementation of plans within the Site.

The team

Due to the very complex and extensive nature of the Meidan Emam WHS a multidisciplinary team of MCTH experts, the WH Base of Meidan Emam and university lecturers and staffs of the Art University of Isfahan, formed to develop the final version of the MP. Based on expertise and experience needed, 9 different disciplines provided in 2-3 expert groups. These groups are:

- Urban Conservation;
- Architectural Conservation;
- Architectural Revetments Conservation;
- Archeology;
- Traditional Handicrafts and Contemporary Art;
- Tourism;
- Education and Presentation;
- Management;
- Disaster and Risk mitigation;

However, due to the importance of disaster and risks management of Meidan Emam WHS, it has been considered as an individual project. Although interconnected with the Management Plan, this team are a group of exerts and scientists who are working on the disaster and risks action plan, the report of which is presented as a separate document and is attached to the report.

Method and processes of developing the plan

The methodology for development of the Management Plan is tripartite.

1. Review and analysis of the documentary evidences (understand what have been done so far through conservation reports, research, plans, papers, books, travelogues, student dissertation and etc.)
2. Condition survey and monitoring (identifying the current state of the site and identify potential risk and challenges)
3. Interview and consultation (from experienced experts in the field, owners, artists, craftsmen, and engaged parties)

This tripartite method has been followed by all different groups. An ongoing interactive communication between all members of different disciplines shaped the basis for the development of the Management Plan.

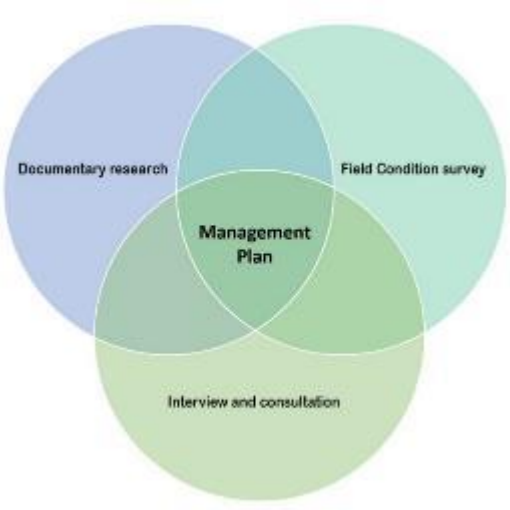


Figure 1: The tripartite methods used for the development of the Management Plan

The Key Partners

- MCTH;
- Governorate of Isfahan;
- The Isfahan Branch of MCTH;
- Meidan Emam WH Base;
- Municipality of Isfahan;
- The Art University of Isfahan;

The structure of the Plan

The structure of the plan includes:

1. Description of the site;
2. history and chronology;
3. The OUV of the site and its authenticity and integrity;
4. State of conservation;
5. Management, the aims, strategies and action plans;
6. Monitoring.

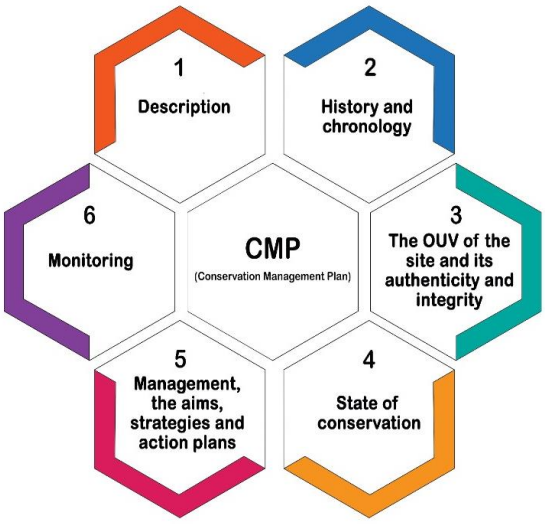


Figure 2: The structure of the Plan

Timetable

The timeframe for the development of the Management Plan is considered to be six months, started from June 2020 and finishes in December 2020. However, the condition of the COVID-19 in autumn in Isfahan adversely affected the field work and survey of the project and as a result two months has been added to the initial timeframe. Therefore, the final version of the Management Plan is hoped to be released in February 2021.

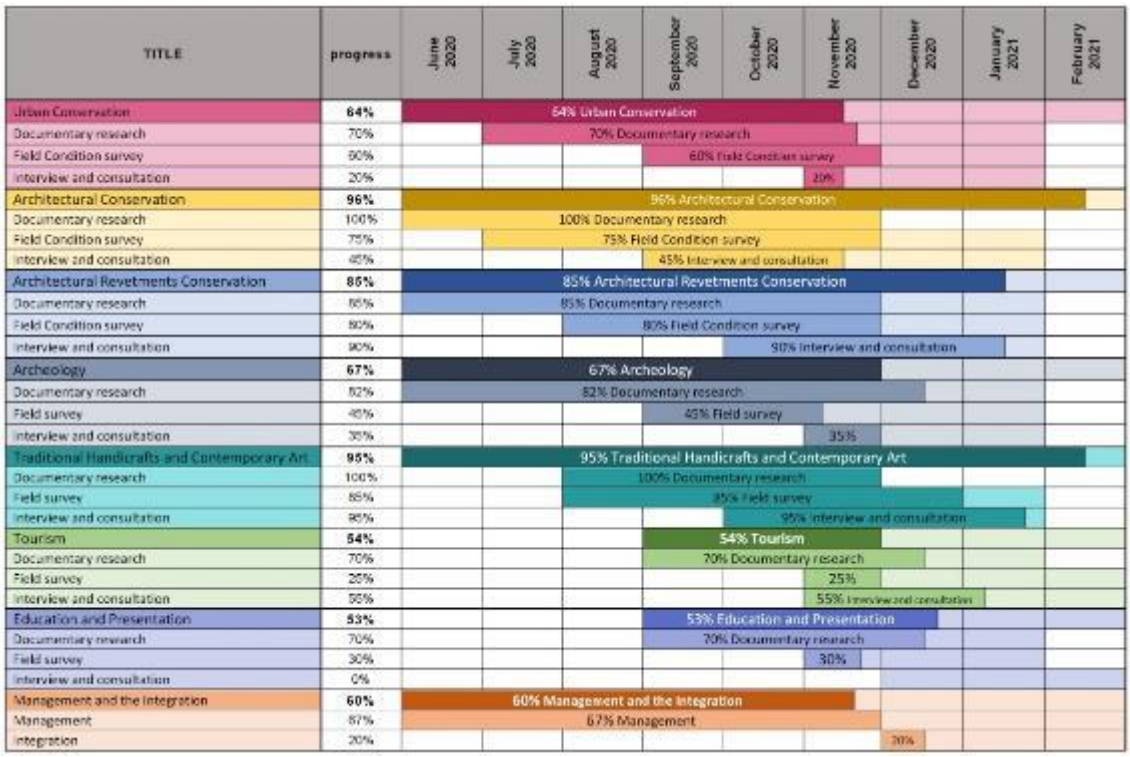


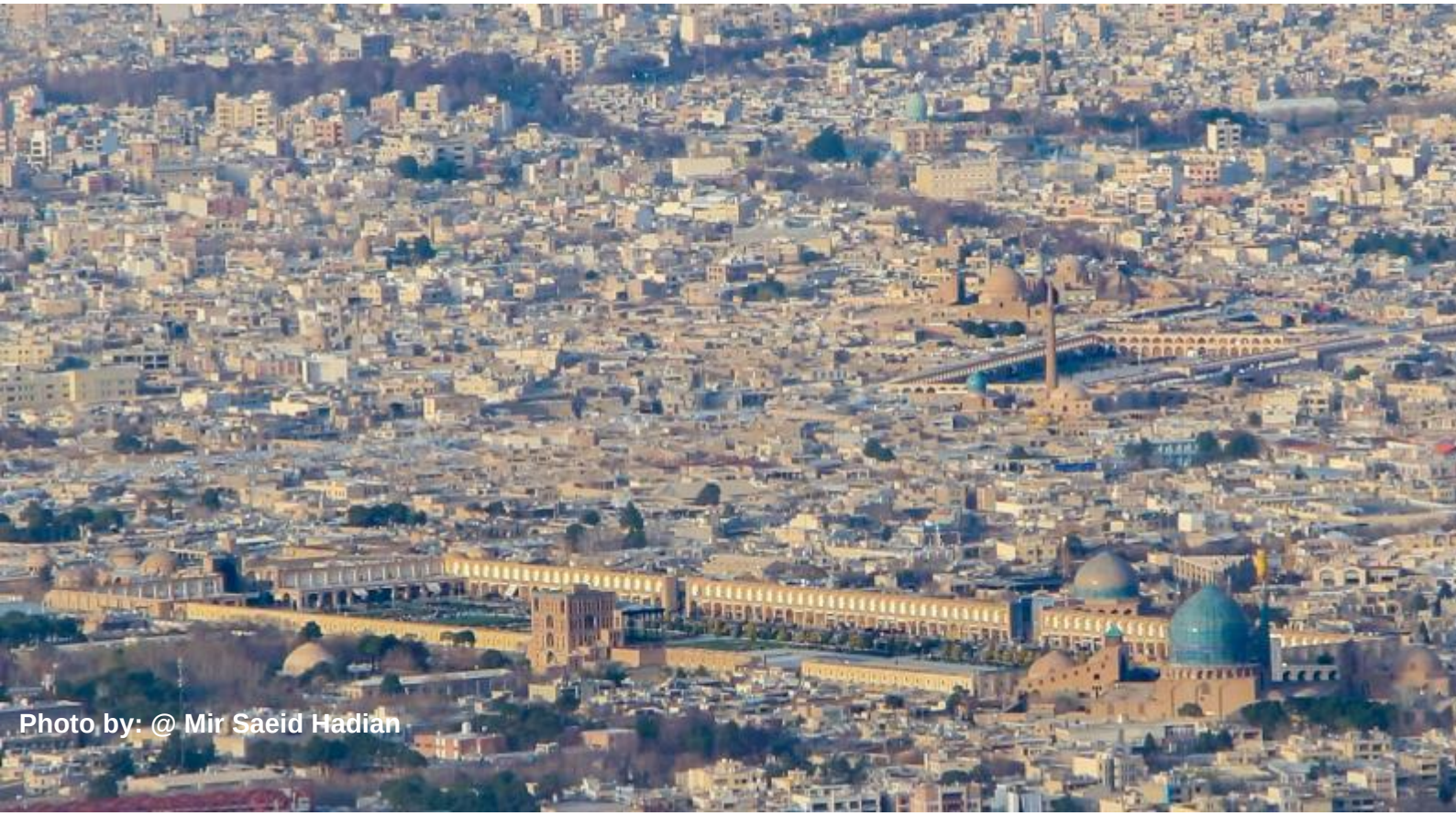
Figure 3: The timetable of the Management Plan for the Meidan Emam

The Report

The final version of the management plan along with the associated reports will be provided in a few months after the completion of studies and its adaptation by MCTH.

primary report of working groups

Photo by: @ soniasmundanelife



1.1 Urban Conservation

The main purpose of urban study in the Meidan Emam WHS Management Plan is to approach a framework for the managing the changes in the buffer zone of Meidan. Since this is a highly dynamic city center, due to the impact of economic pressure and contemporary development, managing changes in the buffer zone is complex.

Urban study group are working in four sections:

1- Reviewing the urban development master plans and documents and their association with Meidan;
2- Assessing values and historical development procedures within the buffer zone;
3- Coding the parcels in the buffer zone;
4- Developing monitoring indicators and templates for the periodic plot by plot survey of the parcels in the immediate vicinity of Meidan.


Photo by: @ Mir Saeid Hadian

1.2 Architectural Conservation

Step 1: Review of the Conservation Documents and Records

Providing preliminary data about conservation background, history of interventions, previous academic research and field studies would facilitate the decision-making process during current and future conservation plans. Moreover, it assists with determining the main policies on development of conservation guidelines, as well as the necessary immediate actions.

The anticipated outcome and the ultimate goal of this chapter are, therefore, defining a general conservation approach, through investigating and defining, scopes and intervention approaches adopted by consultation with different conservation experts and organizations during recent years.

Step 2: Monitoring and Surveys

One of the most important elements for ensuring the effectiveness of any conservation works in general and any Management Plan in particular is

documentation and continuous monitoring. Recording and registering any changes and signs of failure helps with proper monitoring which will lead to the development of policies and intervention that protect and enhance the current state of the site. This will lay the foundation for a systematic and continuous approach and a proactive and dynamic conservation-related actions.

The monitoring of Meidan Emam WHS has started from August 2020 and yet to be continued for further analysis. It has been done for all four major monuments and the ring of Bazaar. It includes all the parts of the complex from top to the base of the architectural attributes.

The basis of this monitoring is a part by part and level by level fieldwork investigation and carful observation of the visible parts of the buildings. It has a diagnostic nature looking for any source of risk or potential factors affecting the property. For those parts that are unseen such as foundation and structures hidden behind the decorative surface, an attempt has been made to distinguish any signs of damage, deformation, cracks, etc. to ensure its structural stabilization and prevent any further damages. In case of understanding such problem, further investigation and monitoring using state of the art technology will be proposed in the Management Plan.

The outputs of this field survey and monitoring will be three different documents.

1. A comprehensive and illustrated field report;
2. A standard single-page template that every individual risk/or potential risk is registered;
3. Producing an Excel data sheet related to all damages;

The result of this monitoring and survey will be, therefore, integrated in the current Management plan.

Step 3: Interviews

As well as being a WHS, highly attractive tourist destination and its importance in various fields of research, Meidan Emam has always been at the top of management agenda in general.

Therefore, using the experiences and knowledge of experts and previous cultural heritage managers, Professors, restorers, and researchers, as to the significance of the place, the challenges it faces, and conservation policies is of particular importance.

Therefore, after reviewing the literary background related to Meidan Emam and the fieldwork investigation of the current situation, the third step towards the preparation of the Management Plan is to consult and interview with a wide range of

people. As such, a questionnaire was designed and experts in this field were invited to submit their comments and contribute in the development of the Management Plan.

For this purpose, a list of people in local, national and international levels has been drown. There are 23 national and 5 international experts invited, making altogether 28 individuals.

Adhering to the safety protocols (COVID-19), it meant forgetting face to face interview and take advantage from digital technology, to have either virtual meetings or benefitting from written forms.

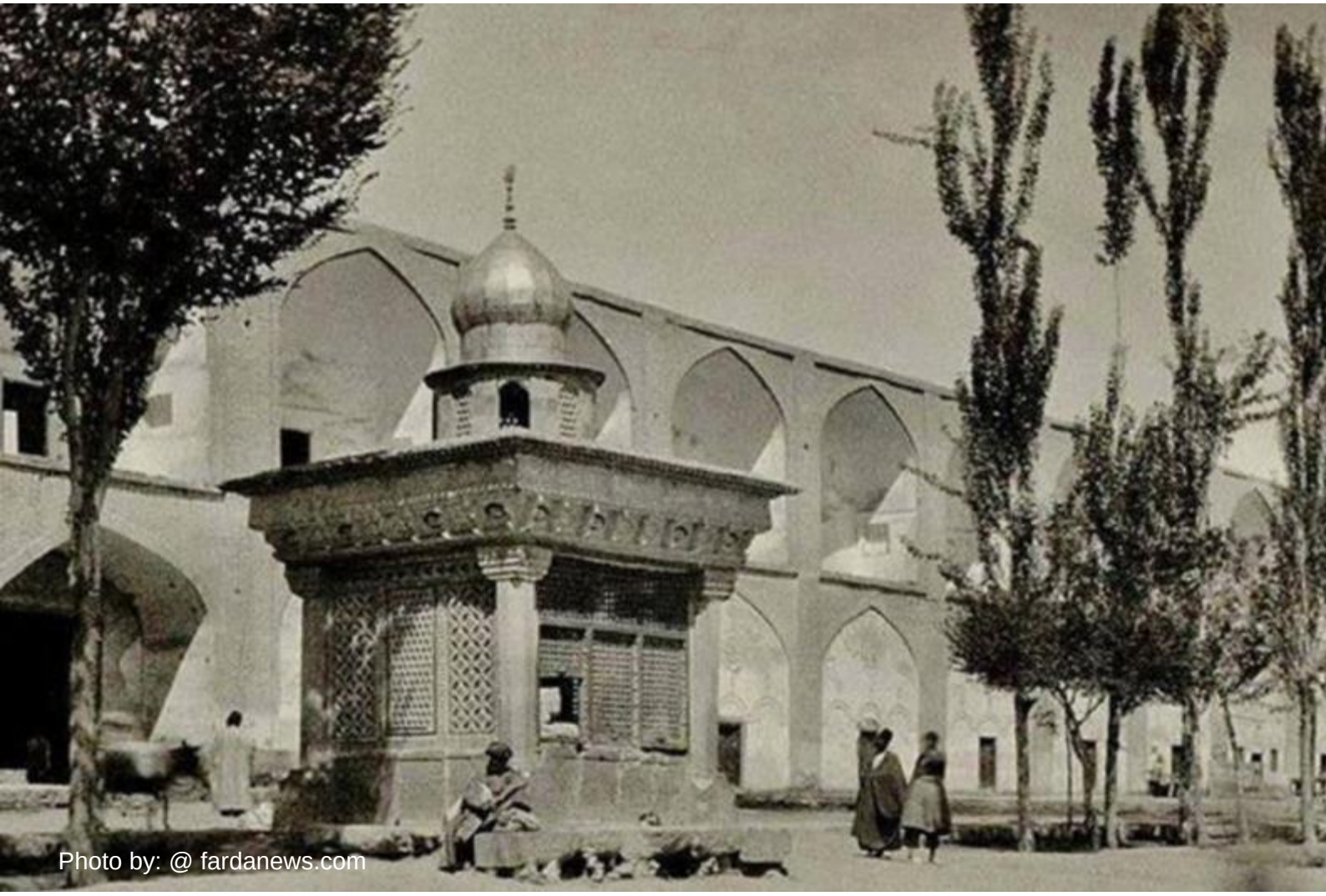
1.3 Architectural Revetments Conservation

There is no doubt that conservation management in Historic complexes such as Meidan Emam, where all the surfaces of the property are extensively covered by various types of architectural revetments, is interconnected with execution of decorations restoration and also with the decision-making process as well. It is evident that, a considerable portion of intervention and restoration activities, as well as reporting will be related to the conservation of decorations. As such, any decision-making and management planning of the Site should be benefitted from a particular attention and specialised vision to the conservation and restoration of decorations.

As Meidan is a major public urban space accessible and visible to people in all seasons, any intervention in such a complex is not only at the eye reach of citizens and Bazaar traders, but exposed to a large number of tourists; with regard to the digital technology it can also be seen by people all over the world. Therefore, the

durability and visual aspect of restoration and intervention works in this complex stimulated urban managers and authorities to invest and do their best to provide the ultimate experience for all.

The present research is undergoing and the following text is an abstract version of a comprehensive report that will be presented shortly after completion of the project. The significance of this part in the Management Plan is to establish theoretical and practical framework and prioritise actions as to the decorative elements of the WHS.



1.4 Archeology

To identify the hidden and unseen aspect of the property and its buffer zones, and to restore, conserve and prioritize actions in the Management Plan, archaeology will play a particular role.

Over the past four hundred years, the material culture and archaeological activities of the Meidan Emam WHS has undergone major phases. Therefore, in the management plan, archeology features for the recognition and identification of the invisible heritage, for a more informed decision and policy making processes.

Photo by: Zahra Bagheri

1.5 Education, Presentation and Raising Awareness

Meidan Emam WHS is a complex with exceptional OUV. Therefore, the preservation of its values, character and authenticity along with increasing the awareness among people who live, work and visit the site is of great significance.

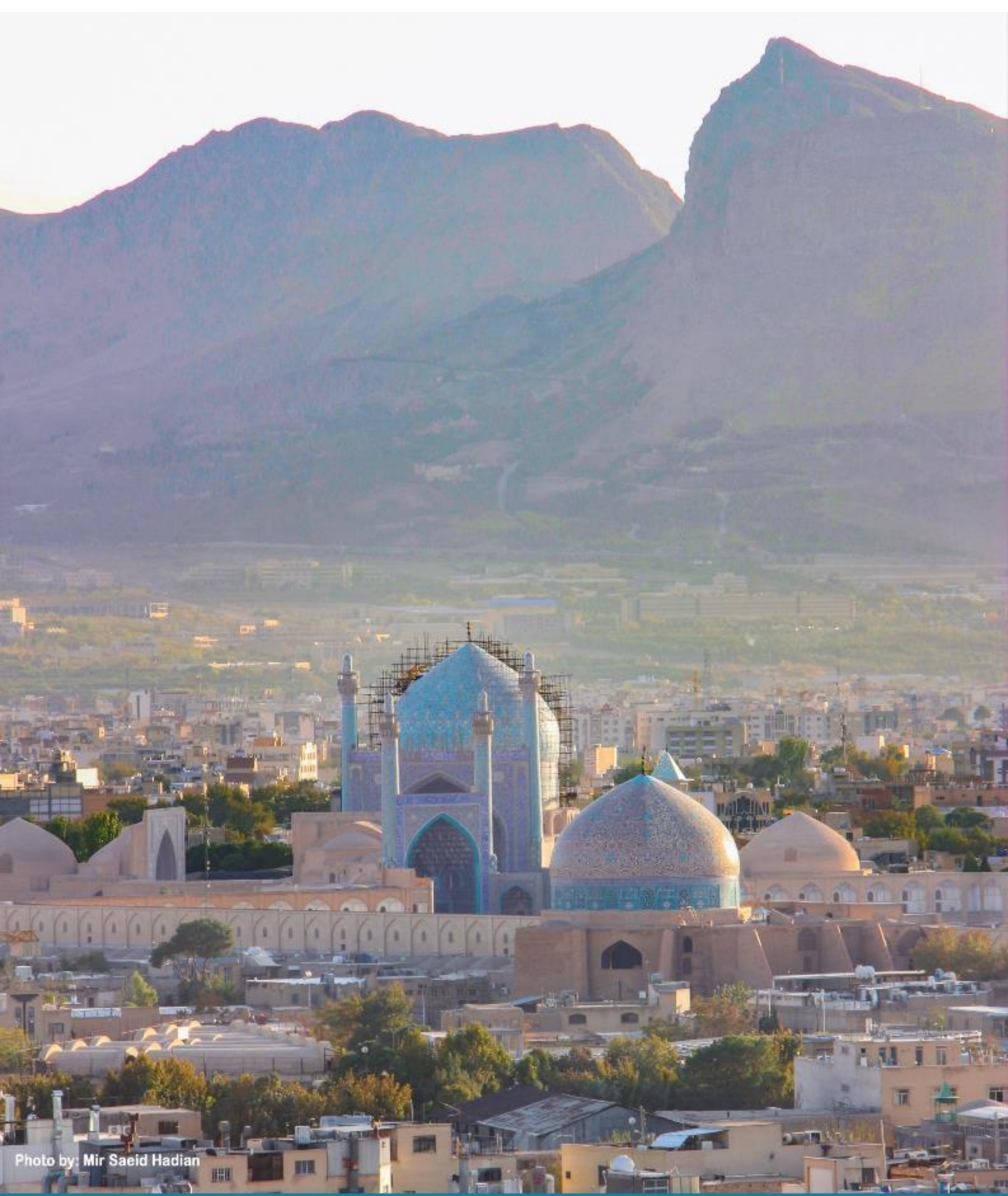
Thus, scheduling a long-term plan for education, interaction, presentation and improving the knowledge of the society is essential to ensure the conservation of the site and implementation of Meidan Emam World Heritage Management Plan. Getting acquainted with the values of this heritage will improve the affiliation of the society and will lead to better preservation of the WHS.

The vision of "Education, Presentation and Awareness raising" will be as follow:

- achieve economic, social and cultural goals through presentation, education, research and innovation as related to the WHS;
- continuous educational planning for improving and increasing knowledge of WHS and its OUV directed towards the preservation of its attributes;
- reinforce the relation between peoples and the WHS;
- promote participation between people, engaged parties and organizations;
- benefit from the extremely high capacities of the WHS as an educational asset for the schools and universities.

WORK IN-PROGRESS

Art University of Isfahan



MEIDAN EMAM WORLD HERITAGE SITE

Disaster Risk Management Plan

1400/2021 - 1405/2026

بایگاه میراث جهانی میدان امام اصفهان
MEIDAN EMAM WHS

Meidan Emam, Esfahan World Heritage Site

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Inscription	**1979**
Criteria	**Cultural: (i)(v)(vi)**

United Nations Educational, Scientific and Cultural Organization

World Heritage Convention

Summary and Framework

1st Phase

Outlines of the Disaster Risk Management Project

Abstract

Meidan Emam including the Abbasi Jami mosque (Emam mosque), Shaykh-Lutf-Allah mosque, Ali Qapu edifice, Qaysariyah portico, and the bazaar around the square, inscribed on the UNESCO World Heritage List in 1979 and is one of the most important historic and cultural monuments in Iran. Due to the importance of this complex, a disaster risk management plan is being developed for it.

This report is organised in seven chapters. In the first chapter, entitled "Overview", problem statement, scope of the plan, necessity and importance of research and implementation of the plan, objectives, literature review, phases of the projects and project schedule will be provided.

The second chapter is dedicated to "methodology". In this chapter, risks are identified and then, by presenting the objective of risk management in cultural heritage, the methodology adopted is explained. Due to the importance of this project, which can be done based on the latest scientific methods accepted in the world and can be considered as a model in disaster risk management plans for other sites and monuments of the country, at the beginning of the project, extensive contacts were established with experts in this field in the world, which resulted in the collection of valuable collections of scientific documents in the field of cultural heritage disaster risk management.

Then, by holding several specialised meetings, the "ABC method: a management method for the protection of cultural heritage" was selected as the approach and methodology. The ABC method is a successful and tested method in Latin America, Asia and Europe, developed over several years jointly by ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property), the Canadian Conservation Institute (CCI) and the Netherlands Cultural Heritage Agency (RCE). Context establishment, risk identification, risk analysis, risk evaluation and risk mitigation are some of the most important steps of the ABC method presented in this chapter.

The third chapter is dedicated to "actions taken" up to the time of preparing this report. In this chapter, the two main steps of establishing the context and identifying the risks are studied. One of the most extensive and time-consuming parts of the plan is included in this chapter, which includes the collection of available information and documents, visual assessment and recording of existing conditions, forming a group of collaborators and experts, determining the scope of the project, timing, identifying the types of risks and causes in the context, preparing, editing and checking the checklists, formation and training the information and data acquisition team, coding of all spaces, and start of information and data acquisition.

In the fourth chapter, "ongoing actions" are presented. In this section, the risk analysis step, which is summarised in scoring three items A, B and C, is discussed in specific sub-steps.

The fifth chapter is presented in the form of "future actions", which refers to risk evaluation, calculation of the magnitude of the risk, prioritisation of risks, and risk mitigation.

Chapter 6 includes geological and geotechnical studies, groundwater studies, downhole test results, and seismicity.

Chapter 7 presents a proposal for an action plan, the steps of which are briefly reviewed.

Some parts of this report are not completed yet, as the data and information are under analysis. Incomplete sections will be completed in few months and will be provided to MCTH for further confirmation.

1. Overview

1.1. Introduction

Many historic sites around the world are vulnerable assets that face a variety of challenges. Cultural heritage is always exposed to various risks, including: natural disasters, fire, urban development and excessive tourism industry, pollution, improper management of sites, conflicts, etc. Threats to historic sites depend on the nature, specific features, inherent agents and environmental factors.

In other words, the risks can be seen in the form of internal and external agents. These threats may be natural or human. Natural risks can be divided into two categories: first, catastrophic and sudden events such as floods or earthquakes that have an immediate and huge impact on historic sites, and second, persistent threats with gradual and cumulative effects such as erosion and material decay. Human risks are the result of various human actions such as development and progress, irregular renovations, tourism, poor management, lack of maintenance and negligence. The vulnerability of these areas depends on environmental, economic, social and political conditions.

In order to reduce these risks, it is necessary to propose a disaster risk management plan in the context of historic sites specifically in the same area, with the cooperation of expert teams in each speciality and relevant authorities. On the other hand, the disaster risk management plan should become an integral part of conservation operations and total management and protection programmes in the premises. In other words, the disaster risk management plan must be at the heart of the site protection plan. Once risks, damages and their causes are identified, evaluating and prioritising them through a management planning process will minimise and reduce their effects and it will be possible to preserve the values and integrity of the historic sites.

The Emam square, located in the midst of Safavid complex in the city of Isfahan and is one of the most important historic and cultural monuments, which has been registered in the UNESCO World Heritage List. Considering the location of the key elements of the Abbasi Jami mosque (Emam mosque), Shaykh-Lutf-Allah mosque, Ali Qapu edifice, Qaysariyah gateway, and the bazaar around the square, developing a disaster risk management plan in this historic complex is also a need for which the risk of disasters should be identified and evaluated according to the context and conditions of the site.

From June 2020 up to present, a team of experts proceeded to advance the project by continuously conducting library studies, field studies and data acquisition on a daily basis, specialised meeting on a weekly basis, and performing other activities for preparation of this report.

1.2. Problem Statement

Natural and man-made disasters around the world cause great loss of life and property. Cultural heritage is no exception to this damage and the damage is irreparable in many cases. Historic buildings and sites are damaged over time, such as material decay and structural cracks, and as a result, their strength to various factors such as earthquakes or fires is reduced. Since these buildings and sites are part of the cultural history and environment and the identity of the society, measures must be taken to protect them against risk agents. Reuse of such buildings and sites in the form of different uses or site-museum, requires infrastructures such as electronic and mechanical installations, development of energy and gas networks, changes in the water and sewage system, use of various equipment and occasional use of flammable materials in repair work, each of which can lead to a disaster such as fire or a change in the load bearing system of the structure, followed by structural damage. Therefore, protection and preventive measures are necessary to reduce the risks of unexpected events in the cultural heritage. Comprehensive disaster risk management plans should be developed based on the specific characteristics of the cultural heritage and the nature of the risks. This plan should be developed taking into account the principles of disaster risk management, historical values, aesthetics and other values of cultural heritage, which necessarily requires the cooperation and support of experts, managers and policy makers.

1.3. Scope of the Plan

The area of the World Heritage Site of the Emam square for which a disaster risk management plan is being developed, is shown in Figure 1 with a rectangle. It consists of the square (No. 1), Abbassi Jami mosque (Emam mosque, No. 3), Shaykh-Lutf-Allah mosque (No. 5), Ali Qapu edifice (No. 4), and the bazaar around the square (No. 2).

(a)

(b)

(c)

(d)

(e)

(f)

Figure 1. The World Heritage Site of the Emam square: a) view from the south, b) the area for which the DRMP is prepared, c) Emam mosque (1612-38 A.D.), d) Ali Qapu edifice (1597-1668 A.D.), e) Shaykh-Lutf-Allah mosque (1601-28 A.D.), f) Qaysariyah gateway

1.4. Necessity and Importance of Research and Implementation of the Plan

The Emam square is the first UNESCO World Heritage Site in Iran since 1979. Despite the structural, historical, social, economic, cultural and aesthetic value of this complex, which is

one of the most visited historic complexes in Iran, it has been exposed to various risks at various levels.

Among the most important risks that threaten this historical complex and its valuable structures, i.e. the Abbasi Jami mosque (Emam mosque), Shaykh-Lutf-Allah mosque, Ali Qapu edifice, Qaysariyah gateway, and the bazaar around the square, the following can be mentioned.

- The presence of adobe, mud and brick materials in the main structure of the square and the brick façade has maximised the absorption of moisture in it. This threat is exacerbated by the existence of old water and sewage system that has eroded over time, causing surface water to slightly leak in the area;
- The wooden structure on the veranda of the Ali Qapu edifice will increase the risk of fire and will be dangerous;
- The existence of live markets in the square causes the movement of citizens to meet daily needs. In addition to the traffic of citizens and travellers on weekends and public holidays, which certainly increases the risk;
- Etc.

Managing and preserving national heritage assets requires a systematic and comprehensive approach. The most fundamental steps towards the systematic protection and preservation of these assets as a whole and the protection of its values and integrity is research in the field of risk management and identification, mapping and monitoring of risks.

1.5. Objectives

The main objective of this project is to identify the types of risks that threaten the World Heritage Site of the Emam square. While identifying the risks, the factors that cause them will also be investigated.

1.6. Phases of the Project

The phases of the project for preparing the Disaster Risk Management Plan of the Emam square are presented in Table 1.

Step	Sub-step	Activity Number	Activity description
1. Establishing the Context	-	1.1	Identification of aspects related to context (political, physical, socio cultural, legal, financial, administrative and operational, actors and stakeholders, ...)
2. Risk identification	Risk types	2.1	Identification of types of the risks that cause the deterioration and loss
	Deterioration agents and loss	2.2	Identification of deterioration agents and loss (both internal agents and exterior agents such as physical, accidental, biological, etc.) which will be demonstrated on the maps
	Layers	2.3	Identification of layers (building ornaments, spaces, etc. in the context) which will be demonstrated on the maps
	Risk Occurrence	2.4	Types of risk occurrence (rare events, common events, cumulative processes)
	Communicating Risks	2.5	Benefitting from the experience of engaged parties

3. Risk analysis	-	3.1	Analysis of information based on ABC scoring and total score (MR)
4. Evaluation of risks	Risks priority	4.1	Prioritising the risks based on the total scoring
5. Mitigation of Risks	-	5.1	Proposal of mitigation plans

Table 1. phases of preparation of the DRMP for the Emam square

1.7. Project timing (Gantt Chart)

The project timing is based on Table 1. The final completion of the project will in few months as established in table below.

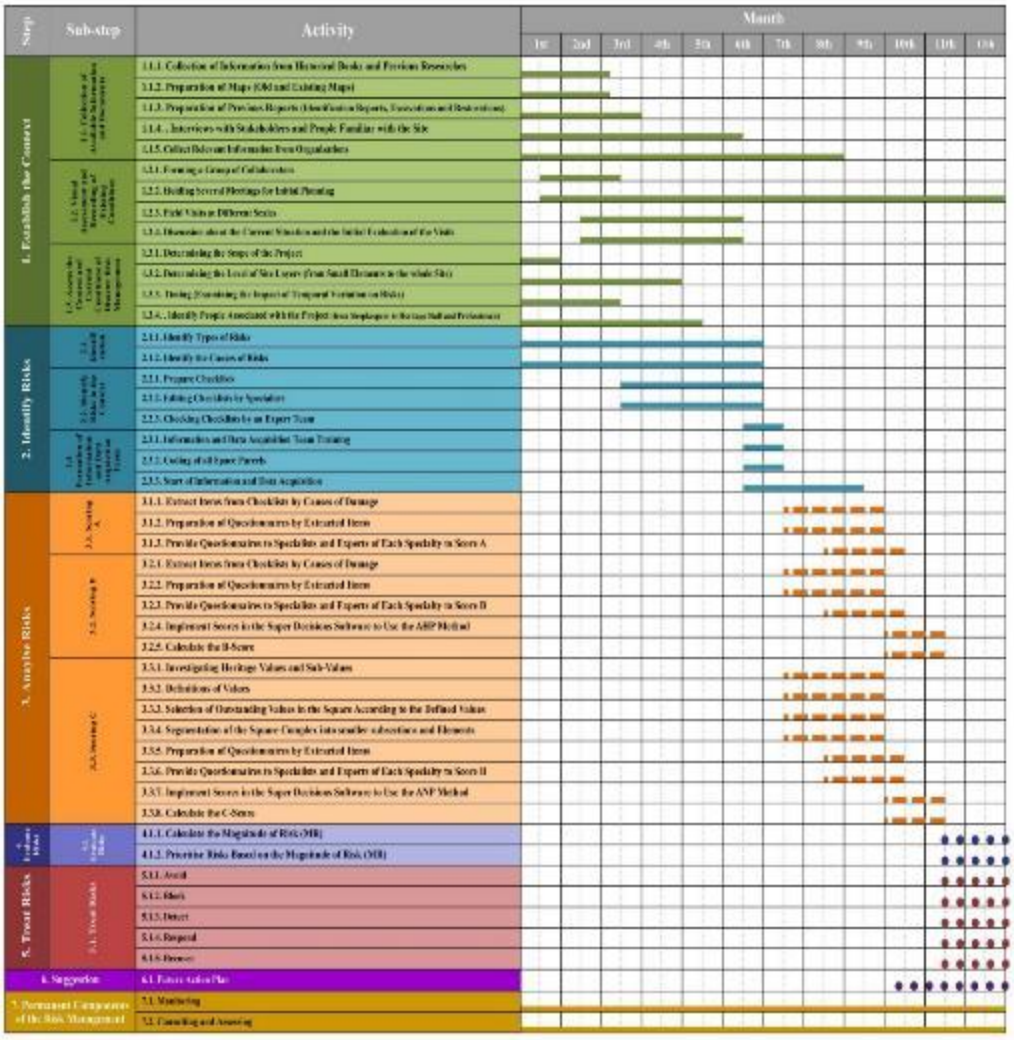


Table 2. Project timing (Gantt chart) for the Disaster Risk Management Plan (DRMP) of the World Heritage Site of the Emam square

2. Methodology

Disaster risk management activities can be classified into three phases: before disaster, during disaster and after disaster (Figure 3).

Figure 2. Three phases of disaster risk management: before, during and after disaster [20].

After reviewing the various methods of disaster risk management tested, the disaster risk management plan based on the ABC method was selected to carry out this project.

The ABC method is the result of a collaboration between ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property), the Canadian Conservation Institute (CCI) and the Netherlands Cultural Heritage Agency (RCE) between 2006 and 2012 to create an international movement from a traditional approach of preventive protection towards risk management in the field of heritage. Activities of this cooperation include research, education and dissemination of information, and production of references and resources. The basis of this method is taken from the Australian-New Zealand International Standards 2009. Since then, the method has been fundamentally revised based on the Canadian Conservation Institute's experience with the use of the ABC method by Canadian institutions as well as ICCROM in projects in Latin America, Asia and Europe.

In this method, the systematic application of disaster risk management process before disaster consists of five steps:

1. Establish the context
2. Identify risks
3. Analyse risks
4. Evaluate risks
5. Mitigate risks

The two components of the risk management process will be based on the evaluation of values and evaluation of site conditions.

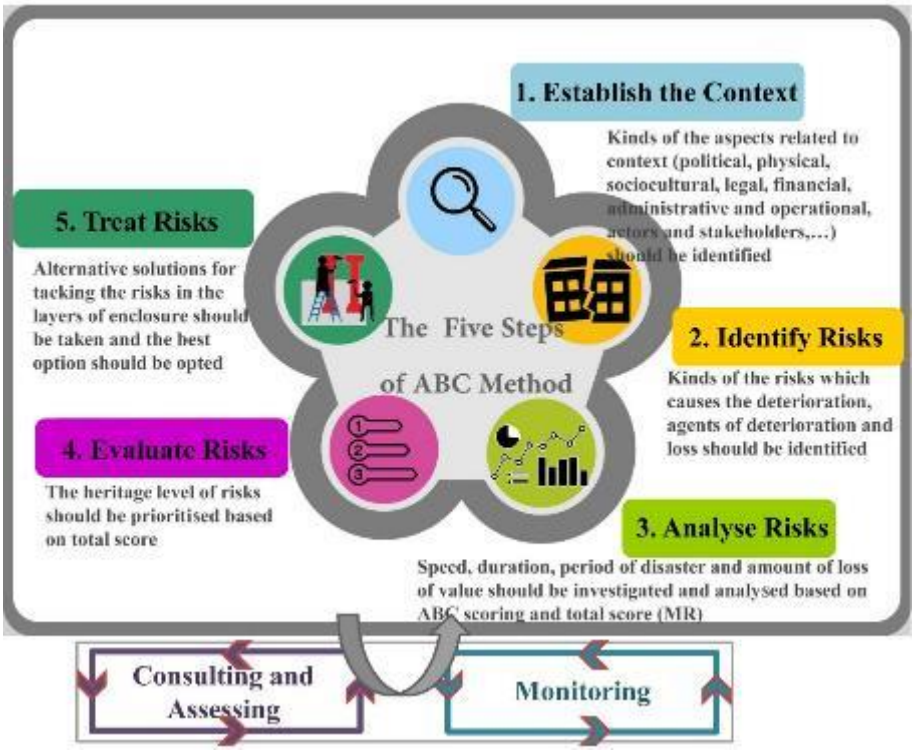


Figure 3. The ABC method

With regard to the disaster management in the Emam square, it was decided from the outset to use the predefined classification of threats, risk agents and damages provided and standardised by ICCROM and to adapt them to the present conditions of the Emam square.

3. Actions Taken

Based on the adopted method and Gantt chart presented (Table 2), the following actions are taken. All five main steps of the ABC method and its sub-steps are to be performed sequentially and in some cases in parallel, as follows.

3.1. Step 1: Establish the Context (Evaluate the Conditions and the Context)

The assessment of conditions in the site of the Emam square to identify the context and understand the physical location, was focused on the activities of collecting initial information, visual assessment and assessment of risk management conditions. The data obtained in the historical area under study are influential in future decisions.

3.1.1. Collection of Available Information and Documents

Documenting and collecting available information is the first stage of assessing the situation. Documentation was done in the form of collecting information from historical books, preparing maps, collecting previous reports, interviewing stakeholders and people familiar with the place, and preparing relevant information from organisations. This data is helpful in better understanding and identifying any changes over time.

So far, many studies have been carried out on the subject of Meidan Emam, but almost every one of them only points to a specific feature of the square and focuses on that feature. In

general, these studies were reviewed at two scales. The first scale is related to the monuments around the square and the second scale is related to the whole complex. In this section, was tried to collect information related to the Emam square, which has been done in the form of books, articles, dissertations and researches, in the form of libraries, which will be presented in detail in the next report. Most of the obtained information refers to the situation of the Emam square, the history of its formation and its evolution in the Safavid period until today. A number of references have described the structure of buildings and gardens around the Emam square, the analysis of the spatial body and proportions of the square and its four main monuments (Emam mosque, Shaykh-Lutf-Allah mosque, Ali Qapu edifice, Qaysariyah gateway).

3.1.2. Preparation of Maps

Before preparing a final report and detailed studies of monuments and structures, it is necessary to have maps of the area and the building. Table 3 shows the extent of maps needed which are to be provided in the next few months.

Architectural Maps		**Structural and Details Maps**		**Electrical Installation Maps**		**Mechanical Installation Maps**	
Existence		Existence		Existence		Existence	
Incomplete	✓	Incomplete	✓	Incomplete	✓	Incomplete	✓
Non-Existence		Non-Existence		Non-Existence		Non-Existence	

Table 3. Status of maps of the Emam square

The upper mentioned steps have been carried out and will be completed with the following steps in the months to come, the final version of which will be provided for the next 15 years according to the national and international standards and by taking into account the current conditions of the site, will be integrated into the management plan of the site and will be submitted for validation as soon as its approval in the associated committees.

3.2. Step 2: Identify Risks

4. Ongoing Actions

4.1. Step 3: Analyse Risks

5. Future Actions

6. Geological, Geotechnical and Seismicity Studies

7. Future Action Plan

Plan for the Reorganisation of the Water System and Sewage System within the Emam Square and Its Buffer Zone

Water and Sewage Systems Study of the Emam Square

As part of the Disaster Risk Management Plan the available data and information about the water system and the sewage system of the property are collected from the organisations in charge of water and sewage, at the same time, a field study is being carried out to review the data and complete the information.

For this reason, field monitoring was performed to investigate the condition of water and sewage pipelines in the area of the Emam square, and the obtained results were compared with the existing maps of the location of these pipelines. Figure 1 shows the location of some of the points examined.

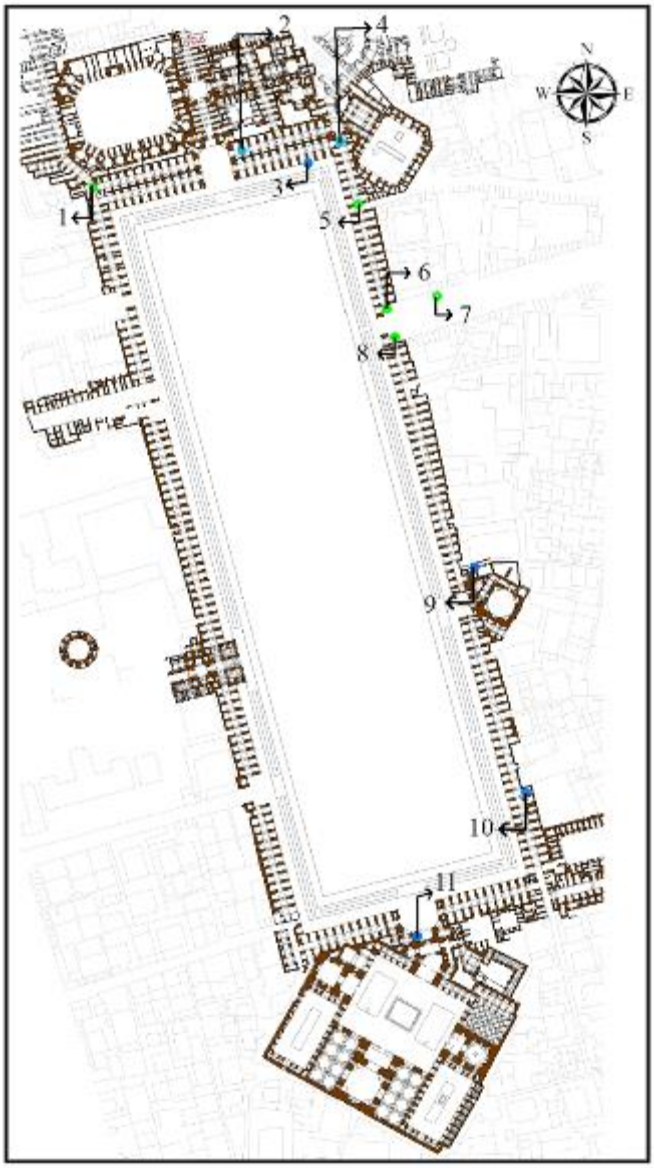


Figure 4. Location map of some surveys related to water and sewage network in the Emam square

Water System

Figure 2 shows the position of water pipelines in the vicinity of the Emam square.

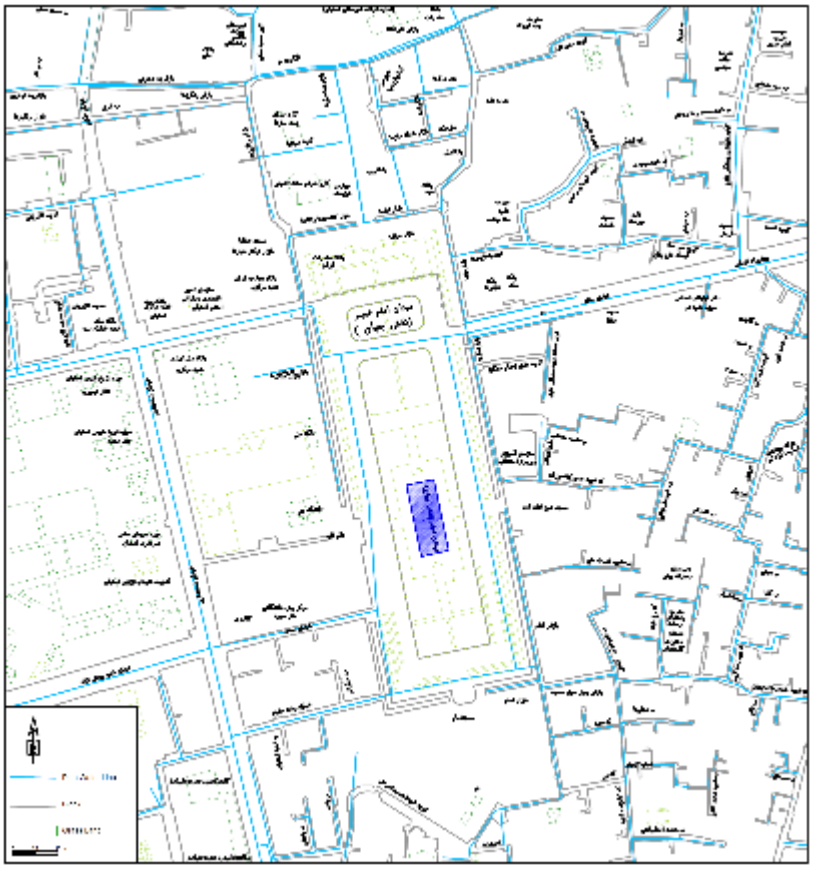


Figure 5. The main lines of water pipes in the area of the Emam square

The general results of the field monitoring show that the new water pipes, which are made of polyethylene, are located at a depth of approximately 1 m to 1.5 m, and according to the way the pipes are connected, there is a possibility of water leakage from them. Figure 3 shows the water pipeline observed in the moisture vent at the site. In case of no further action, due to the presence of debris and fine grains in the depth range of the pipeline, there is a possibility of water leakage.

Figure 6. Water pipeline crossing the area of the Emam square, point 2 in Figure 1

Sewage System

The situation of manholes in the bazaar around the Emam square was also examined (Figure ٤). Studies show that the depth of manholes is not constant and varies from less than 1 m to more than 3 m and in them other facilities such as water pipelines has also observed. Examination of these manholes will be useful for monitoring the sewage passage, possible clogging of the sewage pipeline and their maintenance. It is also possible to determine the slope of the sewage pipeline between the manholes by measuring the depth of the sewage pipes inside the manholes and to ensure the correct operation of the sewage pipes. Examination of the existing manholes shows the effects of the presence of vermin inside the manholes. Corrosion of sewage pipes can also be seen inside the manholes. Also, the slope of the sewage pipeline is not the same in the whole network.

(a) (b)

(c) (d)

Figure 7. Investigation of manholes in the area of the Emam square, point: a) 5, b) 7, c) 4, d) 6 in Figure 1

Figure 5 shows the position of the main sewage pipelines in the area of the Emam square. No written information is available from the date of initial construction of these lines, but in recent years these lines have been repaired. Field studies show that there is a leakage of sewage from these pipelines and in some areas, the quality of repairs has not been satisfactory to the trader. The depth of sewage main canals and pipelines varies between 1.2 m and 3 m, and the depth of sewage pipes connected to buildings is between 1.2 m to 1.5 m.
In field studies so far, the direction of sewage movement in the pipes and the slope of the pipes have been determined and a completed map will be presented soon.

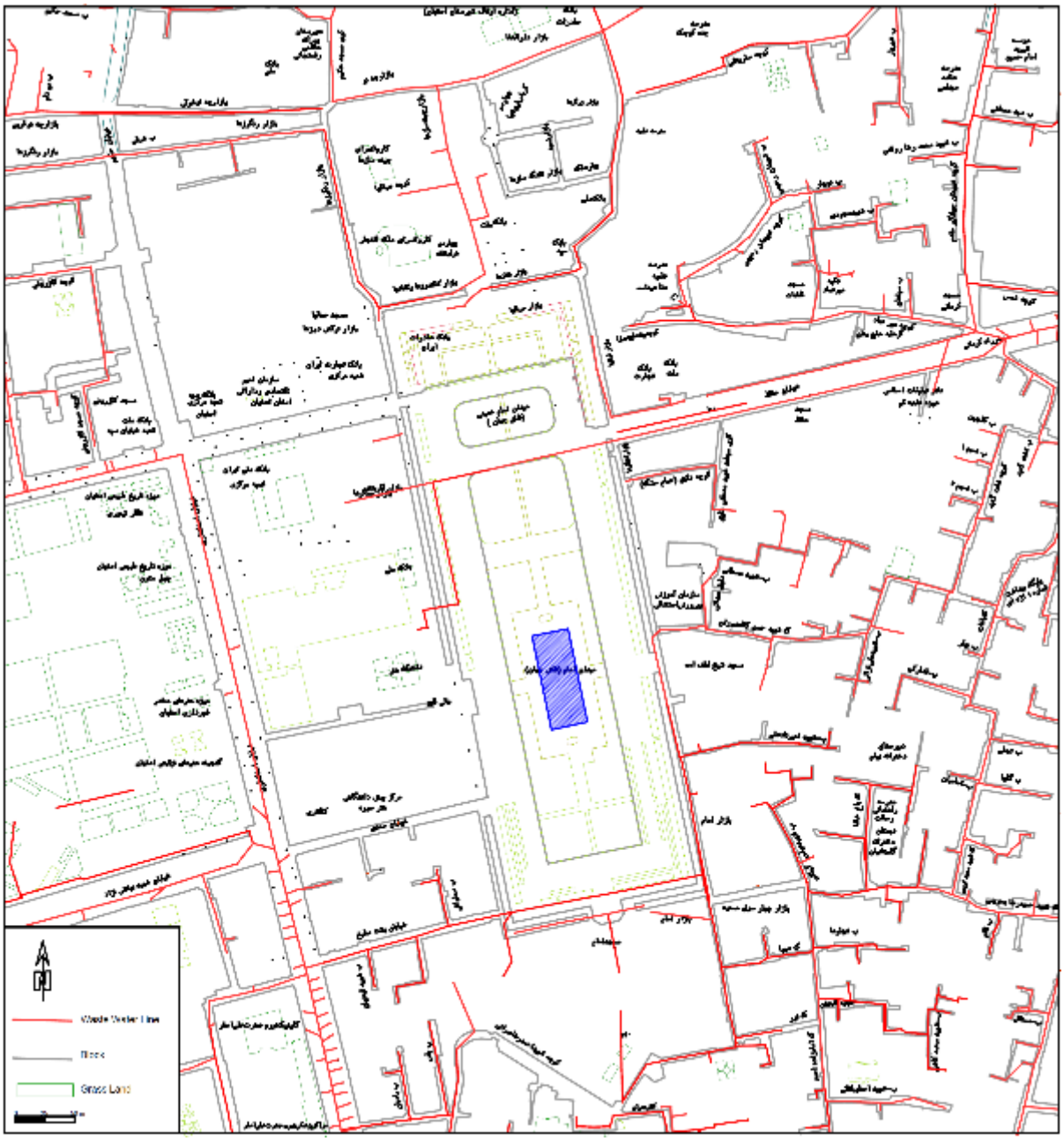


Figure 8. The main routes of the sewage pipeline in the area of the Emam square

Studies show that there is a slight leakage of sewage from pipes and canals due to their decay and destruction (Figure 6). The main sewage pipes, between the manholes, are made of

concrete with asbestos with a diameter of 25 cm and more. The pipes of the sewage sub-lines in some alleys and dead ends, which are connected to the buildings, are made of PVC or possibly cast iron (in some areas) with a diameter of 11 cm.

Figure 9. Destruction and decay of the sewage pipe in the area of the Emam square, point 1 in Figure 1

The effects of leakage can be seen in the dampness and the presence of dandruff on the walls inside the bazaar round the Emam square. (Figure 7).

(a)

(b)

(c)

(d)

Figure 10. Leakage effects from sewage pipes, point a) 9, b) 10, c) 3, d) 11 in Figure 1

The variable slope of sewage pipes and canals and in some areas, their low slope and the presence of solid parts such as plastic containers may cause blockage (Figure 8).

Figure 11. Existence of plastic containers in the sewage path and the low slope of the sewage pipeline, point 9 in Figure 1

In addition, it should be borne in mind that soil subsidise due to sewage leakage in man-made fine soil and clay might be likely.

Conclusion

A Disaster Risk Management Plan (DRMP) is currently underway for the whole heritage site and its built structures. The DRMP includes the evaluation of the risk of water system and sewage system, in addition to other existing risks, to the buildings in the heritage site.
As part of the DRMP, a plan for the investigation and reorganisation of the property's water system and sewage system has already been started.
The plan is expected to be completed within the next few months and will be provided for further validation as soon as the final confirmation of MCTH.

Anti-earthquake measures for Ali Qapu Edifice and other built structures in Emam Square

Anti-Earthquake Measures for the Ali Qapu Edifice

Two main restoration works have been carried out during the last six decades. The first and more comprehensive restoration on the whole building was done in the 1960s and 1970s. The second restoration work that focused on the wooden structure and its *talar* was in the 2000s, as is described as follows:

Restoration Works in the 1960s and 1970s

The most comprehensive maintenance of the building started in 1964 and continued for six years. It covered the whole masonry section but the work on the wooden structure remained incomplete.

Rehabilitation of the Masonry Section in the 1960s

The load bearing masonry structure of the Ali Qapu is made of yellow-brown moderately fired bricks. They are 24 cm square and 5.5 cm thick. Gypsum mortar is used between bricks.

The maintenance of the Ali Qapu was offered to Italian experts from Istituto Italiano per il Medio ed Estremo Oriente (IsMEO), in 1964. At that time the masonry section, including the base of 22×20×33 m^3 and the part of 29×17×12 m^3 under the wooden structure, was damaged in all parts and two exposed cracks were observed on the northern and southern sides. It was supposed that the cause was the demolition of the lower load bearing walls or the settlement of the foundations.

The foundations of the Ali Qapu edifice rest on compacted clay soil. The thickness of the foundation varies from 1.2 m on the north-east part to 3.6 m on the south-east part. The foundations are made of lime. The system of foundations comprises of four cores placed on the four corners of the building. The four cores are inter-connected using thinner foundations. By experimenting the foundation, it was discovered that there was no possibility of settlement. However, the area of the foundation was still increased by 27%.

Then the maintenance concentrated on the upper structure and this continued from 1965 to 1970. The main aims of the interventions were:

1. Supporting the damaged or cracked parts of the building;
2. Repairing the most critical damages in the building by using the same traditional materials;
3. Lightening the roofs and elements under thrust from excess loads (Figure 1);
4. Connecting the different parts of the building by using continuous spreaders in order to distribute the loads (Figure 2);
5. Creating a horizontal circumferential frame in the whole building in order to prevent the external parts from detaching (Figure 3).

Figure 12.Ali Qapu edifice, lightening the roofs at sixth floor, 1965-1970

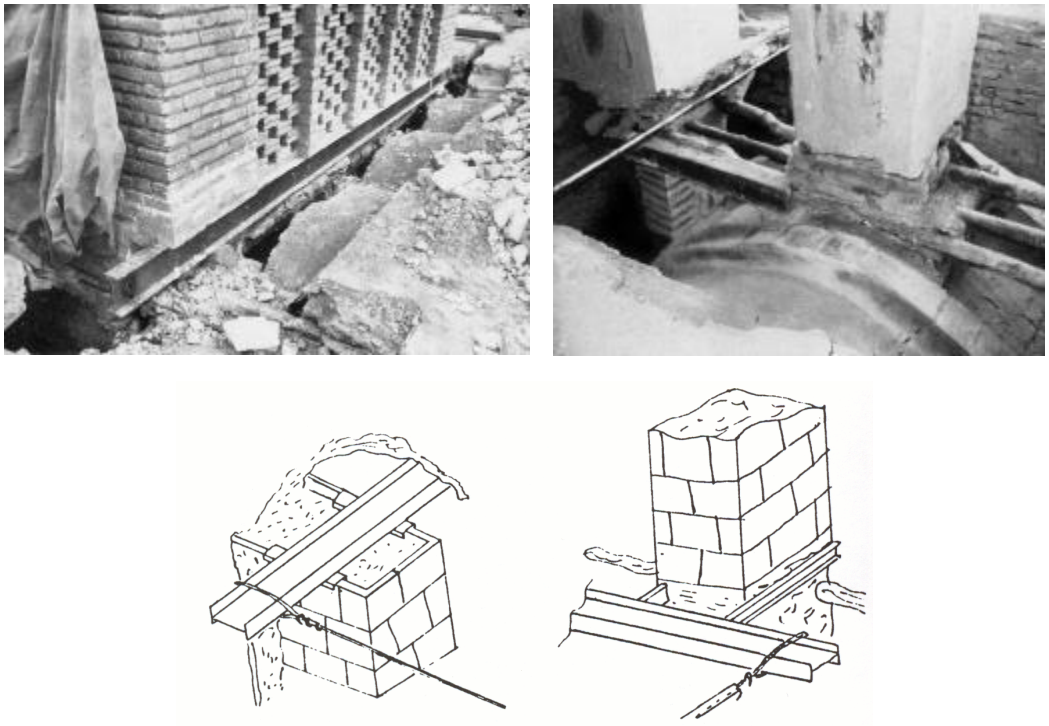


Figure 13. Ali Qapu edifice, using continuous spreaders in order to distribute the loads, 1964-1970

Figure 14. Ali Qapu edifice, using horizontal circumferential frame in the whole building in order to prevent the external parts from detaching, 1964-1970

Rehabilitation of the Wooden Columnar Structure in the 1970s

Description of the Wooden Columnar Structure

The wooden columnar structure covers the eastern veranda of the main building. It comprises columns, main beams, secondary beams on the top or between the main beams, and truss elements that transfer the load from the upper secondary beams to the lower main beams. A part of imposed load on the structure is supported by the side wall. A horizontal bracing system in the roof transfers the lateral load (Figure 4 and 5).

Eighteen columns (columns α′ to ιη′, Figures 4 and 5 (b)) along with the side wall (hatched section, Figures 4 and 5) carry the roof weight. Each column has a height of 10.5 m and an octagonal shape of cross-section with a diameter of 0.5 m at the base decreasing to 0.3 m at the top. Six columns (α′ to ς′) were stabilized by cutting the wooden column into two parts, then emptying the central section of two parts and putting a □-shape steel profile between them, connecting the wooden and steel parts using bolts, and re-erecting the wood/steel column. The columns stand on a wooden spreader (Figure 5 (c)) that was stabilized by I-shape steel profiles during the rehabilitation of the building.

There are two types of main beams. Perpendicular to the side wall, there are six beams of 17.5 m long of which 1.2 m are inside the side wall. The cross section of the beams is circular with a diameter of 0.4 m at the wall and 0.55 m at the other side (frames 1-6, beams a_7a_{10} to f_7f_{10}, Figs. 4 and 5). Parallel to the side wall, there are three lines of beams with a length of 28 m, each beam comprising three parts of 10 m, 8 m, 10 m long, and a diameter of 0.5 m (frames B-D, beams a_7f_7, a_8f_8 and a_9f_9, Figure 4).

Parallel to the main beams in lines 1 to 6 there are 10 lines of secondary beams with a cross-section of semi-circular shape and diameter 0.25 m (like beams a_1a_2, a_2a_4, a_4a_6, g_1g_2, g_2g_3 and g_3g_4, Figure 4). Each secondary beam comprises of three parts and in frames 1 to 6 it lies at a distance of 0.2 m from the lower main beams near the wall and this distance gradually diminishes towards the other end (Figure 6).

There are 24 π-shape trusses which transfer the load from secondary beams to the main beams (a_8a_3, a_3a_9, a_9a_5 and …, Figures 4 and 6).

All around the roof in the outer span there is a horizontal bracing for lateral loading. The rectangular cross section of the members is 0.1×0.15 m. The members form π or ×-shape trusses with beams (Figures 4 and 5 (d)). As it is shown in Figure 5 (d), a steel cable had previously been added to the structure to keep the f_7f_8 beam, which was cracked at one point, from moving outwards.

All the elements of the structure are made from the wood of sycamore (*platanus occidentalis*). Sycamore used to be an abundant species in Isfahan, capable of reaching 30 m in height, with tough, dense and hard wood. The connections between the elements are made by using iron nails. The roof structure is covered by an upper sloped plate and the lower wooden decorated roof of the veranda making a closed pyramid shape space with a maximum height of about 2 m.

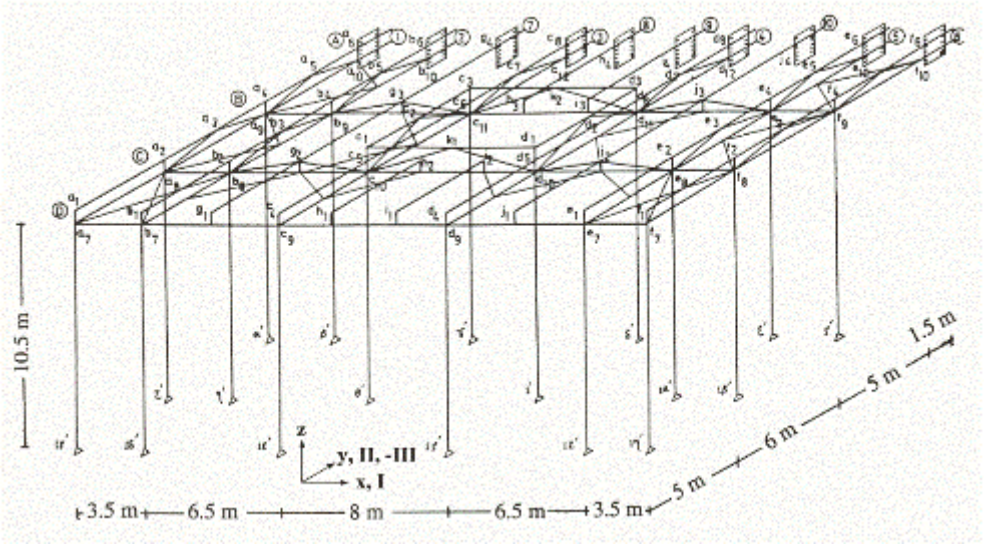


Figure 15. Ali Qapu edifice, the wooden columnar structure

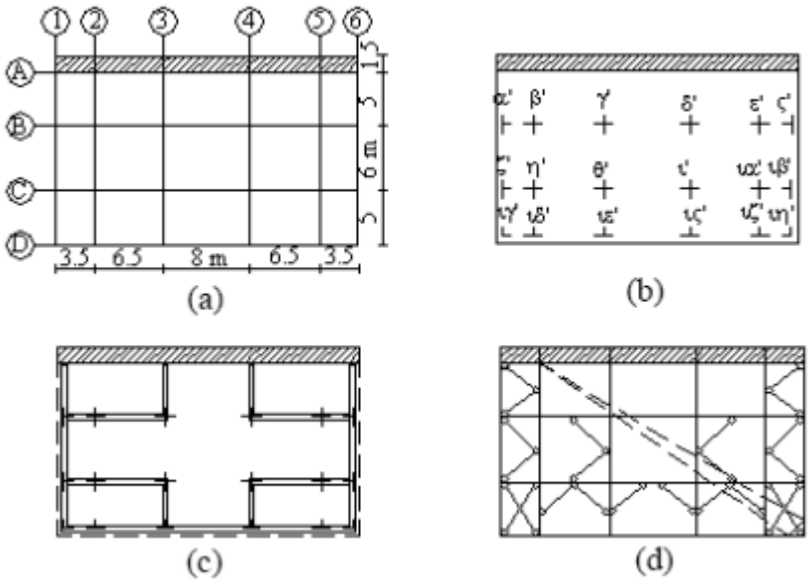
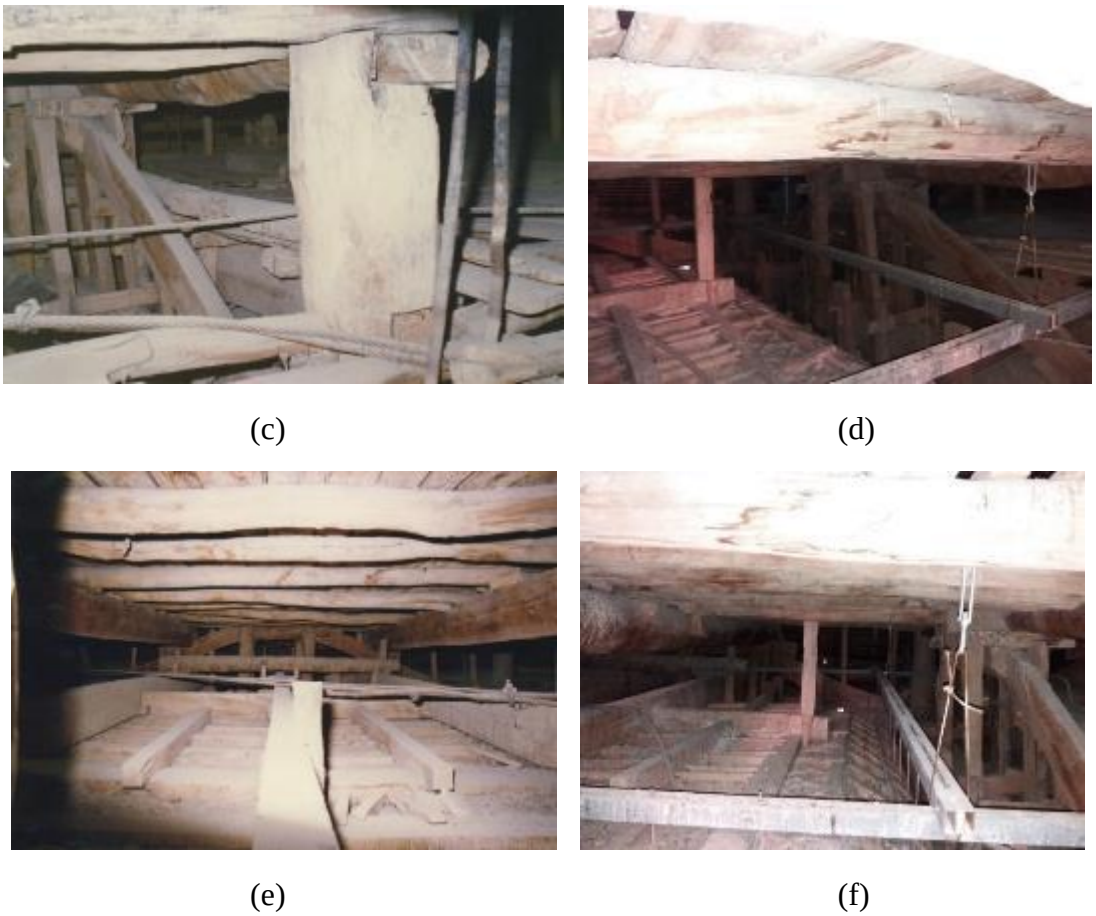


Figure 16. Ali Qapu edifice, wooden columnar structure: a) horizontal plan of the frames, b) horizontal plan of the columns, c) horizontal plan of the wooden spreaders under the columns, d) existing lateral bracing system before 2000

(a) (b)



(c) (d)

(e) (f)

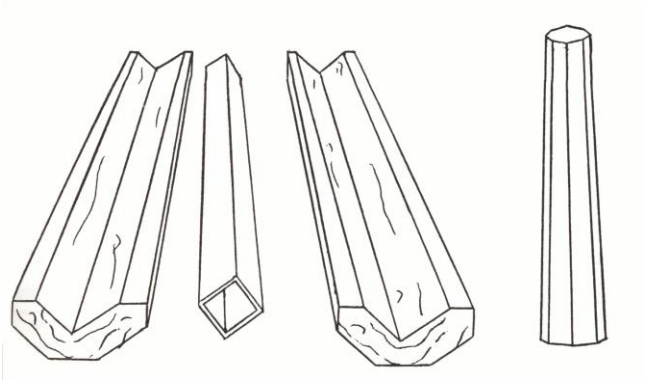
Figure 17. Ali Qapu edifice, wooden columnar structure: a) and b) wooden main and secondary beams in two directions (1990 and 2020), c) and d) a wooden truss (1990 and 2020), e) and f) wooden roof over the pond (1990 and 2020)

Load Bearing System

In the load bearing system of the wooden columnar structure, nine frames 1 to 6 and B to D participate (Figure 4 and 5 (a)). The load on the upper sloped plate is transferred to the secondary beams, which in turn transfer the load to the lower main beams through π-shape trusses. Main beams also carry the weight of the lower wooden decorated roof of the veranda, which is connected to the main beams by iron connectors. Main beams are connected to the columns. The 18 columns of the structure along with the side wall support the load of the upper structure.

Strengthening the Wooden Columns in the 1960s and 1970s

During 1967 to 1968 and 1972 to 1975, six columns α′ to ς′) were stabilized by cutting the wooden column into two parts, then emptying the central section of the two parts and putting a □-shape steel profile between them and re-erecting the wood/steel column (Figure 7). The spreader under the columns was also stabilized by I-shape steel profiles.



(a)

(b) (c)

(d) (e)

Figure 18. Ali Qapu edifice, method of strengthening of wooden columns: a) schematics of the method, b) to e) the method (1960s and 1970s)

Restoration Works in the 2000s

The last period of restoration of the building started in 2005 and completed in 2017. The restoration work focused on two parts: 1) the wooden columnar structure, and 2) the veranda on which the wooden structure stands.

Restoration of the Wooden Columnar Structure

The restoration of the wooden columnar structure involved the following parts.

Columns

The remaining wooden columns that were not stabilized by steel profiles, were cut longitudinally into two parts, emptied and embedded by □-shape profiles; the method similar to that implemented in the 1960s (Figure 8).

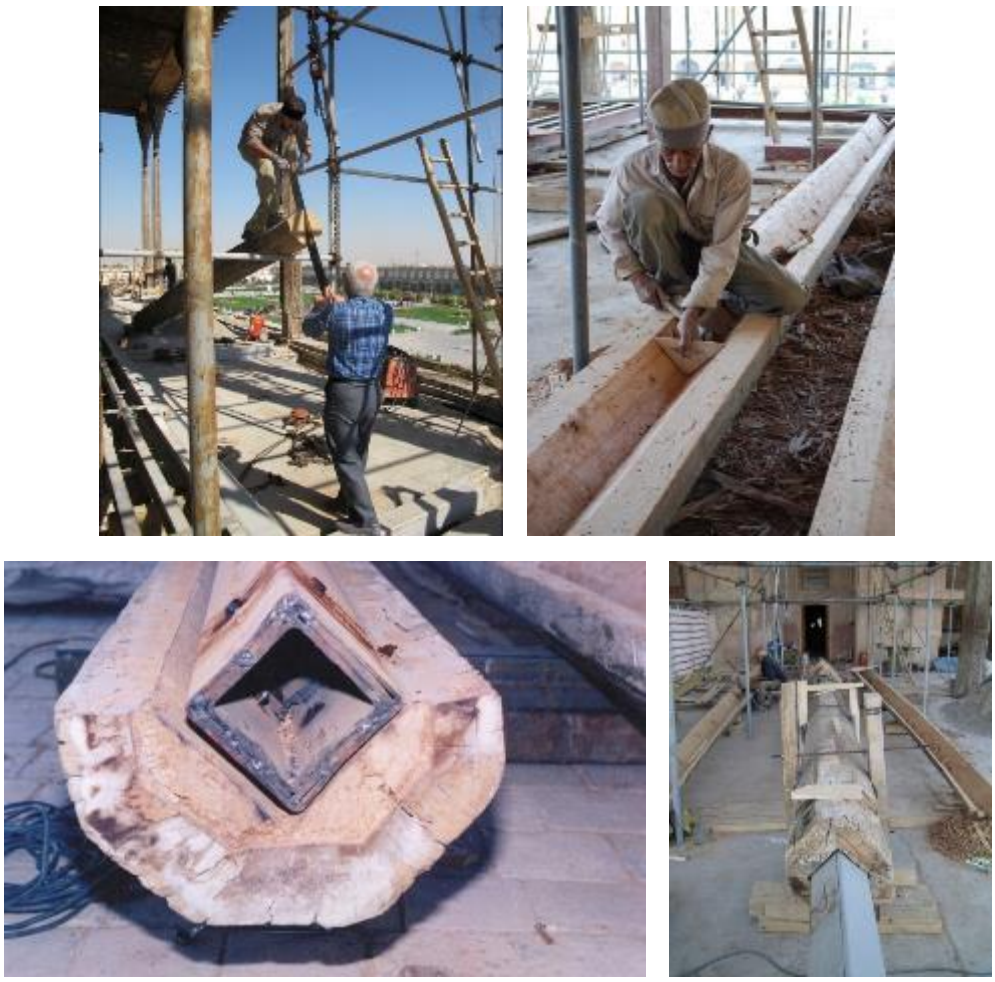


Figure 19. Ali Qapu edifice, stabilizing wooden columns with steel profiles (2005 to 2017)

Supports and Connections of the Columns

For strengthening the connection between the steel profile inside the column and its support, a reinforced concrete foundation was constructed under each column and the connection was stabilized by welded steel stiffeners (Figure 9).

For the top of the column, a steel plate was connected to the beam above and the top of the steel profile was connected to the steel plate using welded steel stiffeners (Figure 10).

Figure 20. Ali Qapu edifice, strengthening the supports of the columns (2005 to 2017)

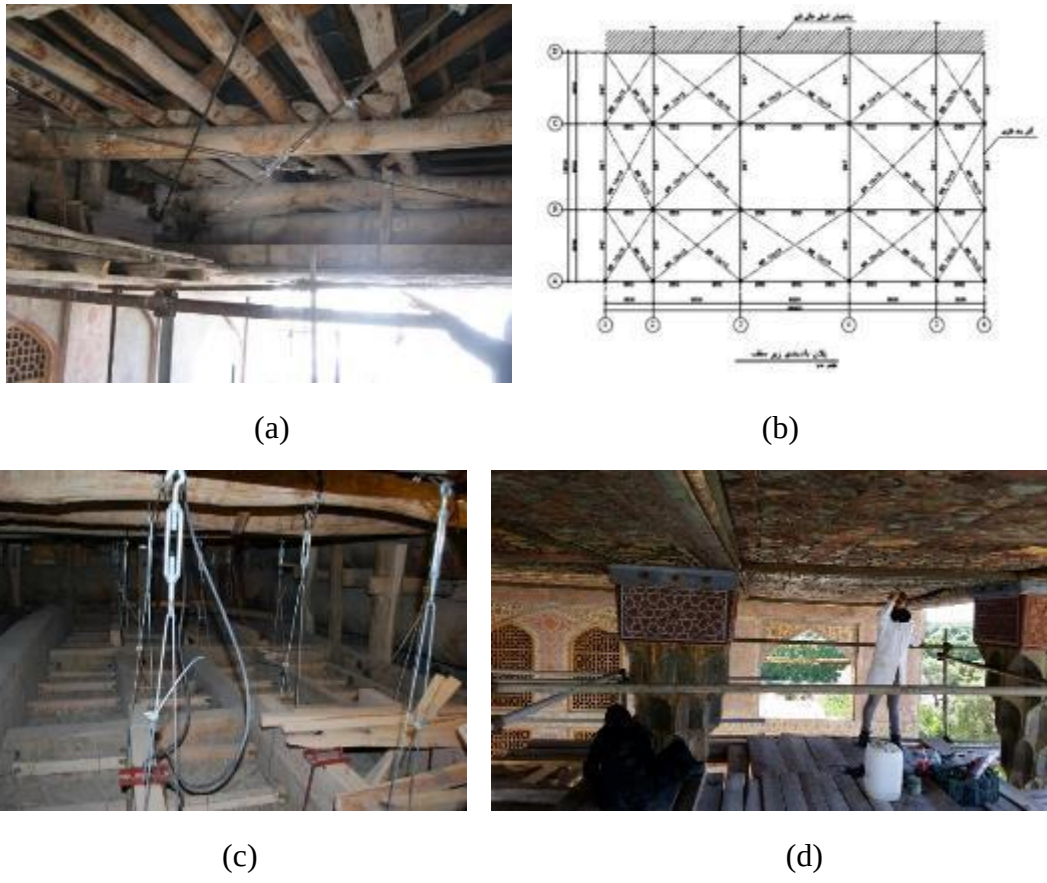
Figure 21. Ali Qapu edifice, strengthening the connections of the columns to top beams (2005 to 2017)

Lateral Load Bearing System in the Roof of the Wooden Structure

As shown in Figures 4 and 5 (d), the original lateral load bearing system of the wooden columnar structure exists in the roof and consists of a number wooden members horizontally laid around the outer spans between main beams.

In the restoration works between 2005 and 2017, a horizontal system of steel cables consisting of ×-shape bracing in all spans, except the span over the pond, was added to the roof, as seen in Figures 11 (a) and (b). It is expected that lateral load of wind and earthquakes is transferred by this system to the side thick masonry wall.

The decorated wooden ceiling is hanging and its weight is transmitted to the beams inside the roof by wooden connection and original iron strips. In the restoration work additional steel hangers were used to give additional strengthened the route of weight load from the ceiling to the upper beams (Figures 11 (c) and (d)).



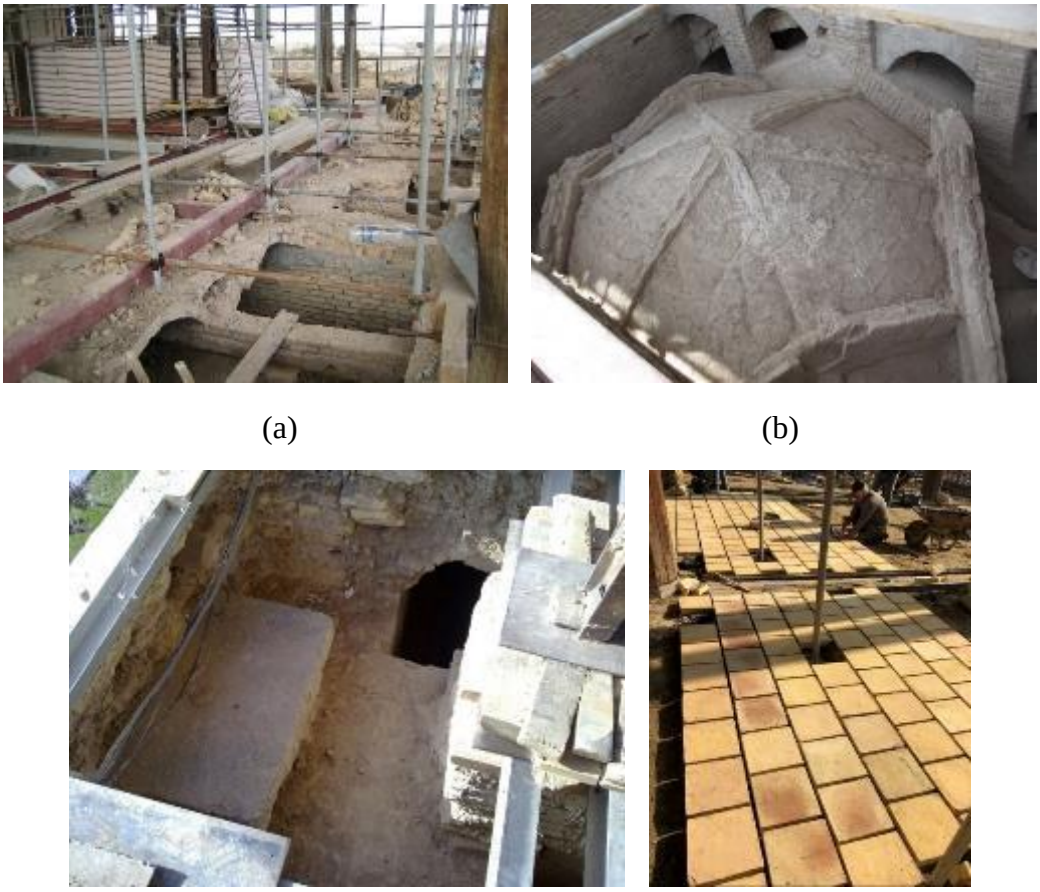
(a) (b)

(c) (d)

Figure 22. Ali Qapu edifice, the roof of the wooden columnar structure: a) and b) adding steel cables as the lateral load bearing system, c) and d) supporting the hanging ceiling by steel hangers (2005 to 2017)

Lightening the Floor of the Veranda

As shown in Figures 4 and 5 (d), the original lateral load bearing system of the wooden columnar structure exists in the roof and consists of a number wooden members horizontally laid around the outer spans between main beams.



(a) (b)

(c) (d)

Figure 23. Ali Qapu edifice, the floor of the veranda under the wooden columnar structure: a) to c) lightening the floor, d) traditional pavement (2005 to 2017)

Anti-Earthquake Measures for the Other Built Structures in the Property

As it was explained, there has been no seismic rehabilitation project carried out and no anti-earthquake measure has been taken for any of the structures. All restoration works have been focused on the partial and in some cased on the overall maintenance of the buildings. Therefore, separate seismic rehabilitation projects must be assessed and carried out in future for all built structures in the property.

Geotechnical and Seismotectonic Studies of the Site

A part of the DRMP is allocated to the geotechnical and seismotectonic studies of the site in order to study of earthquake occurrence and characteristics and its relation to the tectonics of the heritage site and its overall dynamics. The information about the geotechnics and seismotectonic of the site is almost prepared (Figures 13 to 17). Geotechnical and seismotectonic information will be used in future for seismic study of the built structures in the property.

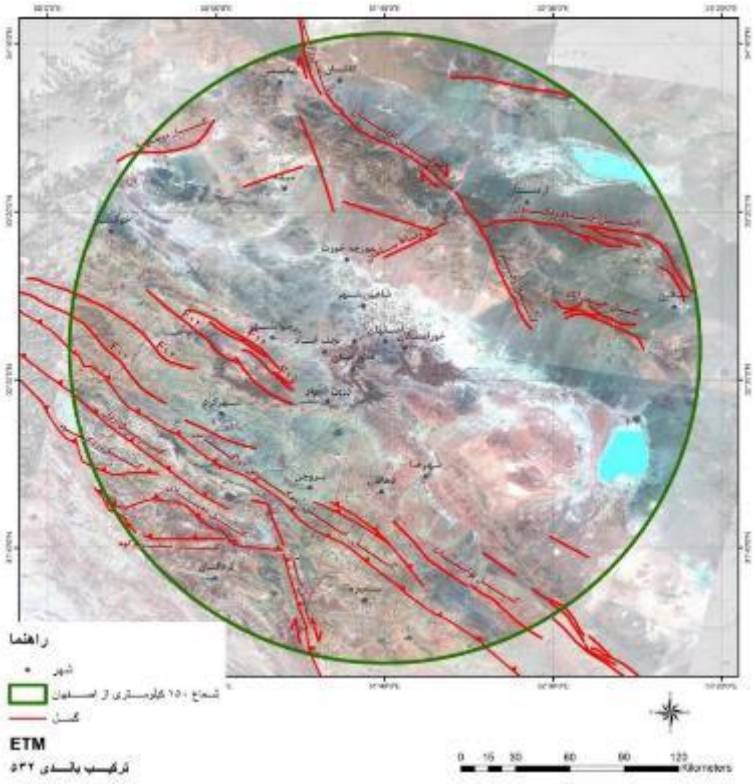


Figure 24. Faults in the 1: 250,000 geological maps within 150 km around Isfahan

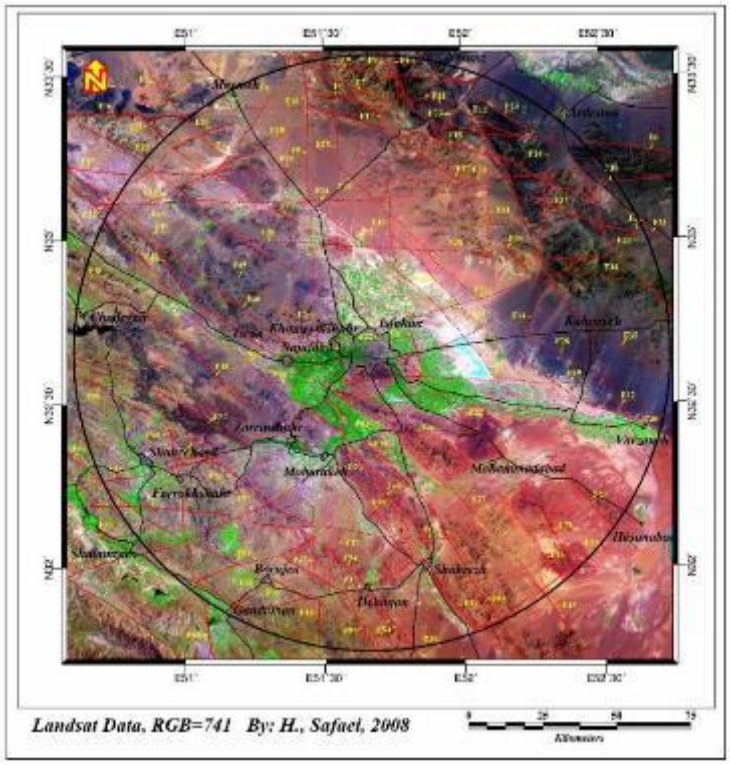


Figure 25. faults identified from satellite data within 100 km of Isfahan

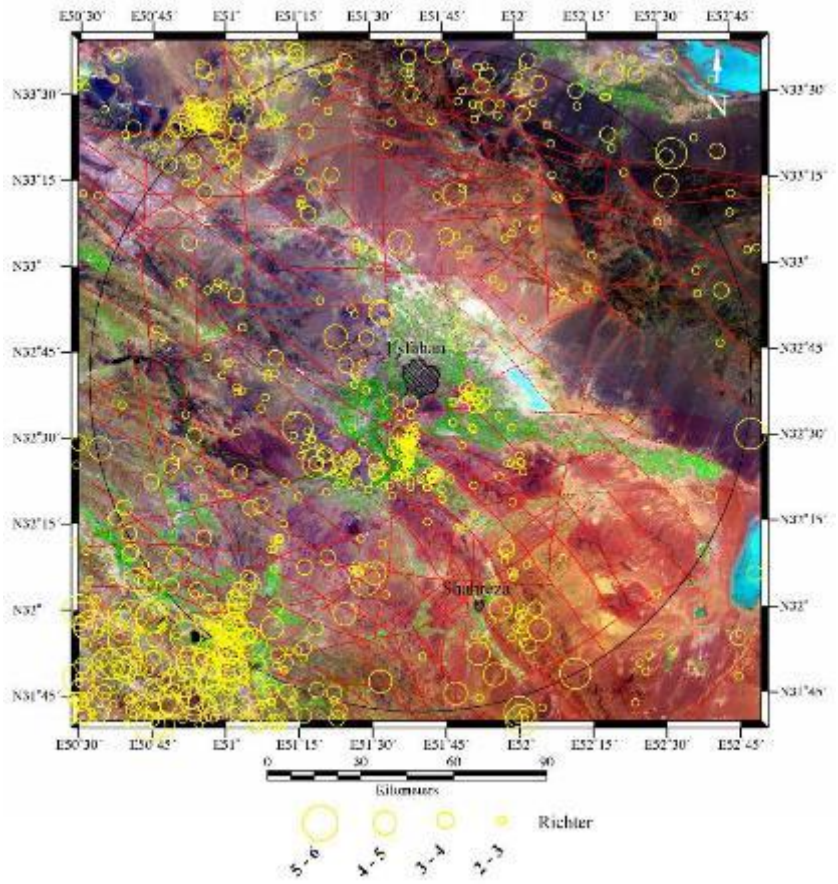


Figure 26. Earthquakes occurred within 100 km around Isfahan

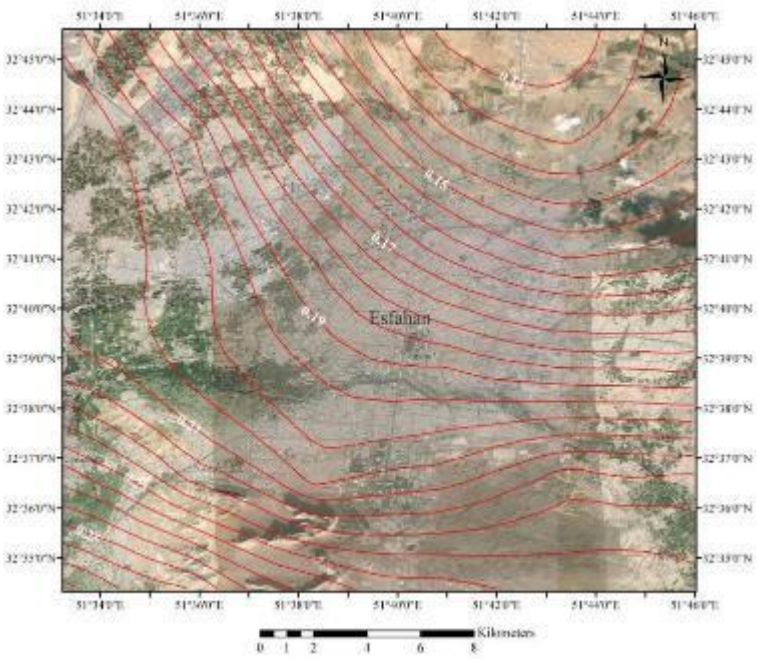


Figure 27. Earthquake hazard map at 475 years return period (10% probability of occurrence in 50 years)

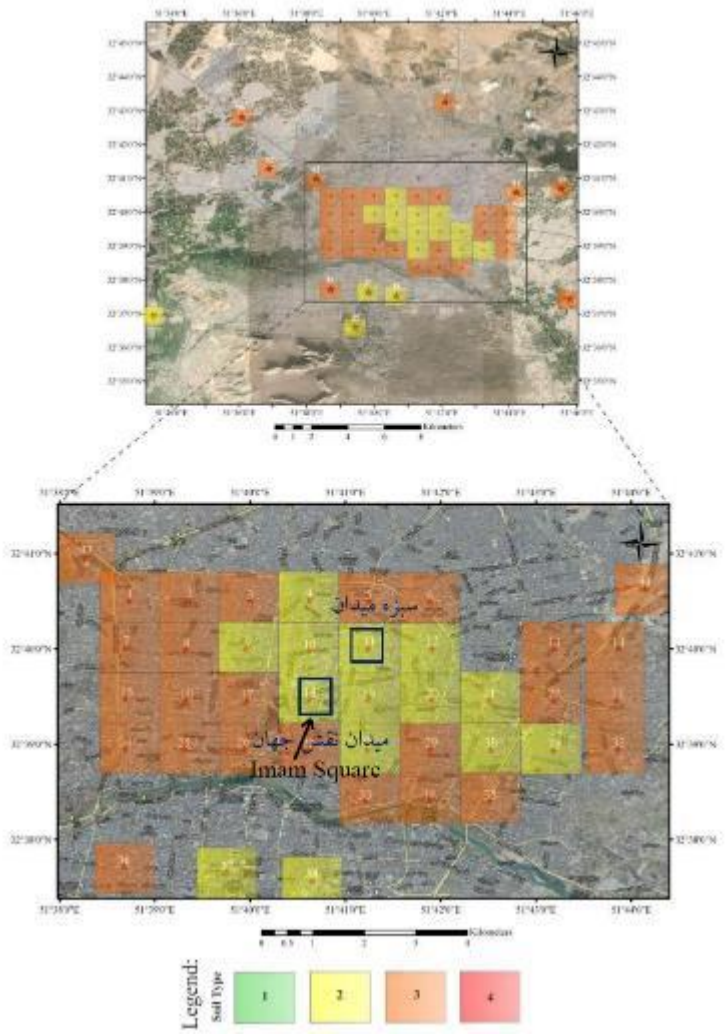


Figure 28. Location of Emam square based on soil type

WORK IN-PROGRESS

University of Isfahan