STRUCTURAL CONSERVATION OF CEVHER PAŞA BATH IN KALE, DENİZLİ

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by
Feyza DURMUŞLAR

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İZMİR

We approve the thesis of **Feyza DURMUŞLAR**

Examining Committee Members:

Assoc. Prof. Dr. Mine TURAN
Department of Architectural Restoration, İzmir Institute of Technology

Prof. Dr. Bozkurt ERSOY
History of Art Department, Ege University

Prof. Dr. Koray KORKMAZ
Department of Architecture, İzmir Institute of Technology

20 December 2018

Assoc. Prof. Dr. Mine TURAN
Supervisor
Department of Architectural Restoration
İzmir Institute of Technology

Assoc. Prof. Dr. Engin AKTAŞ
Co-Supervisor
Department of Civil Engineering
İzmir Institute of Technology

Prof. Dr. Başak İPEKOĞLU
Head of the Department of
Architectural Restoration

Prof. Dr. Aysun SOFUOĞLU
Dean of the Graduate School of
Engineering and Sciences

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ABSTRACT

STRUCTURAL CONSERVATION OF CEVHER PAŞA BATH IN KALE, DENİZLİ

The study has focused on structural conservation of a historical monument in an archeological site. Cevher Paşa Bath, which is located in Kale (ancient Tabae) archeological site in Denizli and dated to the 15th century, is selected as the case study. The aim of the study is to propose a framework for structural conservation of the ruins of Cevher Paşa Bath so that conservation work regarding similar masonry ruins in archeological sites belonging to Turkish period can be guided. First, the bath was documented by using 3D Laser Scanner. Then, historical and theoretical framework including development of baths, loads of masonry buildings and evaluation of interventions in similar cases was constituted. Characteristics of the case study was defined in terms of location, landform, history, site and mass characteristics, architectural features, structural characteristics, structural calculations and alteration analysis. Condition report of the bath was prepared in form of tables. To identify original state of the bath, restitution was carried out. Nevertheless, the restoration approach is not reintegration, but only consolidation and presentation in order to sustain integrity with the archaeological site whole. Therefore, to prevent further damages, emergency interventions such as temporary shoring are proposed. Structural calculations have revealed that strength of the walls corresponds to stresses and overturning moment. So, the restoration work includes only supporting of arch remains and the weakest corner of the bath, which was determined by calculations. Some walls of the ruin are weaker than other parts. These parts need further analysis by civil engineers, and if necessary, consolidation can be carried out. The monument management plan points out the necessity of collaboration of Kale Municipality, RT Ministry of Culture and Tourism, Aydın Regional Council for Conservation of Cultural Assets, Directorate of Excavations in General Directorate of Cultural Assets and Museums, Aydın Conservation Implementation and Inspection Office, Department of Architectural Restoration and Department of Civil Engineering of IZTECH and History of Art Department of Ege University, and monitoring of the changes the bath four times in every year.

ÖZET

DENİZLİ, KALE'DEKİ CEVHER PAŞA HAMAMININ STRÜKTÜREL KORUMASI

Bu çalışma, arkeolojik sit alanında bulunan taşınmaz kültür varlıklarının strüktürel korumasına odaklanmıştır. Denizli, Kale (antik Tabae) arkeolojik sit alanı içerisinde bulunan ve 15. yüzyıla tarihlenen Cevher Paşa Hamamı, çalışma konusu olarak seçilmiştir. Çalışmanın amacı, Cevher Paşa Hamamı'nın kalıntılarının strüktürel korumasına yönelik ilkeler ortaya koymaktır. Böylece, arkeolojik alanlardaki Türk dönemine ait benzer kalıntıların koruma çalışmaları yönlendirilebilecektir. Çalışma kapsamında ilk olarak, hamam yapısı 3B Lazer Tarayıcı kullanılarak belgelenmiştir. Daha sonra hamamların tarihsel gelişimi, yığma yapılardaki yükler ve benzer örnek olaylardaki müdahalelerin değerlendirilmesinden oluşan tarihsel ve kuramsal çerçeve oluşturulmuştur. Hamamın; konum, arazi şekli, tarih, yakın çevre, kütle özellikleri, mimari özellikler, yapısal özellikler ve değişmişlik durumu ortaya konmuştur. Ayrıca durum raporu tablo halinde hazırlanmıştır. Hamamın özgün durumunu tanımlamak için restitüsyonu yapılmıştır. Yapının arkeolojik alanla bütünlüğünü sağlamak için tamamlamadan kaçınılmıştır. Sağlamlaştırma ve sunuma yönelik bir yaklaşım tercih edilmiştir. Yıkılma riskine karşı geçici destekleme acil müdahale olarak önerilmiştir. Yapısal hesaplamalar, duvar kalıntılarının mukavemetinin gerilimleri ve devrilme momentini karşılayabildiğini göstermiştir. Sağlamlaştırma kapsamında, sadece kemer kalıntılarının desteklenmesi ve strüktürel hesap sonucu belirlenen en zayıf köşenin güçlendirmesi önerilmiştir. Ancak bazı duvar kalıntıları diğer kısımlardan daha zayıf çıkmıştır. Bu kısımlar inşaat mühendisleri tarafından daha detaylı analiz edilmelidir ve eğer gerekli görülürse, sağlamlaştırılmaları sağlanmalıdır. Anıt yönetim planı; Kale Belediyesi, T.C. Kültür ve Turizm Bakanlığı, Aydın Kültür Varlıklarını Koruma Bölge Kurulu, Kültür Varlıkları ve Müzeler Genel Müdürlüğü bünyesindeki Kazı Başkanlıkları, Aydın Koruma Uygulama ve Denetim Büroları, İYTE Mimari Restorasyon ve İnşaat Mühendisliği Bölümleri ve Ege Üniversitesi Sanat Tarihi Bölümü'nün iş birliğine dikkat çekmektedir ve yılda dört kez düzenli olarak yapıdaki değişimlerin kontrolünü önermektedir.

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Abbreviations	**Definition**
w	width
l	length
h	height
d	depth
CC1	condition class 1
CC2	condition class 2
CC3	condition class 3
UC1	urgency class 1
UC2	urgency class 2
UC3	urgency class 3
RC1	recommendation class 1
RC2	recommendation class 2
RC3	recommendation class 3
IZTECH	Izmir Institute of Technology
KTVKYK	RT Ministry of Culture, Supreme Council for the Conservation of Cultural and Natural Assets
KUDEB	Directorate for the Inspection of Conservation Implementation
CEN	Comité Europeen De Normalisation

CHAPTER 1

INTRODUCTION

Denizli, Kale (ancient Tabae) town was abandoned in 1960 because of landslide risk. It is an archaeological site at present. Kale (ancient Tabae) was proclaimed as 2nd degree archeological site in 1985 with the principle decision 880 by Supreme Council for the Conservation of Cultural and Natural Assets. Scientific excavations started in 2007. This decision was revised by the principle decision 3085 and the settlement was proclaimed as 1st degree and 3rd degree archeological site by Aydın Regional Council for the Conservation of Cultural and Natural Property in August 2010. The consolidation proposal of the bath, which was claimed by the head of the excavation, Prof. Dr. Bozkurt Ersoy, was approved with principle decision 118 by Aydın Regional Directorate of Pious Foundations in September 2010. The scientific excavation of Cevher Paşa Bath was carried out in 2013. So, some interventions were undertaken to prevent its further deterioration. However, more precautions should be taken against risks.

1.1. Literature Review

The previous studies about Cevher Paşa Bath and Kale, and studies related with conservation of similar cases in terms of approach, architectural and structural aspects are evaluated.

1.1.1. Studies on Cevher Paşa Bath and Kale Settlement

Research on history of antique Tabae has been carried out by Aydın (2012a) and Ergün (2012). Ürer (2012) have been focuses on the antique water systems in the settlement. Turkish period developments were researched by some scholars: Baykara (2007), Ersoy (2012), Aydın (2012b), İçli and Özçelik (2014) and RT Ministry of Culture and Tourism (2016).

In 2007, scientific excavations started in Kale under the supervision of Prof. Dr. Bozkurt Ersoy. Excavations were continued by Prof. Dr. Kasım İnce starting with 2014. Since 2015, they have been conducted by Assoc. Prof. Dr. Mustafa Beyazıt (RT Ministry of Culture and Tourism, 2016). In 2007; Cistern 1, Fountain 1, Pazaryeri Mosque; in 2008, Inner Citadel; in 2009; Cevher Paşa Mosque, Cistern 2 and Cistern 3; in 2010; Tekkeönü Masjid; in 2011, Cevher Paşa Bath; and in 2013, the Roman bath were excavated under the supervision of Prof. Dr. Bozkurt Ersoy (Ersoy, 2012). Scientific excavation of the historical graveyard of Kale, hazire of Cevher Paşa Mosque and hazire of Tekkeönü Masjid were started in 2015 (RT Ministry of Culture and Tourism, 2016).

Çakmak (2012) focuses on Cevher Paşa Bath and provides information about the excavation process and cleaning process of the case study building. He has some proposals related with restitution of the bath.

1.1.2. Studies on Interventions of Ruins in Archaeological Sites

In the study of Feilden (2003), structural elements and structural actions of historical buildings, causes of decays in materials and structure, the work of conservation architect in terms of research, implementation, cost control, rehabilitation and presentation aspects are discussed.

In the study of Ashurst (2007), the perception towards conservation of ruins and why they should be preserved is discussed. The general perception for ruins is that they have not lost their practical use, unless they are refunctioned. The studies of conservation of historical buildings are developed throughout decades. However, the conservation of ruins are not developed well. Architects, surveyors and builders want to refunction the building to make them useful. The ruin and its site are generally underappreciated and not understood. But archaeology is a science, which present true record of what survives. Conservation and stability concepts, condition survey, conservation philosophy and techniques of intervention are discussed. Conservation types, ecology of ruin sites, submerged ruins, implementation of conservation work on ruins and interpretation of the ruins are argued with case studies.

In the study of Woolfitt (2007), conservation approach for ruins are discussed. Woolfitt argues that, the common approach to the architectural remains in archeological sites is to exhibit them with minimum intervention, but this approach results with bad solution for existing buildings. Therefore, if measures are inappropriate or resources or limited, ruins should be reburied or back-filled in the archaeological context. Protective shelters, reconstruction, open shelters and permanent enclosure buildings may be other solutions according to type of the ruin.

1.1.3. Thesis on Restoration of Ottoman Baths

In the study of Şehitoğlu (2000), problems of Ottoman baths and water springs, which were built in the 14th and 15th centuries in Bursa, were analyzed in terms of structure, environment and function, and possible conservation solutions were suggested. In the study of Sayan (2010), documentation, restitution, analysis and restoration of Rum Bath, which was built in Kütahya, in the 19th century was carried out. In the study of Özcan (2011), the Çukur Bath in Birgi was studied. The bath was documented and analyzed. The restoration project of the bath was prepared. In the study of Aşut (2012), the Ottoman baths in Edirne were documented. The case study building (Zen İbrahim Paşa Bath) was selected and its restoration project was prepared. In the study of Öztürk (2014), restoration project of Yeni Bath in Tarsus, which was built in the 16th century was prepared by taking into consideration location, history, social and economic development of the environment of the bath. In the study of Alkan (2015), some of the historical Ottoman baths, which were built in İstanbul, were analyzed in terms of restoration interventions. These interventions were classified and were evaluated for further intervention decisions. In the study of Tağcı (2015), Güpür Bath, which was built in Çorum in the 13th century was studied. The documentation, restitution, analysis related with its environment and restoration project of the bath were prepared.

1.1.4. Related Charters, Standards, Laws and Regulations

According to Venice Charter (ICOMOS,1964) historic sites must be conserved with special care in terms of safeguarding their integrity and ensuring their presentation appropriate approach (Article 14). Burra Charter was published in 1981 by ICOMOS in Australia. This charter mentioned that conservation is related with retaining the cultural significance of a place (Article 2). To respect cultural significance of a place, there should be no, or minimal intervention to cultural significance. This place can be memorials, places of historical events, urban area, town, industrial places, archeological sites or spiritual place (Article 1). There is a charter related with protection and management of the archaeological heritage, which was accepted by ICOMOS in 1990 in Lausanne. This charter mentions that protection and proper management for heritage is important for future generations. This charter defines archeological heritage as “remains of all kinds (including subterranean and underwater) structures or places with portable cultural elements related with them” (Article 1). Archeological heritage is fragile and non-renewable; therefore, land use and planning policies should be developed to minimize destruction in sites. The implementation to the site should be revised frequently because it represents current state of knowledge (Article 2). The charter is related with conservation and structural restoration was published by ICOMOS in Zimbabwe in 2013. This charter states that values of architectural heritage is not only related with its appearance but also with its inner structure. Conservation of the structure should be as a whole (Principle 1). An understanding of structural and material characteristic is necessary for conservation. Diagnosis should include different aspects of conservation such as structural damage, material decay and historical and archeological research. The quantitative approach such as material and structural tests, monitoring and structural analysis should be part of diagnosis (Principle 2). An international workshop on management planning for archeological sites was organized by Getty Conservation Institute in 2000 in Greece. Threats, challenges of archeological sites, heritage values and challenges of conservation planning and case studies were discussed.

There are also standards related with cultural heritage. The intervention types to historical buildings are defined in the European Standard (EN 16096) which was approved by CEN in 2012. his standard was prepared for the conservation of cultural property. The standard describes how cultural assets should be evaluated. It provides guidance to assess, document, record and report cultural heritages. According to this standard, the condition of buildings can be assessed by visual observation, and simple measurements if necessary. Relevant data and documents should be also collected and added to this report. This standard is effectual for all built cultural heritage including ruins. First, the symptoms are diagnosed. According to the results, they are classified to condition classes. These classes are categorization of the condition. After, this classification, risk assessment of each class is made. Then their urgency is defined.

Possible measures for each component are recommended depending on the risk assessment.

There are many laws related with cultural assets. The law no 2863, which was accepted in 1983, defines the cultural assets which should be preserved. Legal processes of conservation and prohibitions were defined. There is additional article to the 2863, with the law no 3386, which was accepted in 1987. The article no 3(a) defines archeological site (without using this term) as a “settlement remains that reflect social, economic and architectural characteristics of their times. There is a change in the same article, in 2004, with the law no 5226. The new definition added to definition of the 3386: “places where should be conserved with natural assets and have many cultural assets, or in which important historical events that had taken place are to be conserved. With the law of KHK-648, which was accepted in 2011, natural protected area term was also defined. There are some additional laws; numbered 5663 which was accepted in 2007, numbered 5835 which was accepted in 2009, numbered 6498 which was accepted in 2013, numbered 6552 which was accepted in 2014, numbered 7061 which was accepted in 2017, numbered KHK-703, which was accepted in 2018. These additions are related with legal aspects and processes. The principle decision titled 658 was declared by KTVKYK in 1999. The decision is related with conservation and usage conditions for archaeological sites. The archeological site is defined as “a place or settlement that reflects social, economic and cultural characteristics of its period, which are located underground, above ground or underwater. In the 1st degree archaeological sites, there is no permission for any construction. Only scientific excavations can be done. But, walkways, square arrangement, car parking, toilet, guard house, ticket office and infrastructure related with presentation of the sites can be considered for a 1st degree archaeological site. There is a principle decision titled 660 was approved by KTVKYK in 1999. This decision defines intervention types according to condition of the cultural assets. The definitions in this decision will be discussed in the terminology section (1.4.1).

1.1.5. Studies on Management Plan

In the study of Feilden (1998), conservation planning is evaluated with a multidisciplinary approach related with the significance of the site. For a management plan, values regarding cultural assets should be listed and priorities should be arrayed.

There should be a committee consisted of different skills from academics, professionals and artisans. The management plan is evaluated as a continuing process which includes planning, programming and budgeting.

In the study of Güçhan (2011), a new restoration model for immovable cultural assets is suggested by evaluating restoration project of the İlyas Bey Complex. A multilateral model is proposed for dealing with implementation problems of restorations. Importance of scientific knowledge as preparation of restoration projects is pointed out. To provide scientific implementation process for the scientific project; a model for management is defined.

In order to preserve universal values of cultural assets participatory management systems have been proposed. In the study of Binan (2014), the management model and approaches for preparing management model are studied by evaluating Süleymaniye Islamic Social Complex. The vision of the management plan should focus on conservation of universal values of cultural assets. Management plan is a guideline which provides coordination in between agents for conserving cultural assets and transferring it to the future. It can be defined as a strategic plan for providing conservation and management conditions. The management plan of the Historical Peninsula is operative for the area around the studied complex. Approaches for management and organization, planning, accessibility, understanding importance and values of the site, management of visitor and management of risk strategies are developed.

In the study of the Gülersoy and Ayrancı (2011), management plan of the Durham Cathedral and Castle is evaluated. In the management plan of Durham Castle, priority is given to conserving values of the site. The vision are conserving the site for the future and methodologies related with this vision are developed. For the implementation of the plan, three different time was planned short term, mid-term and long term. The aim of the management plan is sustaining, developing and conserving universal values. Some of the important targets of the plan are conserving distinctive characteristics of the site, understanding and presenting the processes and history of the site and assessing the interest of the visitors and the characteristics of the local community for evaluating future use. These targets should be revised after 6 years in accordance with the necessities of the site.

1.2. Problem Definition and Aim

There are remains of numerous immovable cultural assets that needs to be preserved dating to Seljuk, Emirates and Ottoman Period in Turkey. Immovable cultural assets and historical environments are the important for identity of a country. These elements are not only artistic values but also, they are a document of the period in which they were built. Therefore, their transmission to future is very important. However, in Turkey, the firm which gives the lowest bid for a restoration, implements the project, even the firm is inexperienced (Güçhan, 2011). In the implementation process, findings which have emerged during cleaning may not be taken into consideration. Even though the restoration project is prepared well, contractor may not follow the project or change according to his convenience economic considerations during implementation. These implementations may cause further damages or limit the presentation of the potential unity. There is lack of monument management planning in majority of the implementations. However, in order to provide scientific conservation of the cultural assets, there should be a management plan which includes different agents (Güçhan, 2011). On the other hand, archeological studies on Turkish Period assets in archeological sites of Turkey are limited and these studies are generally related with architectural aspects of the cultural asset.

This study contributes to the conservation of Turkish period ruins in archeological sites by providing consolidation guidelines and a management plan. The aim of this study is to propose a guide for structural conservation of the ruins of Cevher Paşa Bath in Kale, Denizli.

1.3. Methodology

In order to discuss the above defined problem, a case study building, Cevher Paşa Bath in Kale, Denizli, was selected and analyzed. 3D Laser Scanner (FARO, X330) was used to document the bath. A software (Scene, 6.2.4.30) was used to convert the point cloud into an orthographic photo. To draft the measured survey, a software (AutoCAD, 2015) was used. Location, landform and history of Kale was presented based on literature research. Analysis of the bath was done with conventional visual and structural analysis techniques. Analysis of spatial characteristics, architectural elements, structural characteristics and material usage and alteration were carried out. Then, the condition report of the bath was prepared in form of tables. The European Standard (EN 16096) was used to evaluate the present condition of the bath. In addition, in this study, content of possible measures were identified according to condition classes and risk assessment. Then, a comparative study and restitution of the bath were introduced. Restitution was carried out in order to identify original state of the building, which was based on historical research, remains, traces coming from building, comparative study within the building, comparative study (literature research) and architectural necessity. The comparative examples were selected taking into consideration similarity in the construction date: 15th century. To determine restoration approach, evaluation of interventions in similar cases which focuses on reintegration and consolidation were analyzed. The effects of each intervention to case study building were evaluated. Then, proper intervention type was selected. In the proposal chapter, restoration proposal and management plan of the bath were prepared. Figures whose source are not written belong to the author.

1.3.1. Terminology

The terms regarding intervention types are acquired from the principle decision titled 660 and EN 16096. Maintenance (*"bakım")* refers to periodic and preventive actions which aim sustaining of an object; e.g. painting. This intervention does not include changes in design, material, structure and architectural elements. Simple Repair (*"basit onarım"*) is an intervention type which requires some small changes; e.g. capping with material similar to the original. The purpose of simple repair is recovering its functionality and its appearance. Restoration (*"Esaslı Onarım"*) is an intervention type, which consists of consolidation, liberation, reintegration, renovation, reconstruction (in building element scale) and moving based on measured survey and restitution. So, designing supportive elements for a historic structure is an example of restoration. There have been some minor changes in terminology in later legal documents. In the law titled 5226 dated July 14th, 2004, maintenance and restoration terms have been sustained. However, simple repair was changed as repair (*onarım*). Instead of "*bakım*" and *"onarım"*, "*tadilat*" and "*tamirat*" terms were used in a regulation date of June 11th, 2005 and involving establishment and processing principles of KUDEB.

Within the frame of this study, the content of intervention terms are defined and used as in the following: Distinguish is defined as “to notice or understand the difference between two things” (Cambridge Dictionary, 2018). Distinguishability corresponds to differentiate the ruin and new structural elements. Integrity is evaluated in two different scales: context and building itself. Integrity is defined as “wholeness and unity” (Cambridge Dictionary, 2018). In this study, intervention to the ruin and its relationship with its environment is evaluated as integrity in terms of context. On the other hand, integrity in building scale is related with wholeness of the ruin and new structure in this study. Compatibility is explained as “the fact of being able to exist, live, or work successfully with something or someone else” (Cambridge Dictionary, 2018). In this study, compatibility of material is evaluated according to the successful of togetherness of new and original material. Consistency is described as “the quality of always behaving or performing in a similar way, or of always happening in a similar way” (Cambridge Dictionary, 2018). The similarity of interventions in different parts of the ruin is evaluated as consistency (Şimşek, 2009). Accessibility is defined as “the fact of being able to be reached or obtained easily” (Cambridge Dictionary, 2018). Accessibility is evaluated according to how a user reach to the ruin and how visitors walk through out the ruin. Reversibility is explained as “ability to be changed in to the opposite direction, order, position, or state” (Cambridge Dictionary, 2018). Since, each intervention makes a trace in the ruin, instead of reversibility, retreatability is evaluated. Retreatability is used for intervening a building so that it can be re-intervened in presence of new information and necessities in the future.

Values of the case study building are defined as follows in this study. Documentary value stems from the qualities of an asset that reflect social and cultural life of the period that it was built (Madran and Özgönül, 2005). Documentary value is referred to preserve information of an existing structure in this study. Authenticity value is related with presence of authentic characteristics of historical buildings or not. Authenticity provides information about structural system, construction technique, spatial characteristics and architectural elements of a buildings (Madran andÖzgönül, 2007). Rarity value is related with whether a building is rare or not in terms of its architectural aspects, structural system, construction technique, spatial characteristics or architectural elements (Orbaşlı, 2008).

1.4. Content

In the first chapter, the previous studies related with ruins and their conservation approaches are analyzed. The problem of the study, its aim, methodology and related terminology of the study are explained. In the second chapter, historical and theoretical framework of the study are presented. This framework is stated in terms of development of Baths in Anatolia, loads on masonry buildings and evaluation of interventions in similar cases. In the third chapter, characteristics of the case study building are introduced. The location and landform of Kale, history of the settlement, site and mass characteristics of the bath, façade characteristics of the bath, spatial characteristics, architectural elements, structural characteristics and material usage based on observation, structural analysis, alteration analysis and condition report of the bath are presented. In the fourth chapter, the comparative study and restitution of the bath are explained with reference to similar baths which were constructed in the 15th century. In the fifth chapter, proposal is suggested. This proposal is consisted of three different stages, which are emergency intervention, restoration and management plan. In conclusion, principles for structural conservations of similar historic ruins are clarified.

CHAPTER 2

HISTORICAL AND THEORETICAL FRAMEWORK

In this chapter, development of bath building type, loads which masonry buildings carry and interventions preferred in similar cases are discussed.

2.1. Development of Baths

In this section, development of baths throughout history is discussed.

2.1.1. Bathing Culture

Baths have been important spaces in terms of cleaning, resting and socializing throughout history. Since the ancient times, cleaning of body and bathing relation created the concept of bath culture. The bathing culture dates back to ancient Egypt, Mesopotamia and Anatolia, 2000 BC. The most developed baths were built in Roman Period. In Roman period, baths became a physical, medical, social, mental development, educational and communal spaces. In Byzantine, related with Christianity, cultural life changed, and usage of baths decreased. These ancient settlements inherited bathing culture to Seljuk period. This culture continued in Ottoman period (Ergin, 2012). The bath as a socializing tool has become an essential part of everyday life in Ottoman civilization (Öney, 2002). In ancient periods, there were water channel remains in cities. There were also gymnasium buildings in ancient period (Ergin, 2012).

2.1.2. Baths in Antiquity

In one of the ancient settlements of Sind in Pakistan, well-developed water channel system remains were found. The settlement was one of the cities (Mohenjo-Dore) of Indus civilization dating back to BC 2500-1500. The remains of bathing facility which belongs to Assyria King III Salmanazar (BC 859-824) was found in excavations in Old Mesopotamia. There are also bath remains in Tell el-Amarna in Egypt. There are remains of baths in houses dating to 3rd century BC in Tell Halaf in Syria. There are some elements related with bath such as clay water pipes (*künk*), water channel remains, bathtubs and cubes. There is a bath remain in Gaziantep, Turkey which dates to Late Hittite Period, BC 1200 (Eyice, 1997).

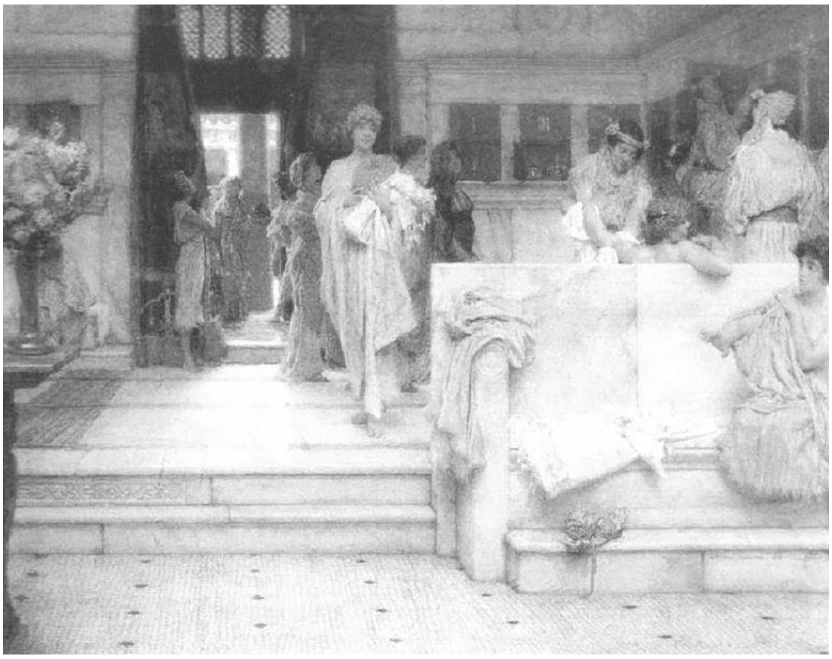

Figure 2.1. Bathing Culture: Lawrence Alma-Tadema, A Favorite Custom, 1909 (Source: Yegül, 2012)

In ancient Greek civilizations, gymnasiums were seen (Yegül, 1992; Eyice, 1997). Bathing with warm water was considered as healthy. It was exclusive for king. Bourgeoisies imitated king's lifestyle. In addition, heroes were awarded with warm water at the end of the battle. This was how gymnasium culture comprised in the 4th and in the 3rd centuries BC. Gymnasiums were earliest example of communal bathing in terms of architectural and social context. It is also the earliest form of Roman baths. Gymnasium was part of every ancient Greek city. It served for both military and athletic training of community (Yegül, 1992). Athletes made sportive activity in gymnasiums*;* afterwards they bathed. There were no water heating systems in early gymnasium (Eyice, 1997; Yegül, 2009). The athletes bathed in the rooms around courtyards. These bathing rooms were named as *loutron* and these courtyards were named as *palaestra* by Vitruvius.

At the end of the 2^{nd} century BC, hot water was used in special rooms which were named as *caldavation*. Heating of spaces started in this period (Yegül, 2009). In the 6^{th} century BC, the idea of merging training of the body and training of mind (ephebic education) was comprised. Musical and intellectual training became part of gymnasiums in this period. While scholars, philosophers gave lectures in the gymnasium, poets and musicians organized performances. Libraries were built in gymnasiums in Hellenistic period. The gymnasiums in the 4^{th} century BC were peristyle buildings with rooms around colonnaded courtyards (Yegül, 1992).

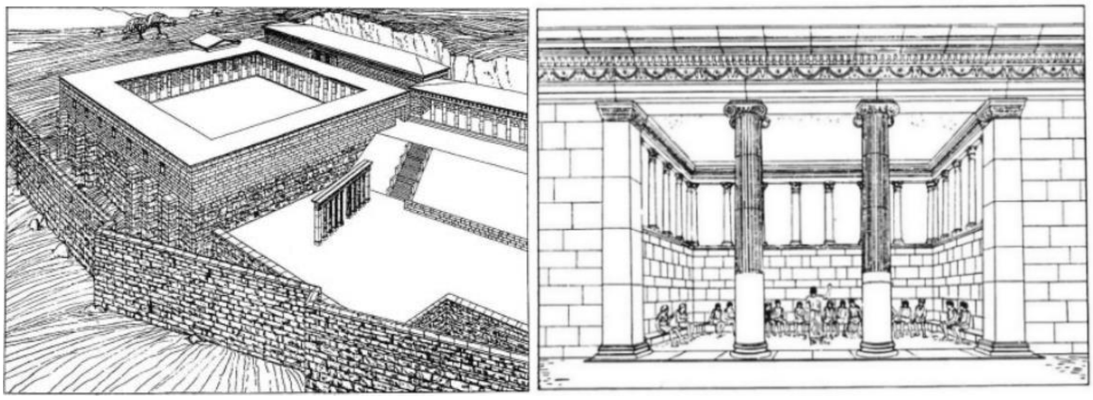

Figure 2.2. Lower Gymnasium in Priene, Perspective view (left), Ephebeum (right) (Source: Yegül, 1992)

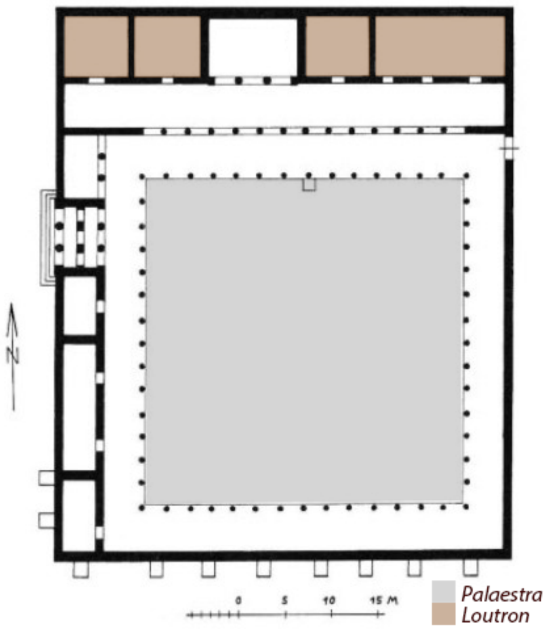

Figure 2.3. Lower Gymnasium in Priene plan (Source: revised from Yegül, 1992)

2.1.3. Baths in Roman Period

In Roman period, baths were part of social life. Many public spaces such as a library were part of baths (Ertuğrul, 2009; Berger, 2012). Baths in Roman period served for wealthy class. Yegül (1992) defined public baths as club like centers. Anyone who could pay the entrance fee, could use baths (Yegül, 1992; Eyice, 1997). In Roman Period, baths were very well-developed. Sergius Orata, architect who lived in the 1st century BC, designed central heating system and warm air system for baths. These systems increased the usage of baths. Baths were classified as public and private baths in this period. Private baths were generally part of houses of rich people (Eyice, 1997). Two separated parts for each gender were seen in public baths. These parts were called as bath of men (*balneum virile*) and bath of women (*balneum muliebre*). Even though they were separate; exercise areas, heating and service facilities were the same. Another practice in this period was establishment of different hours for bathing of different sexes. While women used baths in mornings, men used baths in afternoons (Yegül, 1992).

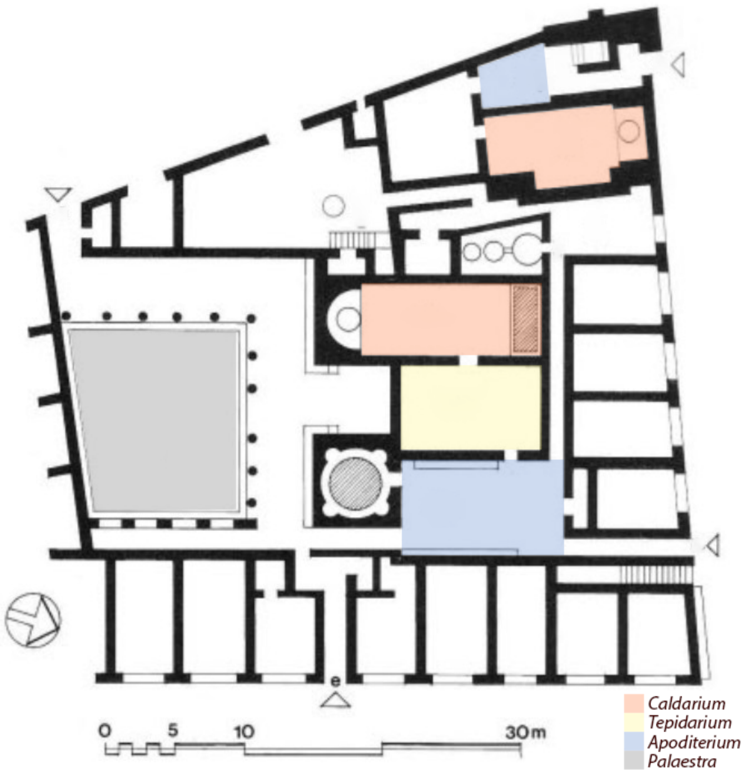

Figure 2.4. Plan of Pompei public baths

(Source: revised from Yegül, 1992)

The plan of Roman baths in the 1st century BC were irregular. In the 1st century AD, they became symmetric. With the new heating system, new spaces were seen in this period. In courtyards, competitions related with sports were held. *Apoditerium* space where people undressed was located besides the main entrance. Then, there was a bathing space which was named as *Frigidarium.* In this space, there was a big pool for swimming purposes. Bathing was realized with cold water in *Frigidarium.* There was a warm space named as *Tepidarium*. The main hottest bathing space was *Caldarium*. The most important baths in Roman period were Caracalla, Titus, Docletianus and Constantinus baths. Caracalla Baths could serve for 1600 people at the same time. Its lot coverage was 25000 m². It housed a library, a theatre and eating rooms (Eyice, 1997; Yegül 2009).

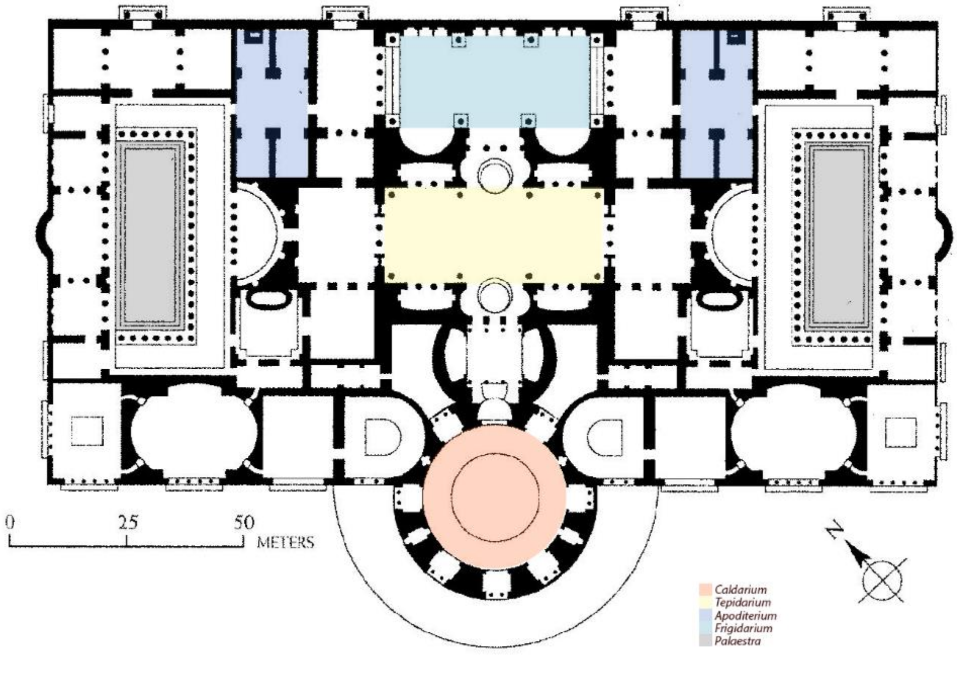

Figure 2.5. Plan of Caracalla baths
(Source: revised from Cartwright, 2013)

2.1.4. Baths in Byzantine Period

Bathing tradition continued in Byzantine period. Byzantines restored the baths from Roman period (Eyice, 1997). With Christianity, daily life and culture changed. People believed that they had to live a reclusive life (Berger, 2012). Bathing and cleaning were contrary to this idea. Usage of public baths decreased due to pressure of church. Bathing was associated with devil in Byzantine period because of imposition of Church. (Yegül, 1992; Berger, 2012). Another reason of decreasing usage of public baths was expensive maintenance and management costs. The construction of new baths decreased due to reduction of economic and political power after the 7th century. New baths were seen only in palaces and wealthy villas. Nevertheless, usage of existing baths continued. Some baths were operated by churches (Yegül, 1992). Bath buildings were converted into administrative and social service buildings in Early Byzantine period (Yegül, 1992). Public baths became places where many things were discussed. It is even known that entertainment activities were arranged in baths (Eyice, 1997). Gymnasium of Port Bath in Ephesus was converted into a bazaar. The bath of Sardes was converted into a *gerouisa*, which means meeting space of elders of the parliament. Larger baths lost their function. Nevertheless, smaller baths in Anatolia served the public and sustained bathing culture (Yegül, 1992). There was a salesroom in Zeuksippos Bath in Constantinople, which continued to be used until the 8th century (Eyice, 1997). In the 5th century, there were 9 large thermae and 153 private baths in Konstantinopolis. Byzantine Emperors used thermal baths in Phytia (Yalova) and Prousa (Bursa) in this period (Berger, 2012). There is not much information about architectural features of baths in this period. Overall composition of baths consisted of a small entrance, main space with dome and furnace at the rear of the main space. They used slack water (Berger, 2012). Nevertheless, bathing culture, which was inherited from ancient world, was kept alive (Yegül, 1992).

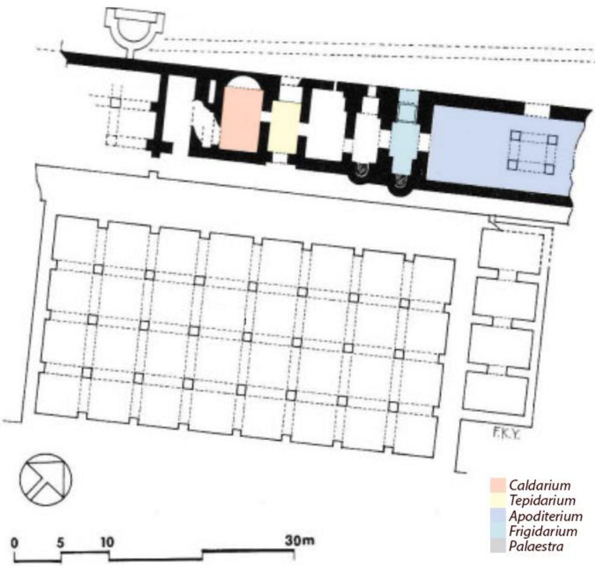

Figure 2.6. Byzantine Bath in Constantinople under Topkapı Palace

(Source: revised from Yegül ,1992)

2.1.5. Baths in Seljuk Period

Baths were elements of social life in Turkish culture. They provided both bathing and socializing space (Erat, 2006). According to Yegül (1992), historical Turkish baths were the continuation of the Roman baths and bathing culture. It is known that cleaning of body and bathing were important for Turks even in Central Asia. There were also some bath types, which were named as "*munçamunçak*" baths and "*çerge*" tent baths belonging to this pre-Anatolian period. So bathing tradition of Turks has it roots in pre-Islamic and pre-Anatolian era. It can be stated that there is a bath type peculiar to Anatolian Turks, which had synthesized traditional architectural features, Islamic impacts and local cultures (Erat, 2006). Anatolian Turkish Baths sustained heating system of Roman Baths but they Baths were differentiated from Roman Baths. There were no pools in Anatolian Turkish Baths. Also, they were not monumental as Roman Baths (Eyice, 1960).

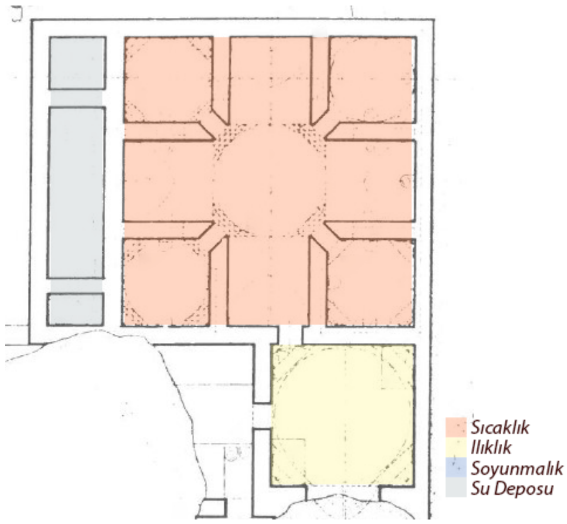

Figure 2.7. Plan of Sitti Radviye public bath in Mardin
(Source: revised from Önge, 1995)

The Anatolia baths in Seljuk Period can be classified into two group as hot springs and baths. Hot springs were baths, which used natural hot water resources. The purpose of this building type was treatment. Water was heated within the bath in the second group. The aim of using this type of bath was cleaning. Baths were classified according to their level of privacy as public baths (e.g. bazaar baths) and private baths. Single and double baths included usage by different sexes at different time intervals and separate parts for men and women, respectively. In double baths, the spaces of men part were generally larger in size than the women part. The entrances of the men’s section were accessed from a square or a main road. Whereas the entrance doors of the women’s section were kept more private. In very few cases, the entrance doors opened to the same street. Public baths were generally part of Islamic social complexes. They were built for commercial purposes. These baths adhered to a waqf (pious foundation). Private baths were the baths in small size that were offered for use by a limited number of people such as inhabitants of a *konak* or a *tekke* (Aru, 1941; Eyice 1960; Önge 1988, Erat, 2006).

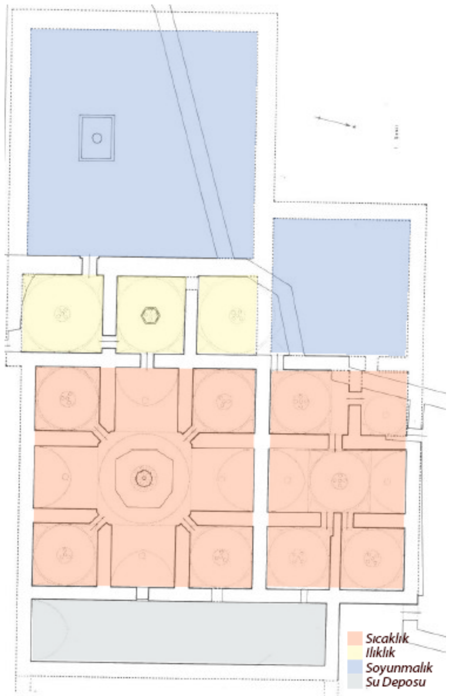

Figure 2.8. Plan of Pervane public bath in Tokat (double bath)
(Source: revised from Önge, 1995)

2.1.6. Baths in Early Ottoman Period

A large number of public baths were built in all Ottoman lands from the 13th century to 19th century. There were also private baths in the *konaks* and palaces. There were only washing places called *gusülhane* in modest size houses (Eyice, 1997). There were two reasons for construction of bath in Ottoman period. One of them was baths were considered as a source of income for waqf. The second reason was baths provided basic health requirements and prevented diseases. They were generally built in Islamic social complexes. Therefore, they served for people, who used mosque, bazaar etc… in this Islamic social complex (Eyice, 1997). In the Ottoman period, plans of baths did not change much, however, architectural details developed (Ertuğrul, 2009). Single and double bath difference was sustained in Ottoman period as well (Eyice, 1997; Ertuğrul, 2009). Ottoman baths were mostly built as double baths, and the general principle that the entrance doors of the male and female parts were to be provided separately had been continued as well (Ertuğrul, 2009). Heating system of Ottoman baths were very similar to Roman baths. Architectural features were different in terms of plan scheme (Eyice, 1997). One of the characteristics of baths in Early Ottoman period was that soyunmalık spaces were built with very large domes (Ertuğrul, 2009). The width of the domes changed in between 10 m to 15 m in some baths such as Sarıca Paşa bath in Gelibolu and Koca Mustafa Paşa bath in Bursa. The width of the dome of Yıldırım Bayezid in Mudurnu bath was the largest: 20 m (Eyice, 1997). Another feature of the baths of the Early Ottoman era was that the domes were decorated with stars, spirals and slices from the inside. The examples which were built at the beginning of 15th century were Orhan Gazi Bath in İznik, Hacı Hamza Baths, Ismail Bey Baths, Demirtas Baths in Bursa, Mudurnu Yıldırım Baths in Mudurnu and Bergama bath. They were characterized by rich ornaments and various dome shapes (Ertuğrul, 2009).

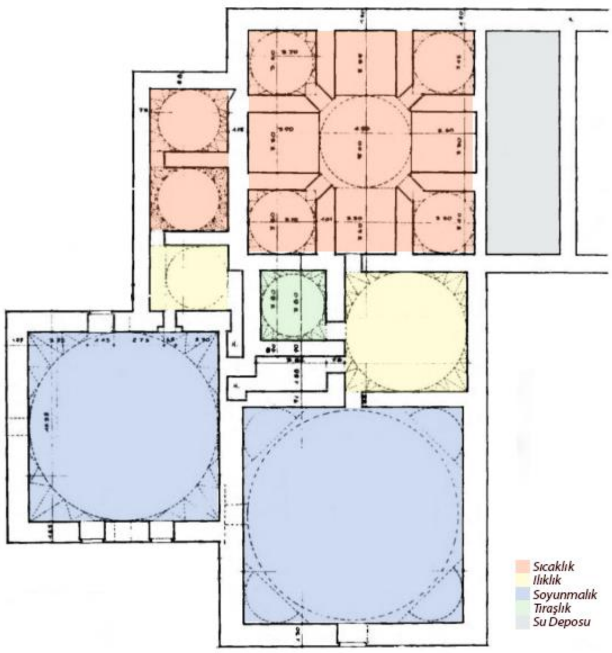

Figure 2.9. Plan of Orhangazi public bath in Bursa (single bath), (1399)
(Source: revised from Ayverdi, 1976)

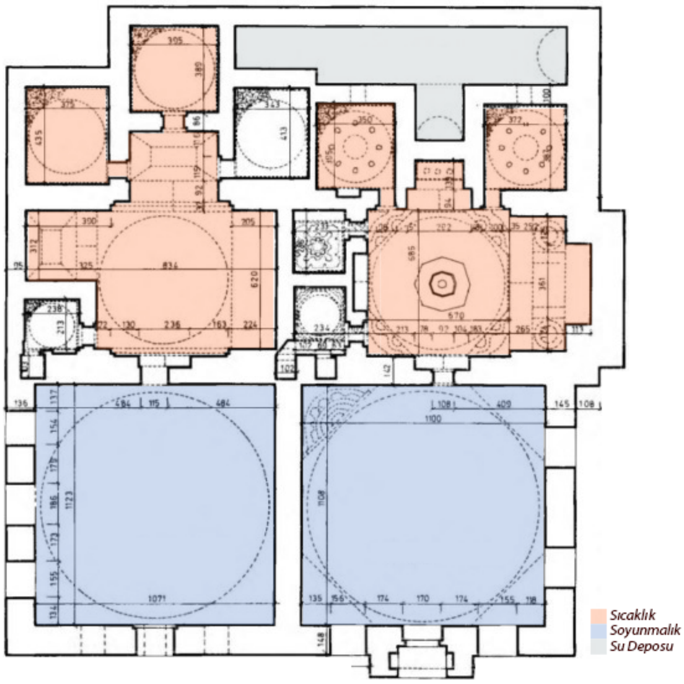

Figure 2.10. Plan of İbrahim Pasha public bath in Bursa (double bath), (15th century) (Source: revised from Ayverdi, 1976)

2.1.6.1. Spatial Characteristics and Architectural Elements

The historical Turkish baths consisted of *soyunmalık*, *aralık*, *ılıklık*, *tıraşlık*, *sıcaklık*, water reservoir, furnace, *keçelik*. (Eyice 1960; Önge 1988, Önge 1995, Erat, 2006).

Soyunmalık provided an area to undress and to rest. It was generally the largest space of the bath. It was generally square or rectangular in plan. The walls of *soyunmalıks* were high and blind to provide privacy. At the top of the walls, there were embrasures which provided light. There were also oculi for lighting at the superstructure of the baths (Önge, 1995; Erat, 2006). There were some timber platforms for resting and fountains with water jets at the middle of the space. There were some niches under the platforms for shoes. There were some niches on the walls to dry wet towels (Aru, 1941). The superstructure of *soyunmalık* spaces were timber roof, masonry vault or dome, which were supported by wooden posts or masonry arches, respectively. In some examples in Early Ottoman Period, vaults cover were supportive arches. One of the important features of timber *soyunmalık* in Ottoman period, was presence of dilatation between the walls of *soyunmalık* and the adjacent masonry walls. To provide protection from weather conditions, there could be a riwaq at the front of the entrance. In Early Ottoman period, these elements were converted into aesthetical elements (Önge, 1995).

A*ralık* was one of spaces which provided passageway and prevented vapor transition to reduce heat loss between *ılıklık* and *soyunmalık*. The space also included toilet and *tıraşlık* spaces. These spaces were seperated with a masonry wall or timber panels. The superstructure of the space was generally domed or vaulted. There were some examples within which *aralık*, toilet and *tıraşlık* were under the same superstructure. From Seljuk period to the 14th century, this scheme was the same. In the 15th century, *aralık* diminished in size. Finally, the space lost its function and became a corridor in between *soyunmalık* and *ılıklık*. In the late 15th century, *aralık* space was completely omitted. There was direct access from *soyunmalık* to *ılıklık* in this period. Toilet and *tıraşlık* spaces were located on one side of *soyunmalık*. In some examples, *tıraşlık* and toilet were on the opposite sides of *ılıklık* space. In the 15th century, a chimney could crown the door in between *soyunmalık* and *ılıklık*. This element was built instead of *aralık* space for to substitute its function.The aim of this element was to prevent vapor transmission and reduce heat loss. (Önge, 1995; Erat, 2006).

Ilıklık space was for maintaining body balance in between the hot *sıcaklık* and cold *soyunmalık* (Aru, 1941). It was generally square planed with a dome or a vault until the 14th century (Çakmak, 2002; Önge, 1995). After the 15th century, it had a rectangular plan and a vault. (Çakmak, 2002). According to Önge (1995), there is no original wash basin remain because there was no bathing in this space. However, there were some platforms for resting purpose. However, according to Aru (1941), people who could not endure hotness, bathed in this place. It may be interpreted that *ılıklıks* were provided as washing element in later eras. There were niches and *halvet*s in some examples in the 14th and 15th centuries. These *halvets* had toilet and *tıraşlık* function. In the 15th century, ablution fountains were seen in the middle of the space. In general, when superstructure of *ılıklık* space is a dome or a vault, *soyunmalık* space's superstructure was timber roof (Önge, 1995).

Sıcaklık was the main bathing space and the hottest zone of the bath (Aru, 1941; Erat, 2006). There were many iwans with platforms approximately 20 cm higher than the ground level. For private bathing, there were cells called *halvet*. *Halvet*s were generally square in plan and had a dome. However, iwans were covered with vault in general. In the center of the *sıcaklık*, there was an architectural element called *göbektaşı* (Aru, 1941).

This was for rubbing the body with a coarse bath-glove. In the 16th century, *aralık* spaces were completely omitted. There was a direct connection in between *sıcaklık* and *ılıklık*. The superstructure of iwans around the central space was generally pointed vaulted. The superstructure of *halvets* were generally domes (Önge, 1995).

Water storage was generally adjacent to *sıcaklık*. Water was stored in this space. Water system consisted of three different subsystems. First one consisted of bringing water to bath and dispatching it to water storage. Distribution of water in bath was the second system. Third system was throwing out waste water. Water was obtained from streams, rivers and water reservoirs of waqfs such as special wells and cisterns. Heated water was distributed with terra cotta pipes named as *künk, merbah* and *pöhrenk*. These pipes were carved into masonry walls (Önge, 1995).

Furnace was generally located at the back of water storage. Its length could be equal to water storage. Its superstructure was generally vault.

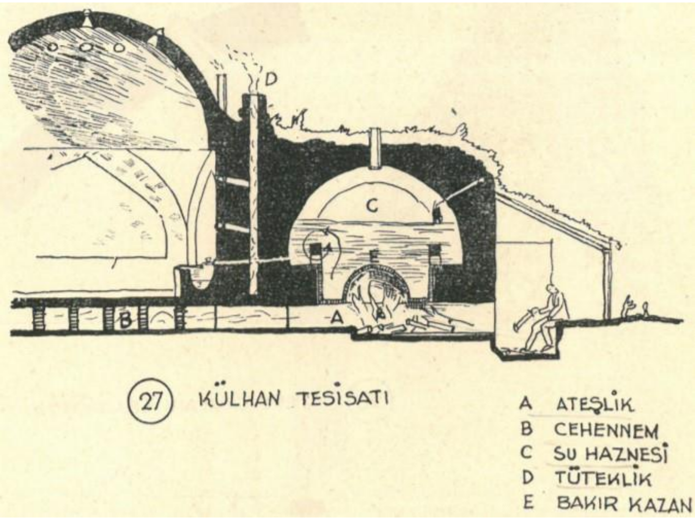

Figure 2.11. Water storage and heating system of Turkish baths
(Source: Aru, 1941)

Felting was a very important craft in Ottoman period. To produce felt, hot water was used. Some bath had *keçelik* part to produce felt. Felt-maker also bathed. There was a connection between *keçelik* and *ılıklık* (Çakmak, 2002).

There were some lanterns at the dome of the baths which provided daylight. If it was not sufficient, candles and oil lamps were used. There were some openings at the upper part of the *soyunmalık* which provided daylight. There were some oculi (*filgözü)*, providing both light and decoration (Aru, 1941; Erat, 2006). Fountain, wash basin, interior walls and domes were all decorated. These building elements could be out of stone block or rubble stone finished with plastering or ceramics. *Kalemişi* could be applied for decoration (Erat, 2006).

2.2. Loads of Masonry Buildings

In this part of the study, loads of masonry buildings and analysis of them is discussed.

2.2.1. Analysis of Loads

According to Ancient and Medieval writings, if the shape of the structure is correct, it could deal with the structural forces. Stress calculation is of secondary interest. They were concerned with geometrical rules to provide stability. The architects had an instinctive understanding of forces and related stresses (Feilden, 1982; Heyman, 1998). Piercing walls, vaults and domes served for the purpose of dispersing forces through load carrying members (Feilden, 1982). However, modern engineering has different methods to design structural elements. Stress calculation is part of the structural design. Stress level-based design is one among these methods. In this study, compression and shear stresses in the structural members are predicted and compared with the strength of the materials from literature.

2.2.2. Natural Stone and Masonry Buildings

Natural stone is one the durable building material. It is extracted from stone quarry and it is resistant to atmospheric affects (Türkçü, 2017). Stone members are very enduring against compression forces, however, they are very weak to tension forces (Calladine, 1992; Ünay, 2002). Masonry structure is assemblage of dry stones together with mortar to obtain a continuous load-transferring pattern (or bricks and other similar materials). The mortar is weak and strengthens with time by setting process (Calladine, 1992; Ünay, 2002). Load bearing walls transmit the loads of superstructure. Cracks occur when material strength is exceeded. Settlement, creep, humidity and earthquake create damages on the building which affect appearance and durability. The major damages that are encountered during the earthquake are; formation of cutting cracks in the plane of the walls, the overturning of the walls out of plane, the separation of the walls from the corners, and the breakage of slabs from walls. The displacement in plane of the wall usually does not risk the stability of the structure (Arun, 2005).

2.2.3. Loads

There are many loads, which affect the buildings. Dead loads are sourced of building itself (Calladine, 1992). Live loads are generally weight of people and goods related to buildings function and usage. Dynamic loads are the loads, which result in vibratory displacement of the foundations such as wind and earthquake. Tension, compression, bending, torsion, and shearing are known as the internal forces (Arun, 2005).

2.3. Restoration Approaches in Similar Cases

In restoration projects, objectives of related interventions should be identified clearly. Then, appropriate intervention decisions can be proposed. These objectives generally depend on to preserve the building from environmental and physical conditions (Feilden, 2003). In this process, the physical condition of building is documented with measured drawings, then, the related analysis is carried out. After analyzing causes of decay, the related precautions are defined (Ahunbay, 2017). On the other hand, values of cultural assets should be legible in both historical and documentary context. The presentation should be part of historical evidence. Presentation of the message of a historic building that has accumulated in its life span should be made. To prevent further damages, consolidation can be done. The concept of consolidation and the presentation of the message should be compatible with each other (Feilden, 2003).

2.3.1. Basilica di Siponto

The restoration includes as an interpretation of an Early Christian Church ruin. It is located in the Archeological Park of Siponto. Wire mesh sculpture proposed in the restoration integrates with ancient buildings and surroundings. The sculpture present historic structure including columns, domes, statues and architectural elements (Sierzputowski, 2017). Intervention related with reintegration, consolidation and presentation purposes was implemente. Reintegration was totally implemented to whole ruin with new material. Both historical and new structure are well legible in the presentation. Integrity of the church was re-established.

However, there is lack of integrity in terms of context. There are some other ruins around the building which are not intervened in terms of their dimension. New material is compatible with original material and it is distinguishable. Each element of the wire mesh is reversible (Ilpost, 2016). So new structure is retreatable.

Table 2.1. Basilica di Siponto

Identification	Current Restoration	Evaluation
Location: Siponto, Italy **Construction Date:** Early Christian **Original Function:** Basilica **Original Structural System:** Masonry **Original Material:** Rubble stone, brick finished with plastering **Conservation State:** In ruin, lost third dimension	**Implementation Completion Date:** 2016 **Director of Project:** Ministry of Cultural Heritage and Activities and the Archaeology Superintendence of Puglia **New Function:** Museum **Architect**: Edoardo Tresoldi **Applied Parts:** The whole ruin **New Structural System:** Steel frame **New Materials:** Stainless steel covered with wire mesh; new walkways out of stainless steel finished with wire network **Award: -**	**Intervention Type:** Reintegration, consolidation, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☐ **Integrity (building itself):**☒ **Compatibility of materials:**☒ **Consistency:** ☐ **Accessibility:** ☒ **Retreatability:** ☒

Figure 2.12. Basilica, after 2016 restoration

(Source: Sierzputowski, 2017)

Figure 2.13. Dome of Basilica (left), Columns of Basilica (right)

(Source: Tresoldi, 2018)

2.3.2. Basilica Paleocristiana di San Pietro

Basilica Paleocristiana was built as an early Christian basilica. There were many interventions throughout history. Therefore, it has lost its original characteristics (Divisare, 2018a). The restoration which was made in 1950, changed the interior space irreversibly. Therefore, to put forward the original form of the superstructure, the structural elements of superstructure were reconstructed with timber framed structure. It was awarded with I'Italian Heritage Award in 2013 (Ieva, 2013). This reintegration was implemented to the historical building with presentation purposes. Reintegration was totally implemented with new material. Documentary value of historic building, restoration which was made in 50s and current restoration was preserved. Integrity of the church was preserved. The church located at the historical city center of the Siracusa, Italy. Therefore, reintegration of the structure is integrated the church with the context. New material is compatible and distinguishable from original material.

Table 2.2. Basilica Paleocristiana di San Pietro

Identification	Current Restoration	Evaluation
Location: Siracusa, Italy **Construction Date:** Early Christian **Original Function:** Basilica **Original Structural System:** Masonry **Original Material:** Cut stone and brick exterior, rubble stone interior **Conservation State:** concrete interventions in restoration in 1950s, lost its characteristics	**Implementation Completion Date:** 2009 **Director of Project: -** **New Function:** Museum **Architect**: Emanuele Fidone **Applied Parts:** The whole building **New Structural System:** Timber frame roof **New Materials:** Timber superstructure elements, steel doors **Award:** I'Italian Heritage Award in 2013	**Intervention Type:** Reintegration, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☒ **Compatibility of materials:**☒ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒

Figure 2.14. Restoration of Basilica Paleocristiana Di San Pietro
(Source: Divisare, 2018a)

Figure 2.15. Restoration of Basilica Paleocristiana Di San Pietro
(Source: Ieva, 2013)

2.3.3. S(ch)austall/S(h)owroom

The original function of the ruin was pigsty. The building is located at a state-owned forest (Bollack, 2013). The additional structure was built off site. Then, it was inserted to the ruin (Yunghans, 2009). The roof which was supported by new structure was installed later than insertion. New structure and existing ruin are independent from each other. The building represents that it was work of past however, it survives in the present (Bollack, 2013). It was awarded with Architectural Review Award for Emerging Architecture in 2005. The additional part was constructed with timber framed structure (Yunghans, 2009). The building was totally reintegrated with new material. Both existing and new structure provides documentary value. The implementation is compatible with original material. It is distinguishable. Integrity of building itself and context is provided. New material is compatible with the historical building. There is consistency in new and historical structure.

Table 2.3. S(ch)austall/S(h)owroom

Identification	Current Intervention	Evaluation
Location: Rheinland-Pfalz, Germany **Construction Date:** 18th century **Original Function:** Pigsty **Original Structural System:** Masonry **Original Material:** Cut stone, finished with plaster **Conservation State:** In ruin	**Implementation Completion Date:** 2005 **Director of Project:** - **New Function:** House **Architect**: FNP Architekten **Applied Parts:** Inserted into the whole ruin **New Structural System:** Timber frame **New Materials:** Plywood panels **Award:** Architectural Review Award for Emerging Architecture in 2005	**Intervention Type:** Reintegration, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☒ **Compatibility of materials:**☒ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒

Figure 2.16. S(ch)austall/S(h)owroom, intervention to the old pigsty
(Source: Bollack, 2013)

2.3.4. Old Church of Corbera d'Ebre

The settlement was destroyed in the Battle of Ebro in 1937. The building has memories related with this war. Therefore, the main objective in the restoration project of the building was to preserve its ruined appearance, symbol and expression related with the Spain civil war. The church ruin was structurally consolidated, and the new transparent cover was constructed. The transparent cover provides preservation against deteriorations related with weather conditions (Metalocus, 2018). The building was totally reintegrated with new material. Documentary value is preserved. Integrity of building itself is preserved. The building is located in rural. Therefore, integrity in terms of context is preserved. The new material is compatible with original material and it is distinguishable.

Table 2.4. Old Church of Corbera d’Ebre

Identification	Current Intervention	Evaluation
Location: Terra Alta in Catalonia, Spain **Construction Date:** - **Original Function:** Church **Original Structural System:** Masonry **Original Material:** Rubble stone, finished with plastering **Conservation State:** In ruin	**Implementation Completion Date:** 2008 **Director of Project:** - **New Function:** Museum **Architect**: Ferron Vizoso Architecture **Applied Parts:** Superstructure **New Structural System:** Steel frame **New Materials:** Steel covered with transparent ETFE material **Award:** -	**Intervention Type:** Reintegration, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☒ **Compatibility of materials:**☒ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒

Figure 2.17. Restoration of Old Church of Corbera D’ebre
(Source: Metalocus, 2018)

2.3.5. Doria Castle in Dolceacqua

The main objective of restoration of the castle was strengthening of masonry. Interventions made with anxiety of structural reinforcement and static improvement have become an architectural element of the building which provides users to experience the building. The iron elements which are consolidation elements have turned into paths and passages. These elements are reversible (Divisare, 2018b). The building was consolidated with steel frames. Documentary value is preserved. Integrity of building itself is preserved. Many parts of the castle is ruined. Therefore, the intervention is integrated with the context. The new material is distinguishable. However, steel frames may damage the historical building material; corrosion may take place in long term. Therefore, it is not compatible with original material.

Table 2.5. Doria Castle in Dolceacqua

Identification	Current Intervention	Evaluation
Location: Dolceacqua, Italy **Construction Date:** - **Original Function:** Castle **Original Structural System:** Masonry **Original Material:** Rubble stone, finished with plastering **Conservation State:** In ruin	**Implementation Completion Date:** 2015 **Director of Project:** - **New Function:** Museum **Architect**: LD+SR **Applied Parts:** Partially **New Structural System:** Steel frame, new walkways out of steel **New Material:** Steel **Award:** -	**Intervention Type:** Consolidation, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☒ **Compatibility of materials:**☐ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒

Figure 2.18. Restoration of Doria Castle in Dolceacqua

(Source : Divisare, 2018b)

2.3.6. La Centrale Restaurant

La Centrale restaurant was residential building in 1920s. It was located in demarcation line in the civil war between east and west Beirut. Therefore, it was abandoned, and it became a ruin. For the rehabilitation, all partition walls and slabs were demolished. The outer walls were reinforced with horizontal beams which were enrolled over the existing structure temporarily. After the rehabilitation process, temporary reinforcement on façades, which consisted of steel beams, was decided to be conserved (Khoury, 2018). The building was opened in 2001. In 2013, restaurant was re-intervened. The additional part was differentiated with different materials. The proportions of interior spaces and architectural qualities were preserved (Architizer, 2018a). The building was totally consolidated with steel frameworks. Documentary value is preserved however due to alterations in interior space, it is decreased. The implementation is compatible with original material and it is distinguishable. The building is located in the city center of Beirut, so with the new interventions, integrity in terms of context is provided. For the new function and consolidation purposes, interior space is changed. Therefore, integrity in terms of building itself is not preserved. The building is accessible.

Table 2.6. La Centrale Restaurant

Identification	Current Intervention	Evaluation
Location: Beirut, Lebanon **Construction Date:** 1920 **Original Function:** Residence **Original Structural System:** Masonry **Original Material:** Rubble stone **Conservation State:** In ruin	**Implementation Completion Date:** 2013 **Director of Project: -** **New Function:** Restaurant **Architect**: Bernard Khoury **Applied Parts:** Partially **New Structural System:** Steel frame **New Material:** Steel **Award: -**	**Intervention Type:** Consolidation, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☐ **Compatibility of materials:**☐ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒

Figure 2.19. La Centrale Restaurant

(Source: Bollack, 2013)

2.3.7. Mill City Museum

Figure 2.20. Mill City Museum

(Source: Bollack, 2013)

Mill City Museum was built in 1874. The facility composed of silos and production buildings. It was closed in 1965 and burned in 1991 after a fire. After 1994, Meyer, Scherer and Rockcastle prepared a conservation project for the building under the guidance of Minnesota Historical Society. They reused the ruin as museum. Meyer and his architecture students prepared the project of the museum (Bollack, 2013). Restoration design of the building connects the river and the ruins with the new architectural elements blended with the old ones. These elements also create spaces in some parts of the building (Architizer, 2018b). The building was partially consolidated with steel frames.

Documentary value is preserved. Integrity in terms building itself is preserved. There is a regional park and Missisippi River at the northern part of the building. There are public buildings such as theatre, restaurant and school at the other sides of the museum. Therefore, integrity in terms of context is provided. The new material is distinguishable. However, steel frames may damage the historical building material. Therefore, it is not compatible with original material.

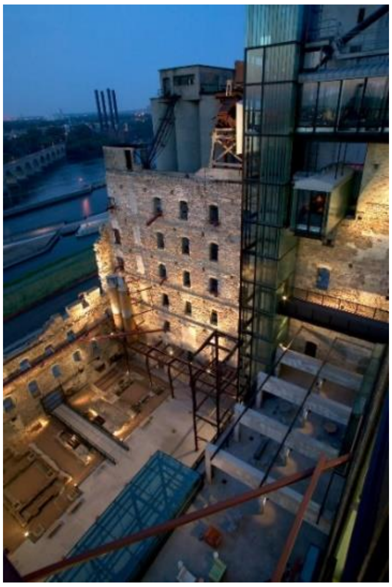

Figure 2.21. Mill City Museum
(Source: Architizer, 2018b)

Table 2.7. Mill City Museum

Identification	Current Intervention	Evaluation
Location: Minneapolis, Minnesota **Construction Date:** 1874 **Original Function:** Silo and production building **Original Structural System:** Masonry **Original Material:** Rubble stone **Conservation State:** In ruin	**Implementation Completion Date:** 2003 **Director of Project:** Minnesota Historical Society **New Function:** Museum **Architect**: MSR Design **Applied Parts:** Partially **New Structural System:** Steel framework **New Material:** Steel **Award: -**	**Intervention Type:** Consolidation, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☐ **Compatibility of materials:**☐ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒

2.3.8. Santa Cataline de Badaya

The building is in Santa Cataline Botanic Garden. It was built as a monastery in between 13th and 14th centuries. The tower house and the monastery which are located in the site are consolidated and presented (Revistaad, 2015). The building was partially consolidated with timber framed structure. The implementation is compatible with original material and it is distinguishable. The ruin is the only structure in the forest. The walking paths, bridges in garden and landscape elements are part of the restoration project. Therefore, integrity in terms of context is achieved. However, original integrity of building itself is not presented.

Table 2.8. Santa Catalina de Badaya

Identification	Current Intervention	Evaluation
Location: Santa Cataline Botanic Garden, Spain **Construction Date:** 13th century **Original Function:** Monastery **Original Structural System:** Masonry **Original Material:** Rubble stone **Conservation State:** In ruin	**Implementation End Date: -** **Director of Project:** - **New Function:** - **Architect**: - **Applied Parts:** Partially **New Structural System:** Timber framed **New Material:** Timber **Award: -**	**Intervention Type:** Consolidation, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☐ **Compatibility of materials:**☒ **Consistency:** ☒ **Accessibility:** ☒**Retreatability:** ☒

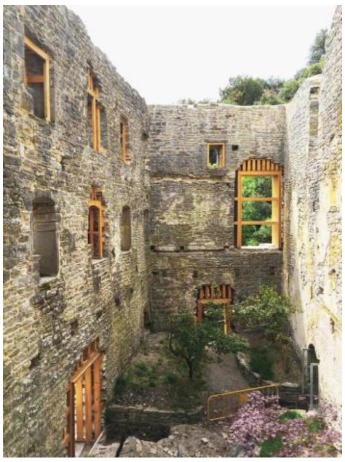

Figure 2.22. Restoration of Santa Catalina de Badaya

(Source: Revistaad, 2015)

2.3.9. Evaluation of Case Studies

Case studies are evaluated in terms of documentary value, distinguishability, integrity of context and building itself, compatibility of materials, consistency of implementation, accessibility and retreatability. Documentary value of each case study (8/8) are preserved. In each example (8/8), existing structure and new structure are distinguishable from each other with new material. Integrity in terms of context is preserved in 7 of 8 case studies. In one case, the historical building lost its original context. Integrity of buildings themselves are preserved in 5 of 8 case studies. In many case studies (5/8), new material is compatible with existing material. In other examples, inappropriate materials are used which may cause damage in the future (e.g. steel and its possible corruption problems) due to its characteristics. Consistency of each case study (8/8) is provided. Accessibility of each case study (8/8) is carried out. In each example (8/8), retreatment is possible.

2.4. Structural Intervention Details in Similar Cases

The emergency consolidation of archaeological ruins in Gazipaşa (Fig 2.23 and Fig 2.24) were carried out with iron elements. However, rusting has taken place in time. Therefore, iron elements are not suitable in archaeological sites. The permanent consolidation of the rubble stone masonry and timber frame walls in Mithat Paşa Vocational High School for industry (Fig 2.24) were carried out with steel connection elements. To reduce damage of steel to structure, fire brick was used. Similarly, the permanent consolidation of the similar walls in Agios Voukolos Church (Fig 2.25) was carried out stainless steel bolted galvanized chrome nickel. The ancient bath in Hierapolis is about to collapse (Fig 2.26). Due to its collapse risk, emergency consolidation with steel frame was applied. The emergency consolidation of Bouleuterion in Metropolis (Fig.27 and Fig.28) was implemented with timber elements. Historic walls and vaults dating to Emirate Period in Beçin Castle were consolidated with steel structure as a permanent structure. Material choice is important. Timber was used in temporary and emergency interventions. Stainless steel was preferred in permanent interventions.

Figure 2.23. Rusting problem in a Roman (left) and Byzantine (right) ruin
(Source: Turan, 2018)

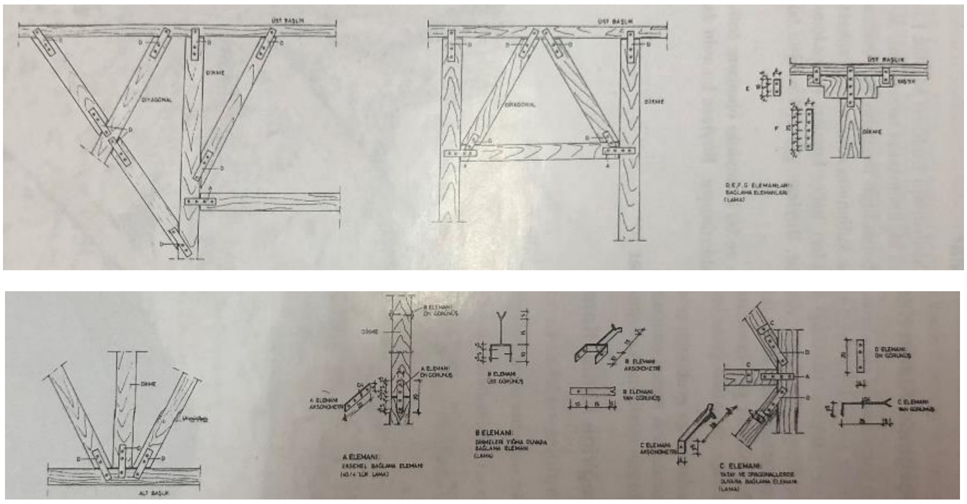

Figure 2.24. Repair detail of timber framework
(Source: İpekoğlu and Hamamcıoğlu, 2002)

Figure 2.25. Strengthening of the wall with stainless steel bolted galvanized chrome nickel connection elements (Source: İpekoğlu et al, 2014)

Figure 2.26. The Basilica Bath in Hierapolis

Figure 2.27. Consolidation of an arch in the Bouleuterion, Metropolis

Figure 2.28. Supporting of the walls in the Bouleuterion, Metropolis

Figure 2.29. Structural interventions in Beçin Castle

CHAPTER 3

CHARACTERISTICS OF THE CASE STUDY

In this chapter, location and landform of Kale, historical background of the settlement and identification of the case study are presented.

3.1. Location and Landform of Kale

Denizli is located in Aegean Region, which is in southwestern part of Turkey. The ancient city of Tabae (Kale) is one the archeological sites located within the boundaries of the district of Kale in the province of Denizli (Fig 3.1). It was proclaimed as an archeological site in 1985 and was registered as grade 1 and 3 natural site (DİKTM, 2018). The settlement was on the road of Denizli-Muğla Highway. Tabae is located on Tavas plain, which is in the southwestern part of Denizli city center. Tavas Plain is surrounded by Babadağ Mountain at its north, Bozdağ Mountain at its south, Kızılhisar Mountains at its east and Kale District at its west. The settlement is surrounded by Tavas, Beyağaç and Karacasu districts. The area of the settlement is 533 km^2. Kale is on butte. All sides of Kale plateau include cliffs. The settlement is located on a bed rock.

3.2. History of Kale and its Vicinity

The history of Kale district dates to ancient periods (Fig 3.2). There were remains which date to Hellenistic, Roman, Byzantine, Seljuk, Emirates, Ottoman and Early Republican periods (Baykara, 2007; Aydın 2013). Tabae means rock (Ergün, 2012). The settlement was part of Caria before Alexander the Great (Baykara, 2007). There is limited information for this period. In the 3^{rd} century BC, the city of Tabae was under the administration of Seleucid Empire (Laflı, 2012). There were three different settlements in Tavas Plain in the 2^{nd} century BC. In the northern part of the plain, Heraklie (Kızılcabölük); in the middle part, Apollonia (Medet) and Tabae (Kale) settlements were seen (Baykara, 2007, Laflı, 2012).

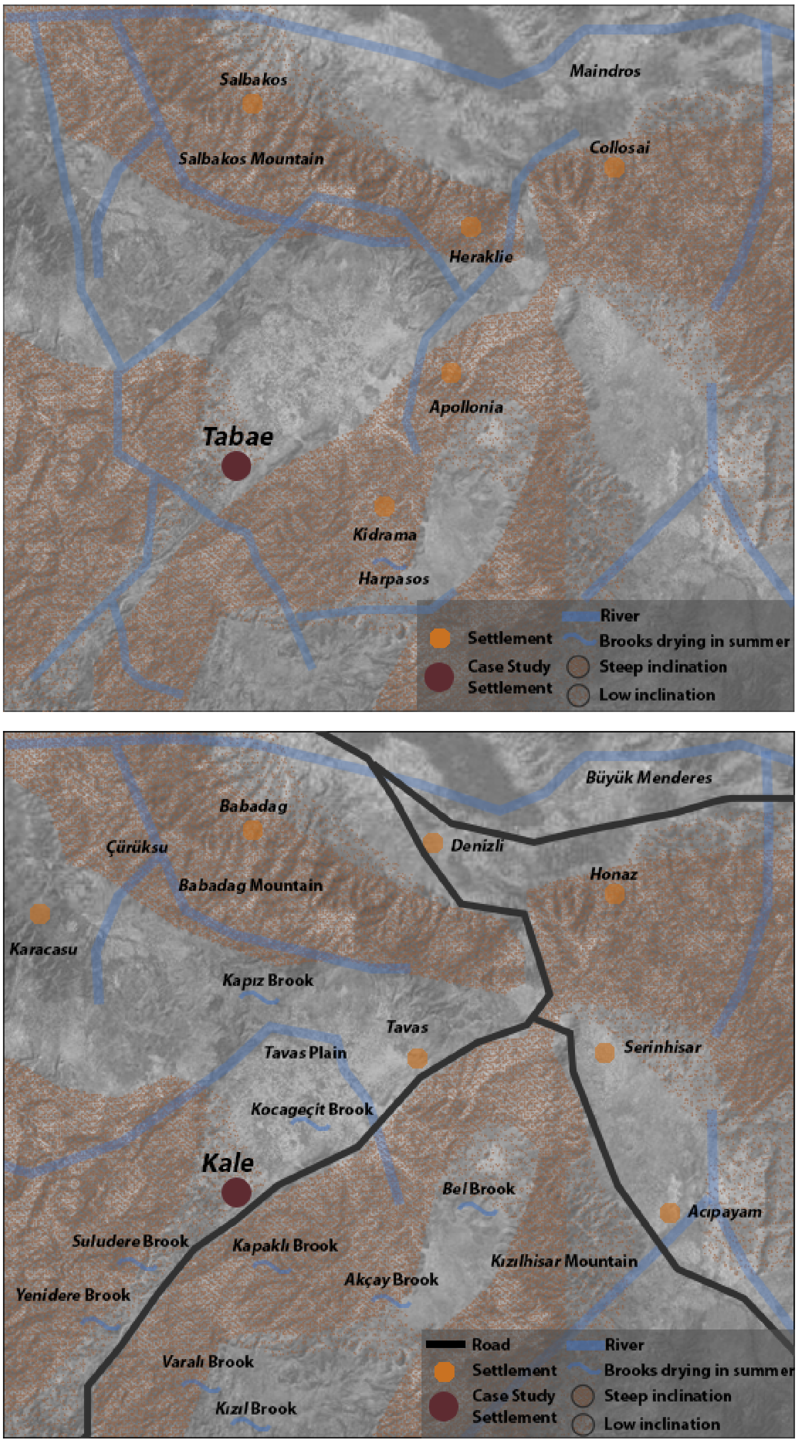

Figure 3.1. Tabae and its vicinity in the Antiquity (above) Tabae and its vicinity at present (below)

Tabae settlement consisted of Pisidia, Hellen and Phrygia communities in Roman Period. There were special coins of the settlement in Roman period (Ergün, 2012). There was a developed water system composed of cisterns, wells, waterways and fountains. Elements were built systematically and each of them were related with each other. Today, remains of some wellbores or ventilation shafts are observable. There are many caves on the western cliffs with monumental graves. Water requirement was provided by water channels from mountain which were located at southern part of the settlement. Different water sources were used: spring water available in the settlement, water carried from the vicinity, rain water collected in cisterns and underground water collected in the caves of the settlement. There are some fountain remains. Cistern 1 dates to the 2nd century AD. It is rectangular in plan. There are many ceramic pieces and coins found in the cistern. The ground of the cistern is brick with lead panels. Water inside the cistern was transported to the villages in the vicinity. Cistern 2 dates to the Roman Period. It was carved on rock. The upper part of the cistern is narrow, the bottom portion is wide. The reason of this shape is collecting rain water. There were some ceramics found in the cistern dating to 1st and 3rd century AD. Cistern 3 dates to Roman period. It is located by the cistern 2 (Ergün, 2012). There is a Roman bath which was excavated in 2013 (Kültür ve Turizm Bakanlığı, 2016). In the Byzantine period, small settlements on plains were reduced in terms of number. Locations with suitable topographical features in terms of security became important. Therefore, Tabae ancient settlement was important in this period (Baykara, 2007). The city adhered to the church of Aphrodisias in Byzantine Period (Laflı, 2012). There were some caves, cemetery and churches carved into bed rock. However, these spaces ruined in times (Ministry of Culture and Tourism, 2016). There is a carved cave at the northwestern side of cliff. There are an entrance opening and two niches at the west façade of the cave. This was the entrance of a church which was carved into rock in Byzantine period. There are some other caves which date back to this period (Aydın, 2012). When Turks came to the region, the population was very low. There were only six Byzantine settlements. One of these settlements was Tabae. In the 11th century, “Tabae” name was converted into “Tavas” (Baykara, 2007). Starting with 1206, administration of Denizli region including the vicinity of Kale district (Yarangüme, Kızılcabörklü, Vakıf and Karahisar) was controlled by Seljuk government. However, Kale was not conquered (Baykara, 2007). The region was conquered in 1260. Many Christians left the settlement after the struggle. As a result, there was no Rum neighborhood dating to this period (Baykara, 2007). In Emirates Period, Tavas (Tuvaza) Emirate was active in the region. Kale and Tabae were ruled by Tavas (Tuvaza) Emirate. Şücaeddin İlyas Beğ was the governor of this emirate. There were four fortresses and six hundred villages within the borders of Tavas Emirate.

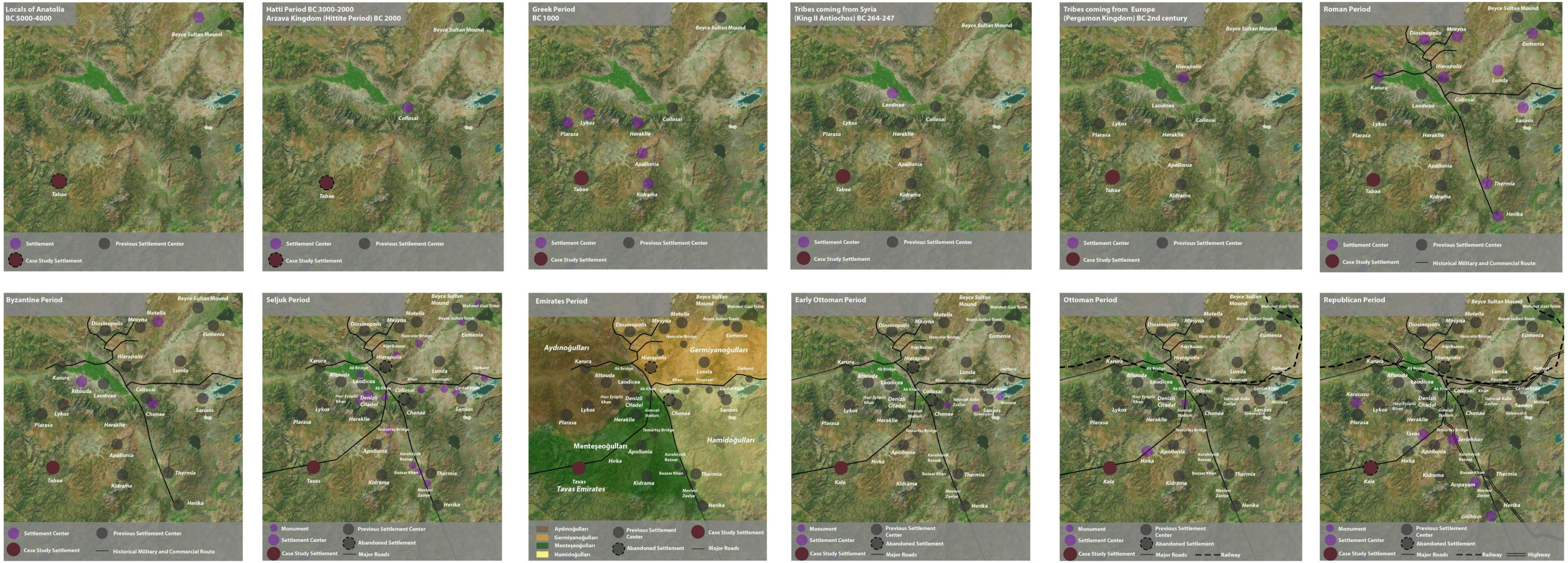

Figure 3.2. History of Kale and its vicinity

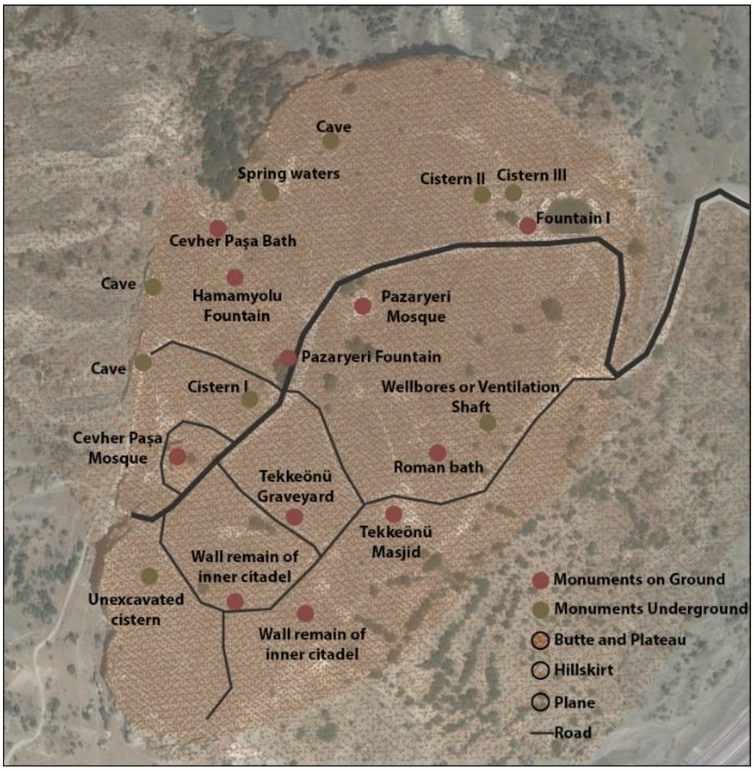

Figure 3.3. Historical elements of Kale

(Source: revised from Ministry of Culture and Tourism, 2016)

Figure 3.4. Ancient cistern (left), Roman baths (right)

Figure 3.5. View of the caves from north (left), an ancient church (right)

The location of Tavas Emirate was strategic. It defined a buffer zone in between Germiyanoğulları, Menteşeoğulları, Aydınoğulları and Hamidoğulları Emirates. While Germiyanoğulları conquered Denizli, In 1390s, the settlement came under to rule of Ottoman Empire. After the Ankara War, the region was retaken back by Menteşeoğulları Emirate. Then, in 1424, in Murat II period, the settlement came under to rule of Ottoman Empire (Baykara, 2007). In the 16th century, Kale had only one neighborhood with 174 houses and 1000 population. There were 2 different mosques. One of them was Cevher Paşa Mosque (Baykara, 2007). Cevher Paşa was from the ruling family of Menteşe Emirate (Ministry of Culture and Tourism, 2016). Although the construction date of Cevher Paşa Mosque is unknown, it is known that it was repaired in 1819. The other mosque is Pazaryeri Mosque. Pazaryeri Mosque was repaired in 1867. Its construction date is unknown (Ministry of Culture and Tourism, 2016). There was only one Turkish bath in the settlement: Cevher Paşa Bath. According to Baykara, it was built together with the establishment of the mosque of Cevher Paşa in the 15th century (Baykara, 2007). Cevher Paşa Bath was used as paint shop until abandonment of the settlement (Çakmak, 2012). There is a masjid dating to the 18th century: Tekkeönü Masjid. There were both inner and outer citadels on the plateau. There are some remains of the inner citadel dating to the 17th century (Ministry of Culture and Tourism, 2016). In the 18th century, administrative center moved to Hırka, which is at the north of Kale. Tavas merged with Yarangüme (Baykara, 2007). There is a fountain remain dating back to the 19th century named as Hamamyolu fountain. There are remains of a fountain dating to the Republican period named as Pazaryeri fountain (Ministry of Culture and Tourism, 2016). Life in the settlement was sustained until 1950. In 1950, people moved to northern part of the settlement due to landslide problems under the supervision of Bank of Provinces (İller Bankası). Almost all buildings of the settlement were devastated except for 2 mosques, 1 bath and few fountains (Bozkurt, 2012). When the settlement was abandoned, historical building material were removed by locals and reused as building material in the new settlement center 2.3 km at the north (Ministry of Culture and Tourism, 2016).

In 2007, scientific excavations started in Kale under the supervision of Prof. Dr. Bozkurt Ersoy. Excavations were continued by Prof. Dr. Kasım İnce starting with 2014. Since 2015, they have been conducted by Assoc. Prof. Dr. Mustafa Beyazıt (Ministry of Culture and Tourism, 2016). In 2007; Cistern 1, Fountain 1, Pazaryeri Mosque; in 2008 inner citadel; in 2009; Cevher Paşa Mosque, Cistern 2 and Cistern 3; in 2010; Tekkeönü Masjid, in 2011; Cevher Paşa Bath; and in 2013; the Roman bath were excavated under the supervision of Prof. Dr. Bozkurt Ersoy (Ersoy, 2012). Scientific excavation of the historical graveyard of Kale, hazire of Cevher Paşa Mosque and hazire of Tekkeönü Masjid were started in 2015 (Ministry of Culture and Tourism, 2016).


Figure 3.6. Cevher Paşa Mosque (left), Tekkeönü Masjid (right)

3.3. Site and Mass Characteristics

The bath ruin is located at the northern part of the site. It was built in the valley. It was settled on the sloping land in the east-west direction which has approximately 60% slope at the eastern part. Northern part of the building is in the valley. The width (w) of the bath ruin is 12.2 m in the south-north direction and the length (l) of the building is 21.3 m in the east and west direction. The highest level of the building is 5.5 m (Appendix A). After the excavation, walls were built in the valley sides because existing walls which has fossils inside of it, melted with water (Ersoy, 2018).


Figure 3.7. West façade (left), south façade (right)

3.4. Façade Characteristics

There is direct entrance from both façades: southwestern and northwestern. However, due to inclination, there is no access from southeastern and northeastern façades.

3.4.1 Southwestern Façade

This is the entrance façade and its totally blind (Appendix A, Fig A.5). The height (h) of the wall ranges between 2.5 m to 1.35 m. The l of the façade is 21.74 m. There is a step remain belonging to space 1. There is a bulge at the central portion of the wall. The corners of the wall are the most damaged parts. The material is rough-cut stone at outer shells, rubble stone and lime mortar in between.

Figure 3.8. Southwestern façade

3.4.2 Southeastern Façade

This façade is the valley side (Appendix A, Fig A.3). Therefore, there is a retaining wall supporting it at its bottom portion. The façade is totally blind. The h of the bath wall changes between 1.45 to 3.54 m. The l of the façade is 13.75 m Beneath this wall, there is a retaining wall whose h ranges between 0.2 m to 2.23 m. The material of upper portion is rough-cut stone at outer shells, rubble stone and lime mortar in between. The material of bottom portions of the façade is rough-cut stone with cement mortar. There are some spolia in this façade.

Figure 3.9. Southeastern façade

3.4.3 Northeastern Façade

Northeastern façade faces the valley (Appendix A, Fig A.2). It is totally blind. The wall of the façade consists of two parts similar with southeastern façade. The material of the upper part is rough-cut stone at outer shells, rubble stone and lime mortar in between. The material of bottom portion, which is the retaining wall of the façade, is rough-cut stone with cement mortar. The h of upper part changes between 1.62 m to 4.30 m. The h of the bottom part ranges between 0.48 m to 2.22 m. The l of the façade is 12.05 m. Space 9 and space 11's ruins are perceivable at the rear of this façade. There is also a water channel remain at the bottom portion. Water still runs through the channel.

Figure 3.10. Northeastern façade

3.4.4 Northwestern Façade

The façade is composed of ruins at its front portion. The h of the walls at the rear ranges between 0.73 m to 4.45 m. The l of the façade is 11.10 m. The material of the walls in this façade is rough-cut stone at outer shells, rubble stone and lime mortar in between. There are two voids at the west and east. There is an arch remain in between space 2 and space 4 at eastern part of façade. Spaces 1, 2, 3, 4, 6, 10 and 11 are seen from this façade. Space 11's ruins are perceivable at the rear of this façade.

3.5. Spatial Characteristics

The bath ruin is composed of eleven spaces (Appendix A, Fig A.1).

3.5.1. Space 1

Space 1 (8.8 m x 11 m) is located at the western part of the building. The northern and eastern walls of the space have collapsed. The southern and western walls are in ruin. The highest wall in eastern part is 0.57 m in height. In the southern wall, there are some portions covered with earth. There are some remains of authentic stone floor covering (Fig 3.11). There is no superstructure of this space. The space had lost its third dimension. There are few steps at the southern part. There is an opening (1.35 m x 2.42 m) in between space 1 and space 2.

Figure 3.11. View of space 1 from the west

3.5.2. Space 2

Space 2 (3.7 m x 1.48 m) is located at the east of space 1. The entrance of the space is through the opening from space 1. There are two different openings except this opening. One of them provides access to space 3, the other to space 4. There is no wall in the western part, but the other sides' walls are in ruin. The highest wall is the eastern wall: 3.79 m. The lowest wall is at the southern part of the space which is 0.65 m. There are some remains of stone on ground. There is no superstructure. But there is an arch on the wall in between space 2 and space 4.

3.5.3. Space 3

Space 3 (2.58 m x 1.50 m) is located at the southern part of space 2. The walls of the space are in ruin with different heights. The h of the northern wall which has opening to space 2 changes between 0.65 to 0.98 m. The southern walls height also changes between 3.45 to 1.54 m. There are some architectural elements such as niches, vertical and horizontal pipes. There are three niches, 2 horizontal and 1 vertical pipes. Floor covering is missing (Fig 3.12). There is level difference between space 2 and space 3. There is no superstructure.

Figure 3.12. Space 3, southern wall

3.5.4. Space 4

Space 4 (3.36 m x 3.45 m) is accessible from both space 2 and space 6. The northern wall is the highest wall: 5.62 m. The southern wall is 3.45 m in height. In the eastern part of space 4, there is a concrete wall (h: 0.8 m), which is part of the concrete pool. There are some remains of the superstructure. In the northern wall, there is a dome remain with muqarnas. There are squinch remains on each wall. There are some architectural elements such as platform and vertical and horizontal pipes (fig 3.13). There is no remain or trace of floor covering.

Figure 3.13. View from entrance to space 4

3.5.5. Space 5

Space 5 (3.17 m x 3.17 m) is converted into a concrete pool. The walls are covered with screed until 0.95 m from ground level. At the back of the cement plaster, there are stone masonry walls at northern, southern and eastern sides, which are part of southeastern façade. The southern wall is the highest wall: 3.36 m. Cement plaster is seen until 0.92 m. The h of eastern wall is 1.37 m. Cement plaster is observed up till 0.94 m level from ground level. The lowest wall, which is the western part of space 5, is 0.8 m in height and it is part of the pool. The depth of this pool is 1.37 m. The ground covering is concrete (Fig 3.14). There is no superstructure.

Figure 3.14. View of space 5 from the entrance

3.5.6. Space 6

Space 6 (5.31 m x 4.76 m) is located at the northern part of the bath. There is no wall in the eastern part of the space. However, there are walls in ruins at the other three sides. The height of the northern wall is 3.45 m. There are wash basin remains and horizontal pipes on this wall. There is an arch remain at the top of the wall. There is an opening with arch in this wall. In the southern wall, there is an arch remain. There are also some architectural elements in space 6 such as water channel remain, concrete pools with different sizes and wash basin and pipe remains as mentioned above. There is no superstructure except arch remains at the top of the wall (Fig.3.15). The floor covering is missing. But flat stones are detected in the water channel remains.

Figure 3.15. Space 6, as viewed from south

3.5.7. Space 7

Space 7 is in the eastern part of space 6. It has rectangular plan (2.64 m x 2.91 m). There is an opening in between space 6 and space 5. There is a concrete pool in the space. The dimension of the pool is 2.34 m to 2.76 m. The highest wall which is at the eastern part of the space is 3.44 m. The bottom portion of this wall is cement plaster until 1.78 m. The lowest wall of space 9 is 1 m high. The material of this wall is concrete (Fig.3.16). There is no superstructure.

Figure 3.16. Space 7, western wall

3.5.8. Space 8

Space 8 (3.09 m x 1.58 m) is located at the northern part of space 7. There are three concrete pools in the space (Fig 3.17).

Figure 3.17. Space 8

3.5.9. Space 9

Space 9 (2.86 m x 2.46 m) is located at the northwestern part of the space 6. There is an opening from space 6 to space 9. The boundaries of the space are not legible. There are wall remains in the eastern and southern part. The h of the eastern wall is 3.37 m. The h of the southern wall changes between 4.37 m to 0.8 m. There are no remains of the authentic floor covering. There is no superstructure.

3.5.10. Space 10

Space 10 (3.77 m x 3 m) is adjacent to space 6. The borders of space 10 are not legible (Fig 3.18).

Figure 3.18. Space 10, as viewed from west

3.5.11. Space 11

The w of space 11 is 4.50 m. However, the l is uncertain. There is a stone arch remain with 0.8 m height at its south. This element is in valley façade. The h of northern wall changes between 4.37 m to 0.8 m. The h of southern wall ranges between 0.75 m to 1.74 m (Fig 3.19).

Figure 3.19. Space 11, as viewed from northwestern

3.6. Architectural Elements

There are eight different architectural elements defined in the bath as it is shown in Appendix B. These are a wash basin remain, niches, horizontal pipes, vertical pipes, a platform, stone floor covering, concrete pools and a water channel remain (Appendix B).

3.6.1. Wash Basin Remain

The wash basin remain is located in space 6. The element has circular shape with 38 cm diameter. Spolia material is reused to provide water to the spout (Fig 3.20).

Fig 3.20. Wash basin remain

3.6.2. Niche

There are five different niches in the building. Three of them are in space 3 and two of them are in space 4. The dimensions of the niches in space 3 are approximately 24 cm to 52 cm with 37 cm depth. They are elevated 50 cm from the ground level. The other two niches have lost their form and they are irregular shaped due to deteriorations. Their height is 1 m from ground level.

3.6.3. Horizontal Pipes

Two horizontal pipes are seen in the bath. One of them is at the southwestern corner of the wall of space 3, the other one is at the southern wall of space 4. They are circular shaped with 11 cm diameter (Fig 3.21).

3.6.4. Vertical Pipes

There are four vertical pipes. One of them is in the toilet. The other one is in space 4 and two of them are in space 6. They are circular shaped with 11 cm diameter.

Figure 3.21. Horizontal pipe in space 4 (left), vertical pipe in space 6 (right)

3.6.5. Platform

There is only one platform in the bath which is located in southern wall of space 4. The dimensions of the platform are 3.45 m to 0.6 m with 0.48 m height.

3.6.6. Stone Floor Covering

Floor covering is observed only in space 1. It is out of marble blocks (Fig 3.22) with different sizes (e.g., 0.9 m x 1.25 m, 0.63 m x 0.61 m).

Figure 3.22. Stone floor covering

3.6.7. Concrete Pools

There are ten different concrete pools with different sizes. The first one is located in space 5. The size of pools is equal to the dimension of the related space. Five of them are located in space 6. The biggest one, which is at the eastern part of the space, is 3.17 m to 2.97 m. The h of their walls is 0.88 m. The d of the pool is 1.26 m. In the northern part of this pool, there are three pools which are adjacent to each other. The h of these pools is approximately 1.6 m. The dimensions of the largest one is 1.16 m to 2 m. In the western part of these pools, there are two pools which are smaller sized. Their dimensions are 1.5 m to 1 m. The h of their walls is 0.75 m. There are also three small sized concrete pools at the western part of space 6. The dimensions of these pools are approximately 0.9 m to 1 m. The h of their walls is 0.75 m. There is also one concrete pool in space 7. Its dimension is equal to related space.

3.6.8. Water Channel Remain

Water channel remain is seen in space 6. It extends to the northern wall of the bath which is the retaining wall on the valley side (Fig 3.25). The w of the channel is 0.51 m. The h of the channel is 0.98 m. There are layers of stone in the channel. The dimensions of the remain in the northeastern façade are 0.22 to 0.93 m.

Figure 3.23. Water channel remain, exterior view from northeastern façade (left), interior view from space 6 (right)

3.7. Structural Characteristics and Material Usage

The masonry bath is consisted of remains of load bearing walls and arch systems with domed superstructure. There are also additional non-load bearing walls (Appendix D).

3.7.1. Dome Remain

There is a dome remain over space 4 at its northern portion. It was constructed with brick (0,5 m x 0,17 m) at outer shells and rubble stone and lime mortar in between (Fig 3.24).

Figure 3.24. Dome Remain as viewed from south

3.7.2. Squinch Remain

They are at the four corners of the dome remain in space 4 projecting bricks and lime mortar were detected at their places.

3.7.3. Arch Remain

There are three arch remains existing in the building. Two of these arches are on the northern and southern walls of space 6 with 3,8 m and 3,7 m spanning distance and 4,00 m and 5,04 m h, respectively. Third one is on the chamfered wall in between space 6 and space 9. Its spanning distance is 1,44 m and h are 3 m. All arches were constructed with brick (0,8 m x 0,28 m) at their shells, rubble stone and lime mortar in their core.

Figure 3.25. Squinch remain as viewed from southeast (left), arch remain as viewed from north (right)

3.7.4. Load Bearing Walls

Load bearing walls are classified in two groups as rough-cut stone at outer shells, rubble stone and lime mortar in between, and rough-cut stone with cement mortar. The first group is seen at all exterior walls except the retaining walls at the bottom portions of northeastern and southeastern façades. The thickness of these walls ranges between 60 cm to 82 cm. So, the second group (approximately h 2.20 m) includes the intervened portions (Fig 3.26).

Figure 3.26. Load bearing walls: First group (left), Second group (right)

3.7.5. Non-load Bearing Walls

Non-load bearing walls are the interior walls which define concrete pools. The height of these walls ranges between 40 cm to 140 cm. The thickness of these walls ranges between 25 cm to 8 cm. They are out of concrete (Fig 3.27).

3.7.6. Floor System

Materials of the grounds are stone, earth and concrete. Stone floor covering is seen in the ground of space 1. Concrete floors are part of the concrete pools. Excluding these grounds, all the others are covered with earth. No hypocaust is observed.

Figure 3.27. Non-load bearing walls

3.8. Structural Analysis of Masonry Walls

In this part of the study, structural calculations and methods are briefly mentioned. Simple equivalent load and hand calculated methods are used to determine the loads and resistance of walls. Apart from the self-weight of the structure only the earthquake loads are considered for the stability of the walls. High density and thick construction of the walls are making them vulnerable to earthquake rather than wind effects. Figure 3.28 shows the wall plan and segmentation of the walls with their tags. In the following sections this naming is used to indicate the representative wall. The walls are composed of mortar and stones. There is not any sample test data to obtain the real strength, hence strength values in the literature for similar walls are used in a conservative manner. Table 3.1 lists the strength parameters of the stones that are present in the walls. The shear strength of the stone is not directly usable since the integrity is provided by mortar. Overall approximate shear strength of a wall is highly dependent on the construction conditions of the wall. However, some approximate strength values in literature is provided in Table 3.2 and 3.3. The wall is assumed to be behaving perfectly elastic up to the strength limit and inelastic range is not considered within the scope of this work.

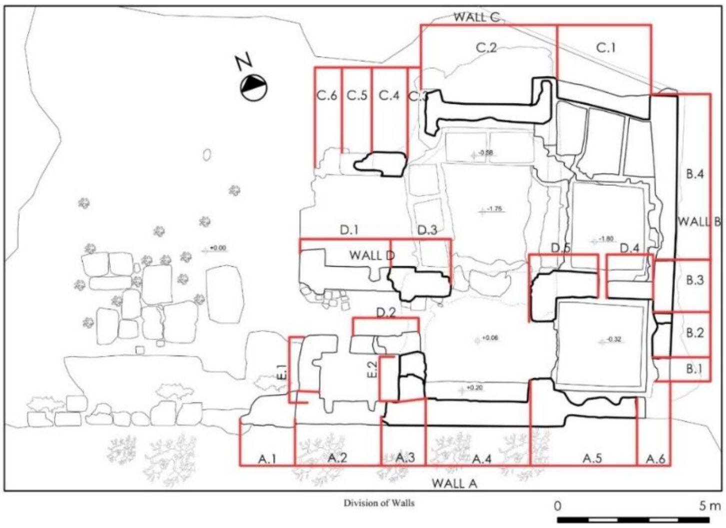

Figure 3.28. Portions of walls defined according to their heights

Table 3.1. Approximate strength of natural stone materials (revised from Ünay, 2002)

Type of Stone	Compressive Strength (mPa)	Shear Strength (mPa)
Granite	30-70	14-33
Marble	25-65	1-15
Limestone	18-35	2-6
Sandstone	5-30	2-4
Quartz	10-30	3-4
Serpentine	30	6-11

Table 3.2. Approximate compressive strength of walls (revised from Türkçü, 2017)

Type of Walls	Allowable Stress (mPa)
Rubble Stone	0.3-1
Pitch-faced Stone	0.4-2

Table 3.3. Approximate shear strength of walls (Milosevic et al)

Type of Walls	Allowable Stress (mPa)
Hydraulic Mortar Rubble Stone Wall	0.33-0.57
Air-lime Mortar Rubble Stone Wall	0.13-0.34

3.8.1. Dead Loads

Calculation of dead load requires unit weights of the material and dimensions of members (Seward, 1998). First, the walls of the bath are separated according to their height. Each wall portion's volume are multiplied by the unit weight of the material. Unit weight of the stone is taken as 23,53 kN/m^3 (2400 kgf/m^3 according to The Turkish Chamber of Civil Engineers, 2018).

Table 3.4. Weight of the wall of the Cevher Paşa Bath (Dead Load)

CODE	AREA OF WALL (m2)	HEIGHT OF WALL (m)	VOLUME OF WALL (m3)	UNIT WEIGHT (kN/m3)	*W* OF WALL (Kn)
A.1	1,59	0,4	0,64	23,53	14,97
A.2	2,34	1,7	3,98	23,53	93,60
A.3	1,09	3,51	3,83	23,53	90,02
A.4	2,82	3,06	8,63	23,53	203,05
A.5	2,94	3,36	9,88	23,53	232,44
A.6	1,42	3,03	4,30	23,53	101,24
B.1	0,17	1,75	0,30	23,53	7,00
B.2	0,84	2,67	2,24	23,53	52,77
B.3	1,11	3,5	3,89	23,53	91,41
B.4	3,83	3,11	11,91	23,53	280,27
C.1	1,87	2,11	3,95	23,53	92,84
C.2	3,51	4,2	14,74	23,53	346,88
C.3	0,69	1,5	1,04	23,53	24,35
C.4	0,93	2,9	2,70	23,53	63,46
C.5	0,67	0,75	0,50	23,53	11,82
C.6	0,6	0,38	0,23	23,53	5,36
D.1	2,63	1,5	3,95	23,53	92,83
D.2	1,43	0,9	1,29	23,53	30,28
D.3	1,63	4,45	7,25	23,53	170,67
D.4	2,42	4,45	10,77	23,53	253,39
D.5	0,87	3,05	2,65	23,53	62,44
E.1	1,5	1,7	2,55	23,53	60,00
E.2	1,3	2,35	3,06	23,53	71,88
TOTAL	41,58	56,33	107,67	23,53	2533,46

3.8.2. Earthquake Loads

Earthquake load is one of the dynamic loads. Seismic waves results in inertia force in the structure. Inertia force depends on seismic wave and dynamic features of structure such as mass distribution in vertical and horizontally, form of building, stiffness and building material (Ünay, 2002). Earthquake loads of the case study building is applied in the direction of “Turkish Earthquake Code 2007” and “Earthquake Risk Management Guidance for Historical Building” which was prepared by General Directorate for Foundations in 2016. The case study building is located in 1st degree earthquake zone.

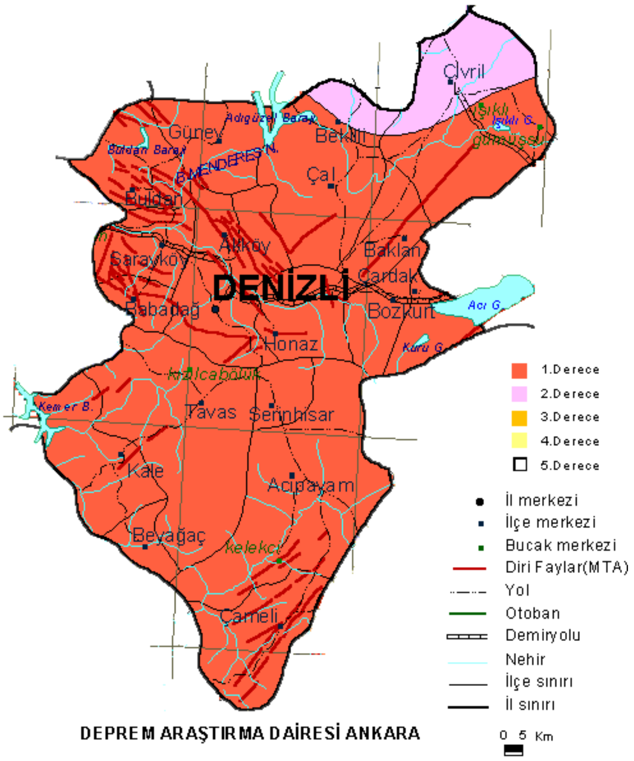

Figure 3.29. Earthquake zones map
(Source: AFAD, 2018)

$$A(T) = A_0 \ \ I \ S(T)$$

(3.1)

$$A(T) = 0{,}4.\ 1.\ 2{,}5 = 1$$

Spectral acceleration coefficient formulation is shown in equation above according to Turkish Earthquake Code, 2007.

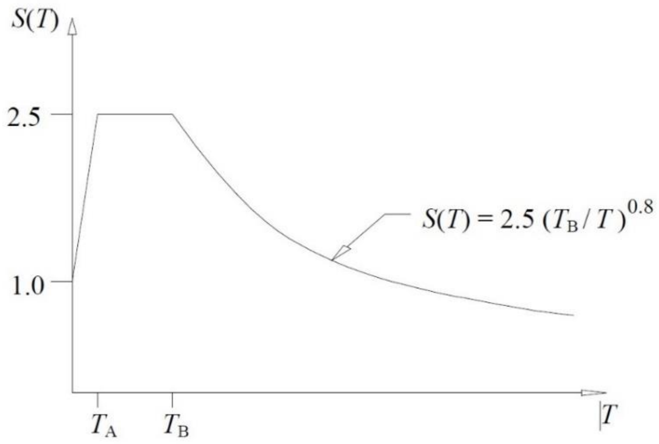

Figure 3.30. Earthquake design spectrum
(Source: Turkish Earthquake Code, 2007)

Table 3.5. Earthquake zones and A_0 value

Earthquake Zone	A_0
1	0,4
2	0,3
3	0,2
4	0,1

Calculation of *A(T)* is shown in Equation 3.1. A_0 is accepted 0,4 because the region is 1st degree earthquake zone. *I* value is taken as 1 according to Turkish Earthquake Regulation and *S(T)* is accepted as 2,5 since the period of walls are predicted to be lower than T_2. *A(T)* value is founded as 1 in the case of this study.

$$V_t = W\,A\,(T_1)\,/\,R_a\,(T_1) \geq 0.10\,A_0\,W$$

$$V_t = 0{,}50\,W \geq 0{,}05\,W$$

V_t *is* calculated for each section of the wall. $A(T_1)$ value is founded as 1. $R(T_1)$ is taken as 2 in historical masonry buildings. As a result, V_t value is founded for each wall. Assumption: The period of the structure is assumed to be low due to high stiffness and low height. Maximum forces at the plates is taken into consideration.

Table 3.6. Equivalent seismic loads of the Cevher Paşa Bath

CODE	COEFFICENT	*W* (Kn)	*Vt*=*W* x 0,5 (Kn)
A.1	0,5	14,97	7,48
A.2	0,5	93,60	46,80
A.3	0,5	90,02	45,01
A.4	0,5	203,05	101,52
A.5	0,5	232,44	116,22
A.6	0,5	101,24	50,62
B.1	0,5	7,00	3,50
B.2	0,5	52,77	26,39
B.3	0,5	91,41	45,71
B.4	0,5	280,27	140,14
C.1	0,5	92,84	46,42
C.2	0,5	346,88	173,44
C.3	0,5	24,35	12,18
C.4	0,5	63,46	31,73
C.5	0,5	11,82	5,91
C.6	0,5	5,36	2,68
D.1	0,5	92,83	46,41
D.2	0,5	30,28	15,14
D.3	0,5	170,67	85,34
D.4	0,5	253,39	126,70
D.5	0,5	62,44	31,22
E.1	0,5	60,00	30,00
E.2	0,5	71,88	35,94

3.8.3. Compressive Stress Levels of Walls

Compressive strength of masonry member is the maximum compressive force resisted per unit of net cross-sectional area of masonry member (Requirement for masonry structures, 2011). Compressive strength of masonry members are affected from geometry, shape, strength, water absorption capacity, mixture ratio of mortar, amount of moisture, thickness of mortar and deformation (Como, 2016). Typical compressive strength of stone units are relatively high, but the strength of the mortar, on the other hand, is very low (Ip, 1999). Thus, overall strength of the wall is used to determine the limit compressive stress of the wall which is provided in Table 3.7. To calculate compressive stresses, forces are divided to affected area. Therefore, compressive stress of a wall is calculated by dividing the self-weight of the wall to area of the wall.

Table 3.7. Compressive stress of walls

CODE	AREA OF WALL (m2)	HEIGHT OF WALL (m)	WEIGHT OF WALL (Kn)	COMPRESSIVE STRESS (kN/m2)	COMPRESSIVE STRESS (mPa)
A.1	1,59	0,4	14,97	9,41	0,009
A.2	2,34	1,7	93,60	40,00	0,040
A.3	1,09	3,51	90,02	82,59	0,083
A.4	2,82	3,06	203,05	72,00	0,072
A.5	2,94	3,36	232,44	79,06	0,079
A.6	1,42	3,03	101,24	71,30	0,071
B.1	0,17	1,75	7,00	41,18	0,041
B.2	4,22	2,67	52,77	62,83	0,063
B.3	1,11	3,5	91,41	82,36	0,082
B.4	3,83	3,11	280,27	73,18	0,073
C.1	1,87	2,11	92,84	49,65	0,050
C.2	3,51	4,2	346,88	98,83	0,099
C.3	0,69	1,5	24,35	35,30	0,035
C.4	0,93	2,9	63,46	68,24	0,068
C.5	0,67	0,75	11,82	17,65	0,018
C.6	0,6	0,38	5,36	8,94	0,009
D.1	2,63	1,5	92,83	35,30	0,035
D.2	1,43	0,9	30,28	21,18	0,021
D.3	1,63	4,45	170,67	104,71	0,105
D.4	2,42	4,45	253,39	104,71	0,105
D.5	0,87	3,05	62,44	71,77	0,072
E.1	1,5	1,7	60,00	40,00	0,040
E.2	1,3	2,35	71,88	55,30	0,055

3.8.4. Shear Stress Levels of Walls

Shear stress is defined as a force tending to cause deformation of a material along a plane or planes by slippage (Britannica, 2018). Shear strength of buildings is referred to resist forces that can cause the internal structure of the material slide against itself. This strength is related to connection of mortar and stone (or brick, concrete etc..) in masonry structures (Ünay, 2002). To calculate strength loads (earthquake load) divided cross sectional area of wall (Seward, 1998).

Table 3.8. Shear Stress of the walls

CODE	*Vt=W* x 0,5	AREA OF WALL	SHEAR STRESS Vt/A (Kn/m2)	SHEAR STRESS Vt/Area (mPa)
A.1	7,48	1,59	4,71	0,005
A.2	46,80	2,34	20,00	0,020
A.3	45,01	1,09	41,30	0,041
A.4	101,52	2,82	36,00	0,036
A.5	116,22	2,94	39,53	0,040
A.6	50,62	1,42	35,65	0,036
B.1	3,50	0,17	20,59	0,021
B.2	52,77	4,22	31,41	0,031
B.3	45,71	1,11	41,18	0,041
B.4	140,14	3,83	36,59	0,037
C.1	46,42	1,87	24,82	0,025
C.2	173,44	3,51	49,41	0,049
C.3	12,18	0,69	17,65	0,018
C.4	31,73	0,93	34,12	0,034
C.5	5,91	0,67	8,82	0,009
C.6	2,68	0,60	4,47	0,004
D.1	46,41	2,63	17,65	0,018
D.2	15,14	1,43	10,59	0,011
D.3	85,34	1,63	52,35	0,052
D.4	126,70	2,42	52,35	0,052
D.5	31,22	0,87	35,88	0,036
E.1	30,00	1,50	20,00	0,020
E.2	35,94	1,30	27,65	0,028

3.8.5. Overturning Moment Evaluation

Overturning or in the specific case out of plane failure, which is likely to occur partially at upper parts of wall, is checked by assuming the wall doesn't show any flexural behavior. Orthogonally joining walls are assumed to be rigid their inplain direction and forms support points in out of plane direction of the wall (Fig. 3.31). Thus, for the wall to collapse out of plain the shear strength at the support ends need to be exceeded. The resisting resultant vector of the shear is assumed to be acting the the mid-height of the wall which is a conservative approach. Then the resisting forces against the earthquake actions are gravity resistance of the wall and shear through the section area at support points. For a wall with thickness t, height H, total weight W, number of support point s and shear strength Ʈ, total resisting moment M_r , driving moment M_{EQ} and factor of safety FS are calculated as follows.

$$M_r = W * \frac{t}{2} + Ʈ * (\mathrm{H} * \mathrm{t}) * \mathrm{s} * \frac{\mathrm{H}}{2}$$

(3.2)

$$FS = \frac{M_r}{M_{EQ}}$$

Overturning moment and safety factor are calculated according to the equations in the above.

Table 3.9. Overturning moment

CODE	*Vt*=*W* x 0,5	H OF WALL /2 (m)	STRENGTH	RESISTANT FORCE	MOMENT	SAFETY FACTOR
A3-A5	262,75	1,53	0,10	452,88	1178,24	2,21
B1-B2	29,89	1,335	0,10	138,84	160,99	5,04
B3-B4	185,84	1,75	0,10	231	201,68	1,62
C1	46,42	1,055	0,10	116,05	98,99	3,02
C2	46,42	1,055	0,10	116,05	98,99	3,02
C3	12,18	0,75	0,10	81	58,19	7,37
C4	31,73	1,45	0,10	226,2	306,73	7,67
C5	5,91	0,375	0,10	54	22,29	11,05
C6	2,68	0,19	0,10	31,16	7,61	15,93
D.1	46,41	0,75	0,10	115,5	87,55	3,52
D.2	15,14	0,45	0,10	51,3	24,90	4,65
D.3	85,34	2,225	0,10	369,35	702,76	4,70
D.4	126,70	2,225	0,10	253,65	354,69	2,26
D.5	31,22	1,525	0,10	262,3	379,25	8,97
E.1	30,00	0,85	0,10	124,1	101,88	5,00
E.2	35,94	1,175	0,10	197,4	219,90	6,21

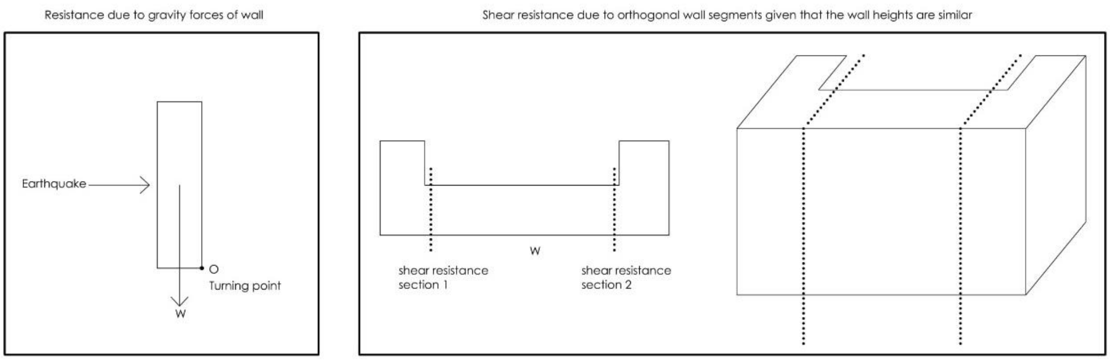

Figure 3.31. Calculation of overturning resistance

3.8.6. Evaluation

A table of the safety factors are listed in which found by above simple approach, which gives an idea on the safety and relative urgency of retrofit among the walls. At the northeastern corner B4-C1 of the building, (Fig 3.28) safety factor is low due to long unsupported span of the wall B4 and free (unsupported) end at the C1 corner. Moreover, intuitively long walls would not behave as single block out of plane direction but shows bulging behavior. Therefore, there should be a consolidation at this wall close to the corner side. This wall can be examined in more detail by civil engineers. If necessary, consolidation proposed in this study can be revised according to the results of the detailed analysis. There are some arch remains as mentioned above (Chapter 3.7). These arches are in almost collapsed state. Therefore, they need structural consolidation.

3.8. Alteration Analysis of the Bath

There are two types of alterations at the bath: missing parts and the additional parts (Appendix C).

3.9.1. Missing

Since the borders of spaces 1, 9 and 11 are not totally observed, these spaces are evaluated as partially missing. Building elements such as arches, domes and squinches, walls and floor covering are also partially missing.

3.9.2. Additions

There are two types of additions in the building. One of them is the stone walls with cement plaster in southeastern and northeastern façades. Second type of addition is concrete pools at spaces 5, 6, 7 and 8.

3.10. Condition Report of the Bath

The present condition of the bath will be discussed respectively in the below (Appendix B).

3.10.1. Symptoms

Symptoms of structural failure and material deterioration are diagnosed in three groups: CC1, CC2 and CC3 (Table B1). CC1 refers to local structural failure with local material deterioration. This condition class contains partial collapses as structural failure, biological growth and cement interventions as a material deterioration. CC2 refers to local structural failure with widespread material deterioration. Cracks as structural failure and crumbling, discoloration, biological growth and cement interventions as material problems are observed. CC3 refers to major structural failure such as total and almost collapses with widespread material deterioration. Joint discharge, discoloration and biological growth are material deteriorations of CC3. These classes are also related with excavation levels. The parts of the building which were discovered with excavation have not been damaged much due to protection of earth. Upper parts of the bath which have been exposed to climatic conditions are damaged more. Therefore, the parts which are under excavation level are generally in CC1. The top portion that has been affected by direct rain penetration is in CC3. The middle portion is in CC2.

3.10.2. Risk Assessment

There are three different urgency classes in correspondence to each condition class. UC1 refers to intermediate actions. This class is equal to CC1. There is a risk of potential loss of historical material due to climatic and seismic effects. UC2 corresponds to CC2. The conservation actions should be done in short term. There is a risk of potential deterioration of original material due to cement interventions. In addition, there is a risk of potential salt crystallization due to cement mortar and plaster. The UC3 is equal to CC3. The actions of this class should be done immediately. There is a potential of seismic vulnerability, which has impact on safety. Salt crystallization under capping may take place.

3.10.3. Possible Measures and Content of Possible Interventions

The actions in RC1 corresponds to conditions class 1, RC2 refers to CC 2 and RC3 refers to CC3. RC1 contains actions such as maintenance and simple repair. RC2 and RC3 involves maintenance, simple repair and restoration.

For partial collapse and biological growth problems in CC1, maintenance is recommended. In the context of partial collapse, periodic monitoring is proposed. For biological growth in CC1, cleaning and periodic monitoring is proposed. There are two types of cement interventions in this class. One of them is cement interventions for capping purposes. Cleaning of cement capping and provision of new capping compatible with original mortar is suggested in the context of simple repair. Other cement interventions are the concrete pools. Their removal should be planned in content of simple repair.

For cracks in CC2, filling the gap with compatible material is recommended in the context of simple repair. For both discoloration and biological growth, cleaning and periodic monitoring is recommended in the context of simple repair. For crumbling, both simple repair and maintenance is proposed. Replacement of deteriorated stones with similar new material is in the context of simple repair. Prevention of rising damp and formation of drainage are in the context of maintenance. There are cement interventions on the walls in this class. Consolidation, which consists of different stages, is suggested for these cement portions in the context of restoration. These stages are shoring, cleaning of cement intervention on the walls and partial reconstruction with original stone and compatible mortar.

For total collapse in CC3, maintenance is suggested. Cleaning, prevention of rain penetration, capping of the remains and traces with material similar to original mortar and periodic monitoring are the possible interventions. For almost collapsed parts, restoration is recommended. In the context of restoration, consolidation is a possible intervention. This consolidation consists of shoring and designing of supportive elements.

For joint discharge problem, filling the gap with compatible material is a possible intervention in the content of simple repair. For discoloration and biological growth, maintenance is suggested.

For joint discharge, simple repair is proposed. For discoloration and biological growth, cleaning and periodic monitoring are possible interventions as mentioned in the above.

CHAPTER 4

COMPARATIVE STUDY AND RESTITUTION

Restitution problems are form of *soyunmalık*, superstructure of *soyunmalık*, plan scheme of *sıcaklık,* central dome of *sıcaklık*, dome covering, and details of domes (Appendix F, Table F.1)

4.1. *Soyunmalık*

In all of the examples of comparative study, *soyunmalık* was the first space, which was located in the entrance of the bath. So, space 1 is corresponding to *soyunmalık*. Since there are remains regarding to this space, this decision is reliable (8/8; Orhan Gazi in Bursa, Mahkeme in Bursa, Hundi Hatun in Bursa, Ağa in İstanbul, Çukur in İstanbul, Gedikpaşa in İstanbul, Tahtakale in Tire and Langa in İstanbul).

In all baths dating to the 15th century, *soyunmalık* spaces were square planed (8/8; Orhan Gazi in Bursa, Mahkeme in Bursa, Hundi Hatun in Bursa, Ağa in İstanbul, Çukur in İstanbul, Gedikpaşa in İstanbul, Tahtakale in Tire and Langa in İstanbul). In turn, the form of *soyunmalık* of Cevherpaşa Bath is evaluated as square. The w of *soyunmalık* wall is obtained from the remain of the southern wall. This information is repeated for western and northern walls of the space. In turn, location and form of soyunmalık are based on comparative study and their reliability are 4th degree. However, dimension, material and detail are based on comparative study within the buildings and their reliability degree are 3 (Appendix F, Fig. F.1).

According to Önge (1995), the superstructures of *soyunmalık* were could be timber-framed roof in the 15th century baths (3/7; Nalıncılar in Bursa, Yukarı Pazar in Kocaeli and Yeşil in Bursa). The thickness of the wall traces which is 50 cm give information that the roof of *soyunmalık* was timber-framed roof. There is no superstructure remain in the upper level eastern part of the space. In turn, roof of *soyunmalık* is evaluated as timber-framed. Location, form and dimension of the roof are based on traces and their reliability degree is 2. However, material and detail are based on comparative study and their reliability are 4th degree.

Soyunmalık spaces were illuminated by luminaire, which were located at the middle of the roof. They were built as part of timber framed structure (Önge, 1995). Sources of location, form, dimension, material and detail of luminaire is comparative study. Their reliability degree is 4.

There was a room for the *keseci* or manager of the bath at one beside of the entrance (Aru, 1941). Location, form, dimension, material and detail of this room are based on comparative study. Therefore its reliability degree is 4.

In baths dating to the 15th century, there were niches for putting user's objects in the *soyunmalık* spaces. Location of them are based on comparative study. Their reliability degree is 4. However; form, material, dimension and detail are based on comparative study within the buildings. Therefore, their reliability is 3rd degree.

The restitution of the location of the door is based on remain. Its reliability degree is 1. The form, dimension, material and detail are based on comparative study. In turn their reliability is 4th degree.

A fountain was provided in the middle of the *soyunmalık* to listen to sound of water and to watch effluent water under the luminaire. They were generally built with marble (Aru, 1941). Sources of location, form, dimension, material and detail of the fountain are based on comparative study. Therefore, their reliability is 4th degree.

In baths dating to the 15th century, there were platforms around the soyunmalık spaces (Önge, 1995). Location, form, dimension and material of platform, which is located at the southern part of the space, are based on remains. Their reliability is 1st degree. The detail is based on comparative study, its reliability degree is 4. Location, form, dimension of the covering of the stated platform are based on remains, so reliability is 1st degree. Material and detail are obtained from comparative study. In turn, their reliability is 4th degree. This information is repeated for western and northern walls of the space. In turn, location of platform of western and northern parts is obtained from comparative study. Its reliability is 4th degree. However, form, dimension, material and detail are based on comparative study within the building. Therefore, their reliability is 3rd degree.

There are stone floor covering remains in the *soyunmalık*. In turn, location, form, dimension, material and details of floor covering are obtained from remains. Therefore, its reliability is 1st degree.

4.2. *Aralık*

In many of the examples of comparative study, *aralık* was located in between *sıcaklık* and *ılıklık* (Önge, 1995). Therefore, space 2 is corresponding to *aralık*. Since there are remains regarding to this space, this decision is reliable (5/8; Hundi Hatun in Bursa, Ağa in İstanbul, Çukur in İstanbul, Gedikpaşa in İstanbul and Langa in İstanbul).

Aralık space was covered with a vault or a dome. The superstructure of the *aralık* was continued above the toilet space in this period. Location, form, dimension, material and detail of the vault of the space is based on comparative study. Therefore, its reliability is 4th degree.

Location of stone floor is determined by comparative study and its reliability degree is 4. In turn, form, dimension, material and details of floor covering are obtained from comparative study within the buildings. Therefore, its reliability is 3rd degree.

4.3. Toilet

Toilet in the 15th century baths may have connection with the *aralık* spaces (4/8; Hundi Hatun in Bursa, Ağa in İstanbul, Çukur in İstanbul and Langa in İstanbul). Therefore, the naming of the space 3 as toilet is reliable. Since space 3 overlaps with the spatial qualities of typical 15th century toilets with its small size, form, niches, position in connection with the *aralık*, its identification as the toilet is 1st degree reliable.

Location of partitions is based on comparative study. Form, dimension and material are obtained from remains. Their reliability is 1st degree. Details are based on comparative study. Therefore, their reliability is 4th degree.

Decision of stone floor covering is determined by comparative study and its reliability degree is 4. In turn, form, dimension, material and details of floor covering are obtained from comparative study within the building. Therefore, its reliability is 3rd degree.

4.4. *Ilıklık*

Ilıklık is located in between *soyunmalık* and *sıcaklık* spaces in most examples in the 15th century baths (7/8; Orhan Gazi in Bursa, Hundi Hatun in Bursa, Ağa in İstanbul, Çukur in İstanbul, Gedikpaşa in İstanbul, Tahtakale in Tire and Langa in İstanbul). So, space 4 is corresponding to *ılıklık*. Since there are remains regarding to this space, this decision is reliable.

Location, form, dimension and material of dome of *ılıklık* are obtained from remains. They are 1st degree reliable. Detail of domes is based on comparative study. Its reliability is 4th degree. Location of stone floor is determined by comparative study and its reliability degree is 4. In turn, form, dimension, material and details of floor covering are obtained from comparative study within the buildings. Therefore, its reliability is 3rd degree.

4.5. *Tıraşlık*

Tıraşlık have connection with *ılıklık* in most examples in the 15th century baths (6/6; Orhan Gazi in Bursa, Hundi Hatun in Bursa, Ağa in İstanbul, Gedikpaşa in İstanbul and Langa in İstanbul). Therefore, space 5 is evaluated as *tıraşlık*. Since there are remains regarding to this space, this decision is reliable.

Tıraşlık space was covered with a vault or a dome in this period baths (Önge, 1995). The superstructure of the case study bath is evaluated as dome. Location, form, dimension, material and detail of dome are based on comparative study. Therefore, its reliability is 4th degree.

Location of stone floor is determined by comparative study and its reliability degree is 4. In turn, form, dimension, material and details of floor covering are obtained from comparative study within the buildings. Therefore, their reliability is 3rd degree.

4.6. *Sıcaklık*

In all of the examples of the 15th century baths, *sıcaklık* was located at the inner part of the composition (8/8; (8/8; Orhan Gazi in Bursa, Mahkeme in Bursa, Hundi Hatun in Bursa, Ağa in İstanbul, Çukur in İstanbul, Gedikpaşa in İstanbul, Tahtakale in Tire and Langa in İstanbul). So, space 6 is evaluated as *sıcaklık*. Since there are remains regarding to this space, this decision is reliable.

Main *sıcaklık* space is surrounded by iwans, which are located four side of the space, and *halvets*, which are located at the corner of the space. This plan scheme of *sıcaklık* are repeated in most of the examples of the 15th century baths (7/8; Orhan Gazi in Bursa, Beylerbeyi in Edirne, Ağa in İstanbul, Çukur in İstanbul, Gedikpaşa in İstanbul, Langa in İstanbul and Yeniçeri in Edirne). Therefore, space 10 are corresponding to iwan and space 8 and space 9 are corresponding to *halvet* spaces. This decision will be reliable since there are remains.

The superstructure of *sıcaklık* is space in the 15th century baths are mostly dome. The location of the dome is based on remains. Its reliability is 1st degree. Sources of the form, dimension, material and detail of the space is obtained from comparative study. Reliability of them is 4th degree. The central dome of sıcaklık of the building, had ellipse shape which was supported by squinches (4/5; Sultan Orhan Mosque in Bilecik, Ulu Mosque in Manisa, Lütfiye Mosque in Mardin and Yakup Bey Almshouse in Kütahya). There are squinches, which supported the main dome. The information of location of squinches are based on comparative study. Its reliability is 4th degree. Information about form, dimension, material and detail are obtained from comparative study within the building. Its reliability is 3rd degree. The superstructure of *halvets* are dome. Location, form, dimension, material and detail of domes are based on comparative study. So, its reliability is 4th degree. The superstructure of iwans are vault. Location, form, dimension, material and detail of domes are based on comparative study. So, its reliability is 4th degree. Location of the arches, which are located in the entrance of iwans, are based on comparative study. Its reliability is 4th degree. Form, dimension, material and detail are based on comparative study within the building. So, its reliability is 3rd degree.

Location, form and dimension of the door of the entrance of *halvets* are shaped by architectural necessity. So, its reliability is 1st degree. Material and detail of the door of the entrance of *halvets* are based on comparative study. Therefore, their reliability degree is 4.

Location of wash basin which is located at the northern wall of the *sıcaklık* is based on trace. Its reliability is 2nd degree. Other wash basins' location is based on comparative study. Their reliability degree is 4. Form, dimension, material and detail of all wash basins are based on comparative study. Their reliability is 4th degree.

The present opening in between the *sıcaklık* and the *ılıklık* has been diminished in size due to heat control necessity (8/8; Orhan Gazi in Bursa, Mahkeme in Bursa, Hundi Hatun in Bursa, Ağa in İstanbul, Çukur in İstanbul, Gedikpaşa in İstanbul, Tahtakale in Tire and Langa in İstanbul).

Location of stone floor covering is determined by comparative study and its reliability degree is 4. In turn, form, dimension, material and details of floor covering are obtained from comparative study within the buildings. Therefore, its reliability is 3rd degree.

4.7. Dome Covering and Details of Domes

In the 15th century baths, domes were generally finished with mortar (5/7; Hekim in Tire, Gazi Mihal Bey in Edirne, Beylerbeyi in Edirne, Kurdunus in Niğde and İbrahim Paşa in Edirne). Therefore, the covering of superstructure of Cevher Paşa Bath is evaluated as mortar.

There were oculi on the superstructure to provide daylight in the 15th century baths (5/5; Gazi Mihal Bey in Edirne, Kamanlı in Urla, Ulamış in Seferihisar, Mezit Bey in Edirne and Yeniçeri in Edirne). Location, form, dimension, material and detail of these elements are obtained from comparative study. Therefore, their reliability degree is 4.

4.8. Water Storage and Furnace

In all examples of the 15th century bath, water storage and furnace juxtapose *sıcaklık* (5/8; Orhan Gazi in Bursa, Mahkeme in Bursa, Hundi Hatun in Bursa, Çukur in İstanbul, and Langa in İstanbul). Therefore, space 11 is evaluated as water storage and furnace of the bath. There are remains related with this space. It is reliable.

Location and form of furnace and water storage are obtained from traces. Its reliability degree is 2. Their dimensions are determined with comparative study. Its reliability is 4th degree. Building material is observed through the traces. . Its reliability degree is 2. Details are based on comparative study. Its reliability is 4th degree.

There is a wood storage proposed neighbouring the furnace. Location, form, dimension, material and detail of both wood storage and roof of wood storage are determined by comparative study and their reliability is 4th degree.

Since, the bath was built on the valley, a retaining wall at the northern part of the wood storage is proposed until the roads. Location, form, material, dimension and detail of this wall is determined due to architectural necessity and its reliability is 5th degree.

4.9. Courtyard

A courtyard is suggested at the northern part of the *soyunmalık*. However, there is a level difference in between courtyard elevation and entrance elevation. A ramp is necessitated to solve level difference instead of stairs, because this road is to be utilized for wood transport. The reliability of courtyard and ramp are 5th degree.

Location of stone floor is determined by architectural necessity and its reliability degree is 5. In turn, form, dimension, material and details of floor covering are obtained from comparative study within the buildings. Therefore, their reliability is 3rd degree.

4.10. Water Systems

Supply of potable water supplement in this period is provided from cisterns and wellbores (Önge, 1995). There is a water channel in the bath, which is located at north-south axis and perpendicular to the water storage. Therefore, cistern 1, which is located in the southern part of the bath, is evaluated as the possible water source (Fig. 3.3). However, according to Ersoy (2018), there is no water pipe seen in the cistern. At the ground of the cistern, lead plates were seen. It refers that, the cistern was used for potable water. So, clean water of the bath is assumed to be provided from spring waters around the bath.

The drainage of used water is evaluated from *sıcaklık* to toilet space. Therefore, it is started from the *halvet* and iwans, and merged with *tıraşlık* drainage in the *ılıklık*, and it is disposed to the toilet.

CHAPTER 5

RESULTS

In this chapter, values of the bath were evaluated. Emergency interventions, restoration approaches were defined. Then related interventions and a management plan for the bath were suggested.

5.1. Values of Cevher Paşa Bath

The bath gives information about structural system, construction technique, material, spatial characteristics and architectural elements of the 15th century baths. Plan and façade organization, spatial characteristics and architectural elements of the building have sustained properties of the 15th century Turkish bath. In terms of these characteristics, the building has documentary value. There are some unqualified additions such as concrete pools observed in the building. However, authenticity of the ruin in terms of monument itself and its context is preserved. Therefore, it has authenticity value. Structural system, construction technique, spatial characteristics have preserved their authenticity. The form of the central dome of *sıcaklık* is one of the attributes of rarity value. The form of the dome is determined as ellipse with restitution. The settlement consists of different layers. There are different elements belonging to various periods: ancient and Turkish. However, all of them except the reconstructed mosque, are in ruin. The ruined monument is in harmony with the archeological site. The ruin is part of its context. On the other hand, some ruins in the site were not existing together in their full scale such as Roman and Ottoman baths. Therefore, their full reconstruction, as if they were existing in the same period, will give wrong information about the archeological site. Therefore, just consolidation and presentation of the present remain are proposed for holistic approach.

5.2. Emergency Interventions

Emergency interventions will be applied to the elements which have seismic vulnerability risk. These vulnerable elements should be consolidated with temporary shoring immediately. As an emergency intervention, pine timber supports are proposed (Appendix G, Fig. G.1). These elements are placed especially under the arch remains.

5.3. Restoration Approach

Three possibilities for restoration approach have been considered: consolidation, reintegration and reconstruction (Table 5.1). The approaches 1 and 2 sustain documentary value; while in the approach 3, all of the building elements will be renewed. In turn, authenticity will be lost in approach 3. In terms of distinguishability, the elements added for consolidation and reintegration will be legible since they will be out of timber and stainless steel. The masonry reconstruction, however, will gain patina in time and be illegible. In terms of integrity, the consolidation approach (1) sustains the ruined appearance of the monument. So, it continues to be an integral part of its context. The others (2,3) have potential to create a three-dimensional building in the archaeological site. All of the approaches fulfill structural integrity necessity. Timber, stainless steel or stone and brick will be all compatible with the building and the context. Consistency of consolidation, reintegration and reconstruction will be undertaken throughout the structure. All restorations will be accessible by the visitors. Consolidation and reintegration elements may be dismantled, if a better intervention is planned in the future. However, the full reconstruction of the structure necessitates total renewal of all elements; so, it will not be possible to retreat the ruin in the future.

5.4. Intervention Decisions

Mechanical cleaning of plants will be done. Permanent supportive elements will be designed instead of temporary shoring. Prevention of rain penetration is provided with capping. Concrete pools will be removed and additional earth will be added if necessary. Existing capping will be cleaned and new capping compatible with original mortar will be applied. A drainage system will be added. Walls will be consolidated with injection.

Table 5.1. Possible restoration approaches

Approach 1: Consolidation	
Applied Parts: Some portions of the ruin **New Materials:** Timber elements, spruce **Additional Structural Elements:** Timber frame	**Intervention Type:** Consolidation, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☒ **Integrity (building itself):**☒ **Compatibility of materials:**☒ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒
Approach 2: Reintegration	
Applied Parts: The whole ruin **New Materials:** Stainless steel; new walkways out of stainless steel or timber frame structure **New Structural System:** Steel frame or timber frame	**Intervention Type:** Reintegration, presentation **Documentary Value:** ☒ **Distinguishability:** ☒ **Integrity (context):**☐ **Integrity (building itself):**☒ **Compatibility of materials:**☒ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☒
Approach 3: Reconstruction	
Applied Parts: The whole ruin **New Materials:** Rubble stone and brick **New Structural System:** Masonry	**Intervention Type:** Reconstruction **Documentary Value:** ☐ **Distinguishability:** ☐ **Integrity (context):**☐ **Integrity (building itself):**☒ **Compatibility of materials:**☒ **Consistency:** ☒ **Accessibility:** ☒ **Retreatability:** ☐

5.5. Restoration

Restoration project will be applied for consolidation purposes. After consolidation of walls with injection, temporary shoring will be removed and permanent shoring with spruce timber supports will be placed. The stainless-steel plates will be applied for vulnerable elements with rubber isolator to prevent rusting. These elements will be supported with timber shoring. Timber floor will be applied. Information panels, binocular and balustrades will be added (Appendix F, Fig.G.8).

5.6. Management Plan

A monument management plan for the bath is prepared. The aim of the monument management plan is to ensure that the restoration project, which was based on scientific knowledge, is implemented in the same scientific way; to determine relevant institutions and agents; to provide the necessary financial resources; to provide that agents work in coordination; to ensure that the implementation is carried out in accordance with the legislation and the project; to enable the evaluation of the new data obtained during the implementation by the project designer, the consultants and etc. and to make possible for revision of the project; to ensure completion of the work safely and to provide regular maintenance after implementation of the project (Güçhan, 2011). The plan is also a pilot application for the whole site. The theme of the monument management plan is cultural tourism. Monument management plan (Table 5.2) consists of three phases. First stage is related with preliminary actions before the implementation of restoration. In the second stage, target of the restoration and the workflow is defined. The third phase is related with the monitoring of the bath after the implementation. Taking precautions against further damage, providing sustainable management of the bath and site and provision of financial resources to preserve and to promote the building and the site are targets of preliminary actions. For the first target, a committee in coordination with Kale Municipality will be constituted and temporary shoring will be applied as an emergency intervention. For the second target, a Consultation Council will be formed, and members of the Control and Coordination Council will be selected. Then, Environmental Organization Project in 1/500 scale and Management Plan for the site will be prepared. For the third target, funds will be increased by the mentioned agents in Table 5.2.

Table 5.2. Cevher Paşa Bath management plan

	TARGET	ACTION	AGENT	DURATION
PRELIMINARY ACTIONS	-Taking precautions against further damage	-A preliminary committee will be constituted in coordination of Kale Municipality. -Temporary shoring will be prepared as an emergency intervention. -The tender of Environmental Organization Project will be made.	-Kale Municipality -RT Ministry of Culture and Tourism -Civil Engineering Department of IZTECH -Architectural Restoration Department of IZTECH[1] - History of Art Department of Ege University -A construction firm specialized in restoration -RT Southern Aegean Development Agency	Short term
	-Providing sustainable management of the bath and the site	-A Consultation Council will be formed. A head for the monument and members of the Control and Coordination Council will be selected. -Environmental Organization Project (The Law numbered 5226, 2004) in 1/500 and Management Plan for the Site scale will be prepared for the site. -The project will be submitted for the approval of Regional Directorate of Pious Foundations and RT Ministry of Culture and Tourism	-Kale Municipality -RT Ministry of Culture and Tourism - Regional Directorate of Pious Foundations -Directorate of Excavation -General Directorate for Cultural Heritage and Museums	Short term
	-Provision of financial resources to preserve and to promote the building and the site	-Funds will be increased.	-RT Ministry of Culture and Tourism -Denizli Metropolitan Munucipality -Kale Municipality -Pamukkale University -Regional Directorate of Pious Foundations -AYDEM[2]	Medium term
	TARGET	ACTION	AGENT	DURATION
RESTORATION	-Preparation of the bath for restoration	- The tender of restoration and restoration project will be made within the scope of Environmental Organization Project. - Civil engineer and ground engineer will study for site scale for restoration project.	-Kale Municipality -Directorate General of Foundations -A construction firm specialized in restoration -Directorate of Excavation -Aydın, Conservation, Implementation and Inspection Office -General Directorate for Cultural Heritage and Museums	Short term

(cont. on next page)

[1] IZTECH İzmir Institute of Technology
[2] AYDEM Aydem Electricity Distribution Corporation in Aydın, Denizli and Muğla cities

Table 5.2 (cont.).

RESTORATION	-Preparation of restoration project for the bath accordance with 660 Principle Decision	-The project will be prepared by contractor. -The project will be submitted for the approval of Regional Directorate of Pious Foundations and RT Ministry of Culture and Tourism.	-Kale Municipality -A construction firm specialized in restoration -Directorate of Excavation -Aydın, Conservation, Implementation and Inspection Office -General Directorate for Cultural Heritage and Museums	Medium term
	-Consolidation of the bath	-Mechanical cleaning of plant will be done. - Cement capping will be cleaned and new capping compatible with original mortar provided. - Concrete pools will be removed. -Drainage system will be done. -Walls will be consolidated with injection. -Temporary shoring will be removed and permanent shoring will be installed.	-Kale Municipality -A construction firm specialized in restoration -Directorate of Excavation -Aydın, Conservation, Implementation and Inspection Office -General Directorate for Cultural Heritage and Museums	Medium term
	-Presentation of the bath	-Information panels will be added. -Binocular and balustrades will be added. -Timber floor will be applied.	-Kale Municipality -A construction firm specialized in restoration -Directorate of Excavation -Aydın, Conservation, Implementation and Inspection Office -General Directorate for Cultural Heritage and Museums	Medium term
	-Opening of the bath for visitors	-There will be a ceremony for opening of the bath for visitors.	-Kale Municipality -Civil Engineering Department of IZTECH -Architectural Restoration Department of IZTECH - History of Art Department of Ege University -A construction firm specialized in restoration	Medium term
	TARGET	ACTION	AGENT	DURATION
MONITORING	-Regular maintenance of the bath will be made.	-Monitoring scheme of the bath (Table 5.2) will be implemented.	-Kale Municipality -Directorate of Excavation -Aydın, Conservation, Implementation and Inspection Office -Regional Directorate of Pious Foundations	Continually

The first stage of the restoration work is preparation of the bath for restoration with mechanical cleaning. The second phase is preparation of the restoration project. Cement capping will be cleaned and new capping compatible with original mortar will be provided. Concrete pools will be removed, and drainage system will be done. The third stage of restoration is consolidation of the bath. Walls will be consolidated with injection. Then, temporary shoring will be removed, and permanent shoring will be installed. After structural interventions to present the bath, information panels and binocular will be added. Timber floor will be applied. Last phase of the restoration is opening of the bath for visitors. There will be a ceremony for opening of the bath for visitors. The last stage of the management plan is monitoring. Monitoring aims to provide regular maintenance to the bath (Table 5.3).

Table 5.3. Monitoring scheme of the bath

	January	February	March	April	May	June	July	August	September	October	November	December
Check drainage												
Cleaning of biological												
Check retaining												
Clean out drainage												
Removal of fallen leaves												
Remove debris												
Repair capping												

CHAPTER 6

DISCUSSION AND CONCLUSION

The structural conservation of historical masonry ruins was carried out in this study. Cevher Paşa Bath in Kale, Denizli was the case study. The case study bath is an example of the 15th century Ottoman Baths. The bath reflects the characteristics of the Ottoman Period in terms of its structural system, construction technique, material, spatial characteristics and architectural elements. Therefore, it has architectural value. Even though the bath is in ruin, its authenticity was preserved in terms of structural system, construction techniques and spatial characteristics. The central dome's form is an ellipse as revealed in restitution. This attributs rarity value for the bath. The bath has the necessary earthquake resistance performance, shear strength and compressive strength. However, there are some possible overturning problems at the eastern wall of the bath. The structural consolidation should be done in these parts of the wall. There were some previous interventions undertaken the bath ruin. These interventions are cleaning, conservation of the top portions of the walls and consolidation of the walls at the valley sides. However, there is lack of intervention against possible collapse of the bath in valley direction and presentation and management strategies were not considered. Structural calculations have revealed that strength of the walls corresponds for stresses and overturning moment. So, the restoration work may be limited with supporting of arch remains and the weakest part, northeastern corner, which was determined by calculations. Some walls of the ruin are weaker than the other parts. These parts need further analysis by civil engineers and if necessary, consolidation can be done. This possible consolidation was proposed in Appendix G, Fig.G.12.

There are three different possibilities of restoration approach; consolidation, reintegration and reconstruction. These approaches were evaluated in terms of conserving values, integrity, compatibility, consistency, accessibility and retreatability (Table 5.1). To preserve building as it is found, to preserve its perception and integrity in terms of the context of archeological site, consolidation was determined as the appropriate restoration approach. A management plan was proposed for realization of the proposed interventions. The management plan, which is consisted of three stages (preliminary actions, restoration and monitoring), envisaged that actors such as Kale Municipality, RT Ministry of Culture and Tourism, Aydın Regional Council for Conservation of Cultural Assets, Directorate of Excavations in General Directorate of Cultural Assets and Museums, Aydın Conservation Implementation and Inspection Office, Department of Architectural Restoration and Department of Civil Engineering of IZTECH and History of Art Department of Ege University work together. There are many methods of conservation of cultural assets. For example, the mosque, in Kale archaeological site, was reconstructed. However, the mosque lost its authentic character. Reintegration and reconstruction may cause some loss of authenticity and other. Therefore, in some cases, it is important to be content with consolidation and presentation. In the Turkey, the firm which gives the lowest bid for a restoration, implements the project. In the implementation process, findings which have emerged during cleaning may not be taken into consideration. After the restoration, the sustainable maintenance of the historical buildings can not be ensured. Therefore, to ensure that, implementation of restoration project, which was based on scientific knowledge, is implemented in the same scientific way, preparation of monument management plan is important. The study contributes to the preparation of management plan Turkish Period assets in archeological sites of Turkey. Consolidations are not providing sufficient level without the contribution of the civil engineers and ground engineers. An interdisciplinary study is required.

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APPENDIX A

MEASURED SURVEY

In this part of the study, measured survey drawings of the Cevher Paşa Bath including ground floor plan, elevations and sections are presented.

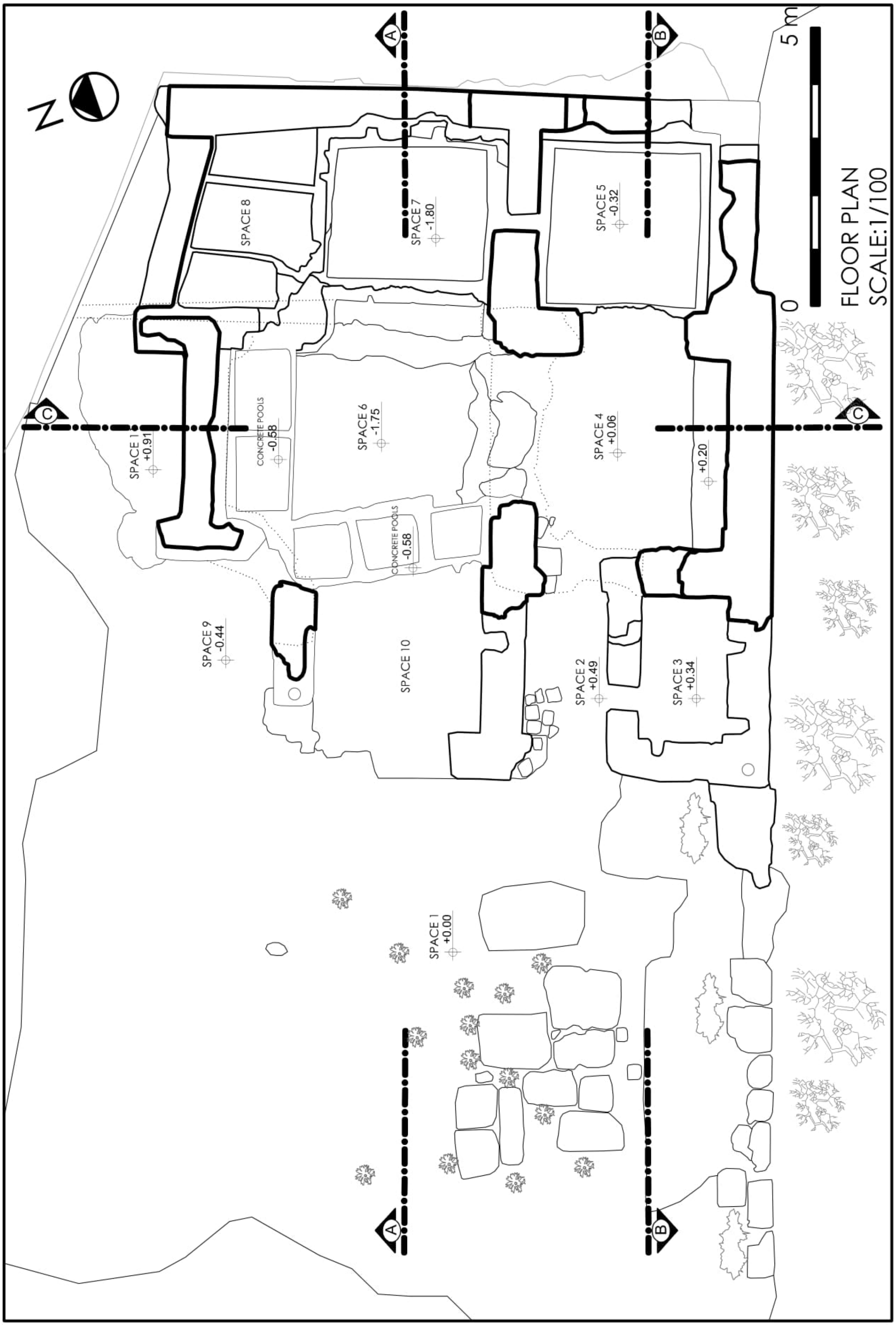


Figure A.1. Ground Floor Plan, Measured Survey

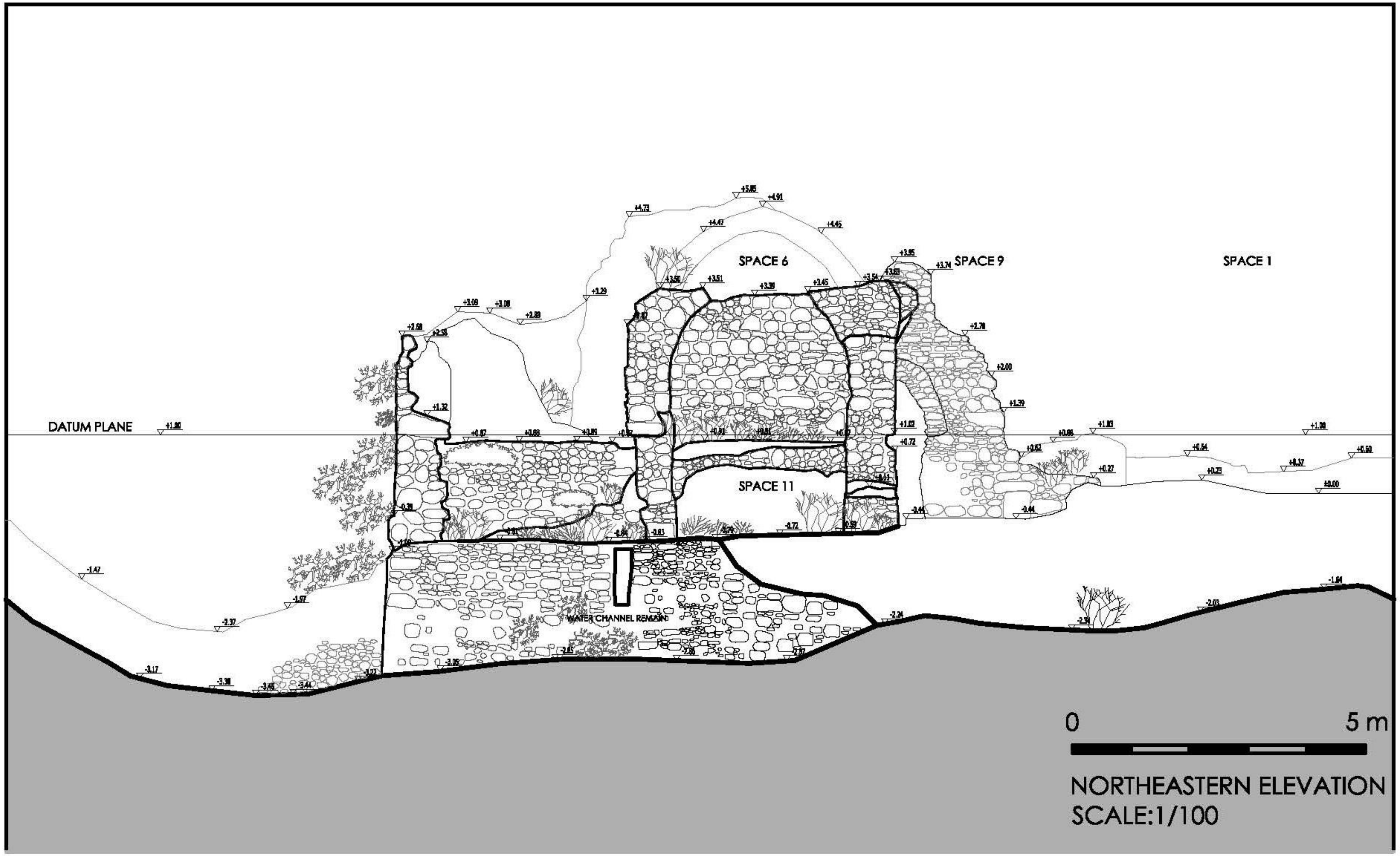


Figure A.2. Northeastern Elevation, Measured Survey

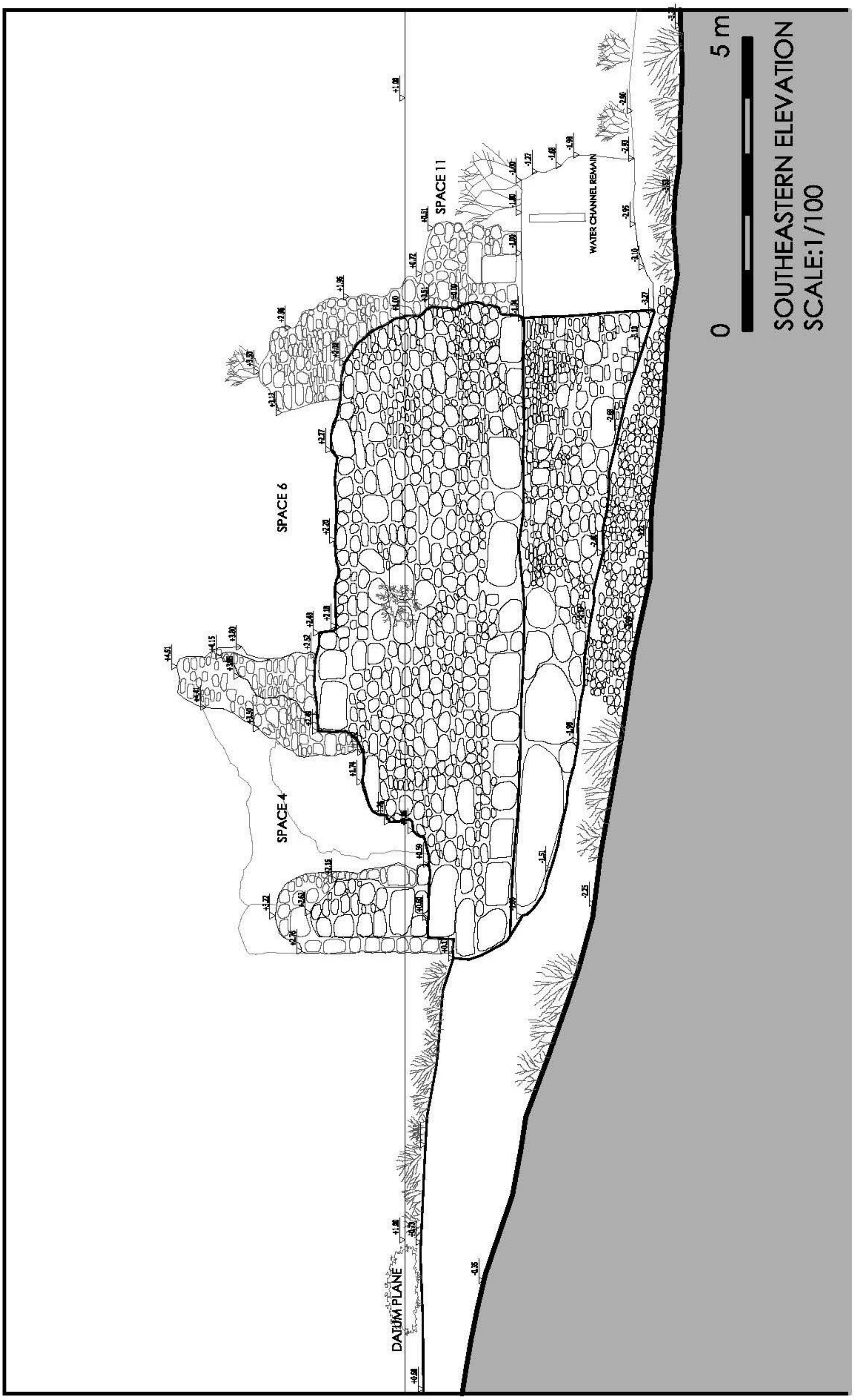


Figure A.3. Southeastern Elevation, Measured Survey

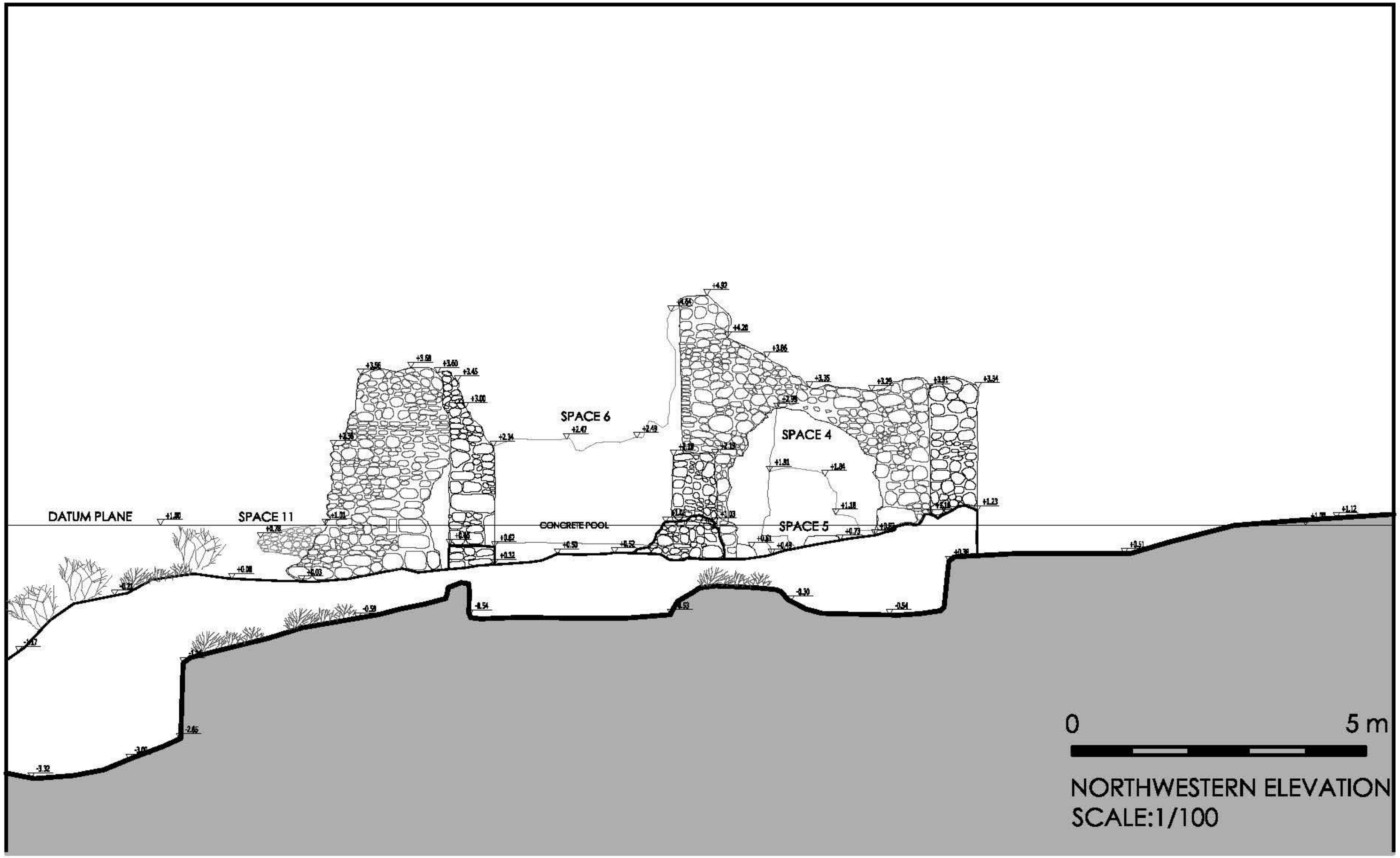


Figure A.4. Northwestern Elevation, Measured Survey

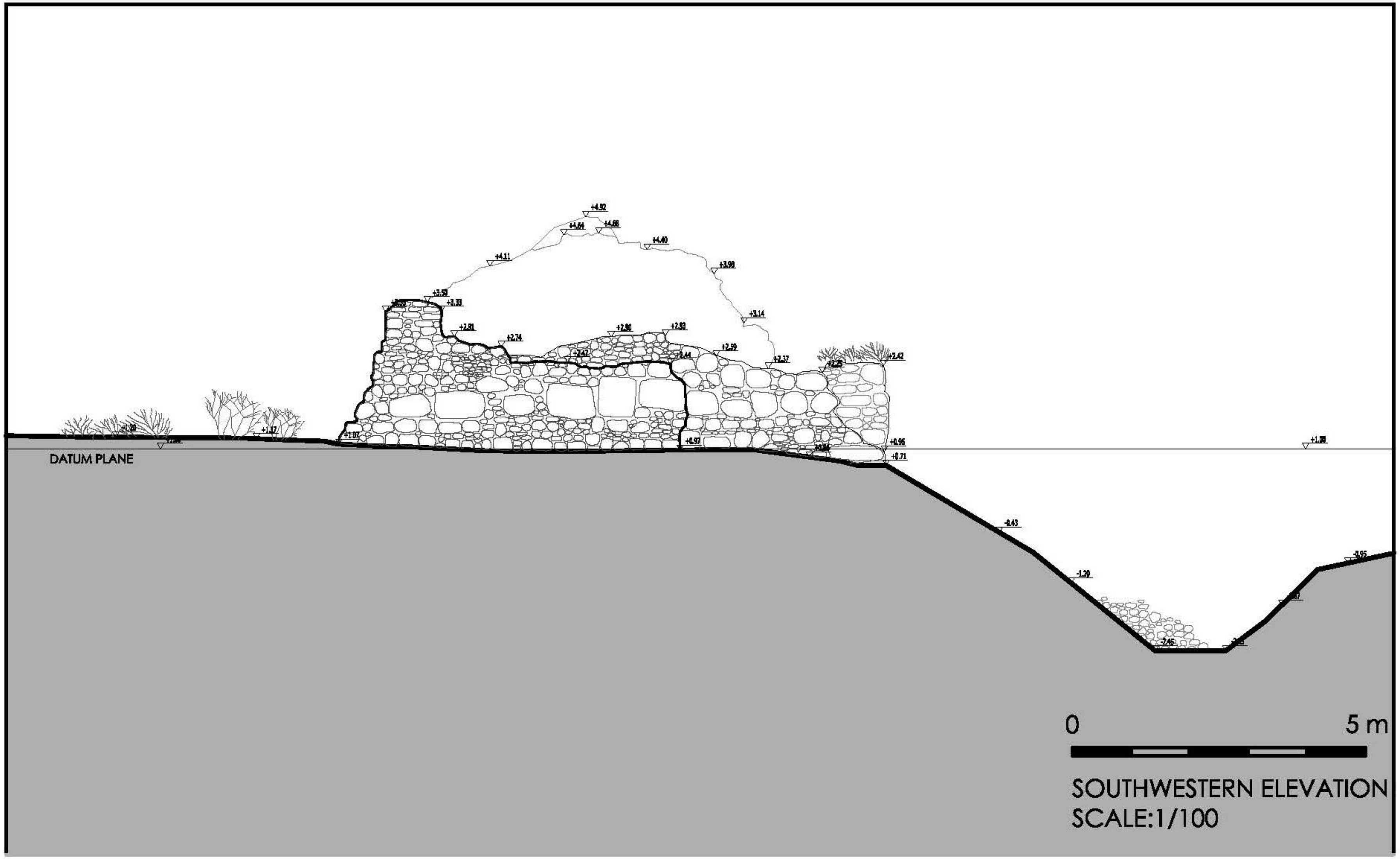


Figure A.5. Southwestern Elevation, Measured Survey

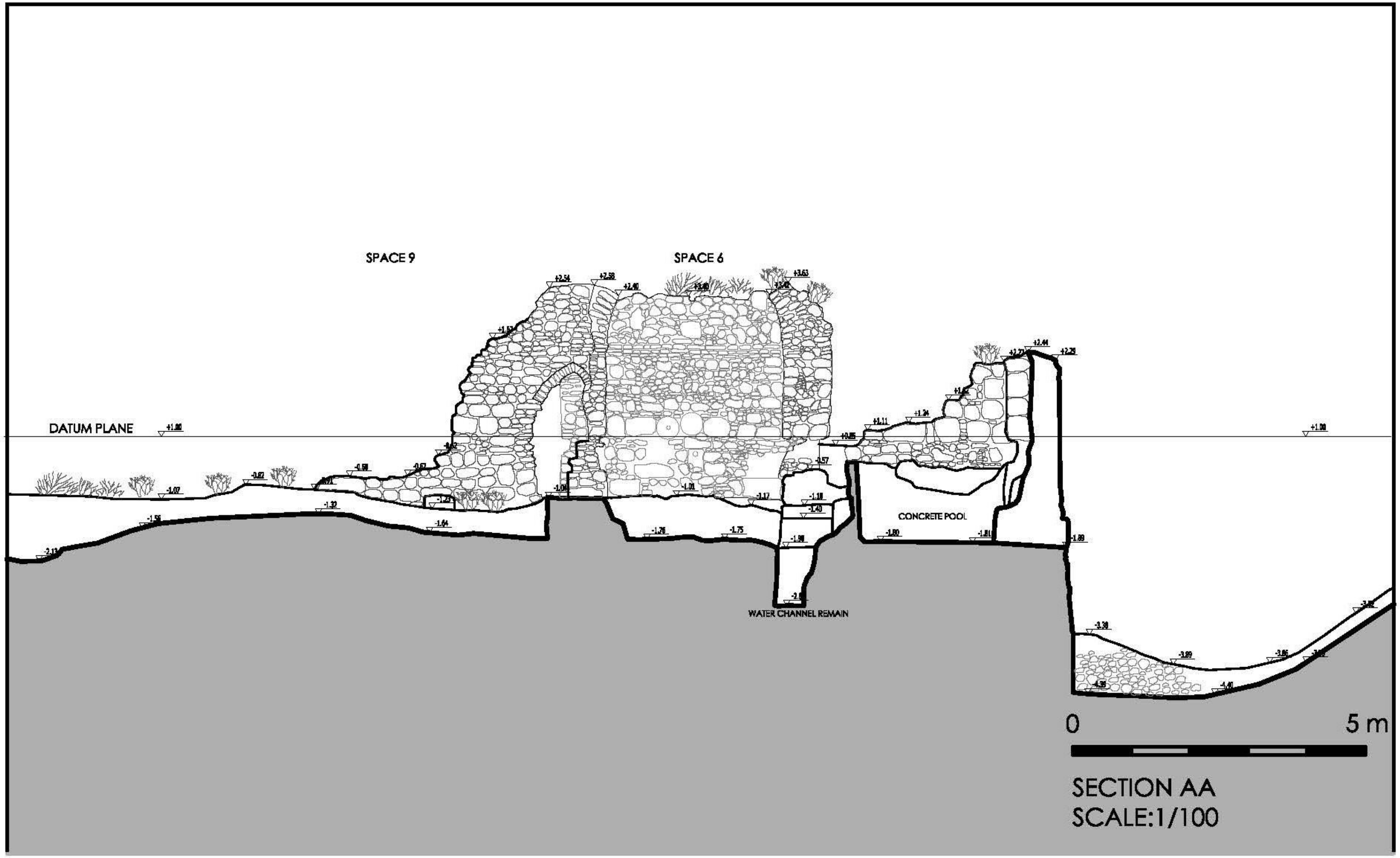


Figure A.6. AA Section, Measured Survey

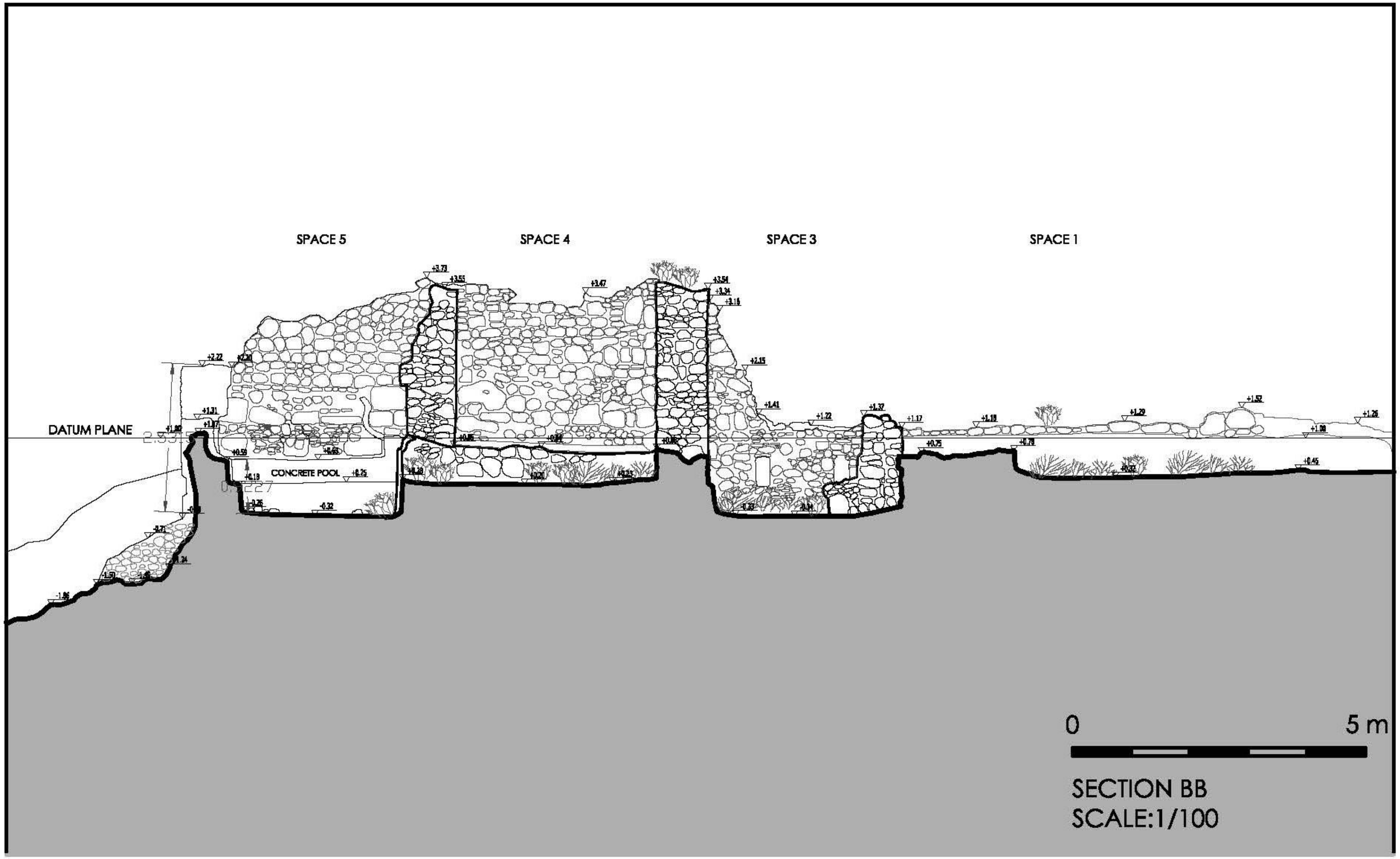


Figure A.7. BB Section, Measured Survey

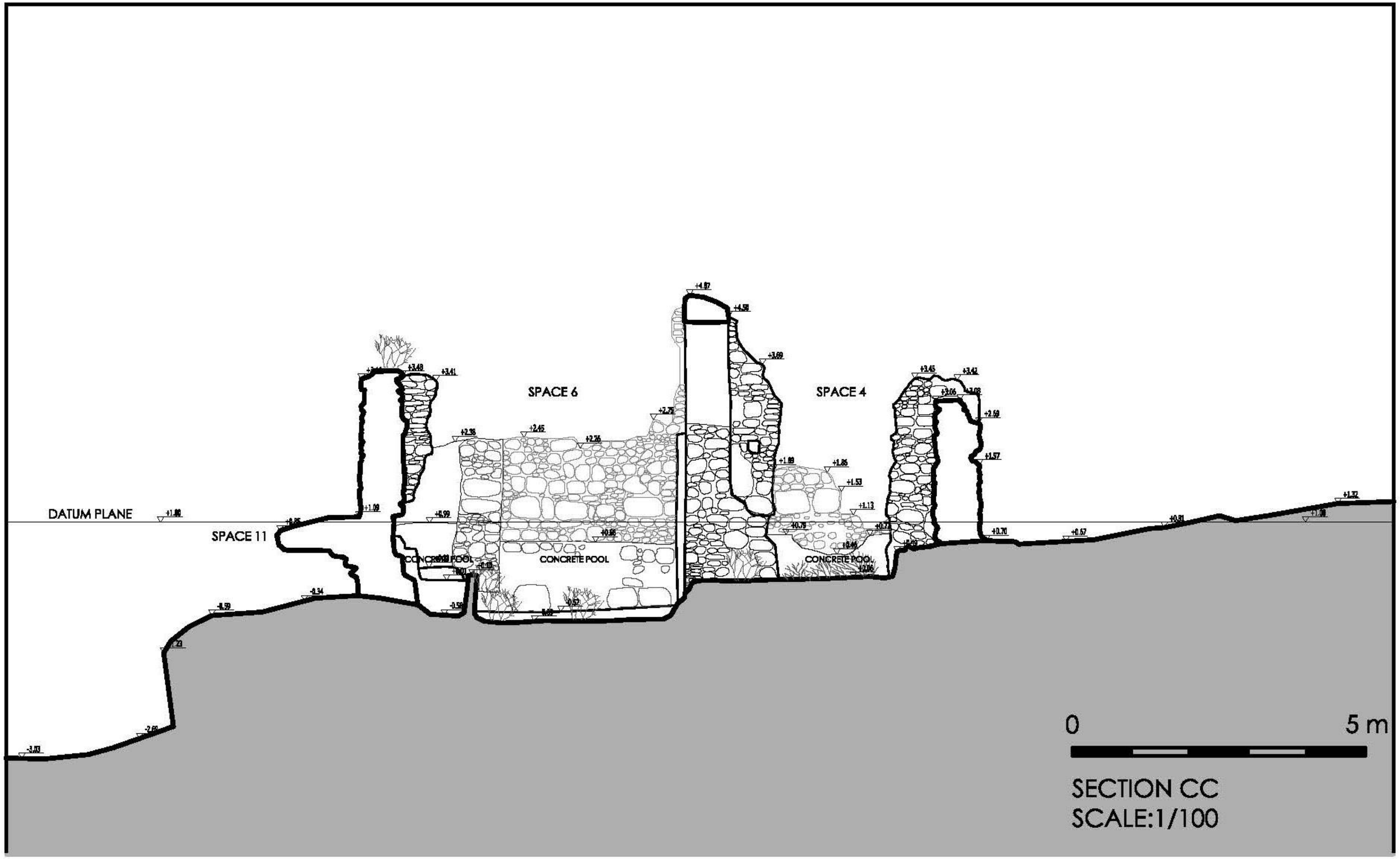


Figure A.8. CC Section, Measured Survey

APPENDIX B

SPATIAL CHARACTERISTICS AND ARCHITECTURAL ELEMENTS

In this part of the study, spatial characteristics and architectural elements of the Cevher Paşa Bath are presented.

1. SPATIAL CHARACTERISTICS
1.1. *"Soyunmalık"*
1.2 *"Ilıklık"*
1.3 *"Aralık"*
1.4 *"Sıcaklık"*
1.5 Water Storage
2. ARCHITECTURAL ELEMENTS
2.1 Wash basin remain
2.2 Niche
2.3 Horizontal pipe
2.4 Vertical pipe
2.5 Stone floor covering
2.6 Concrete pools
2.7 Water channel remain

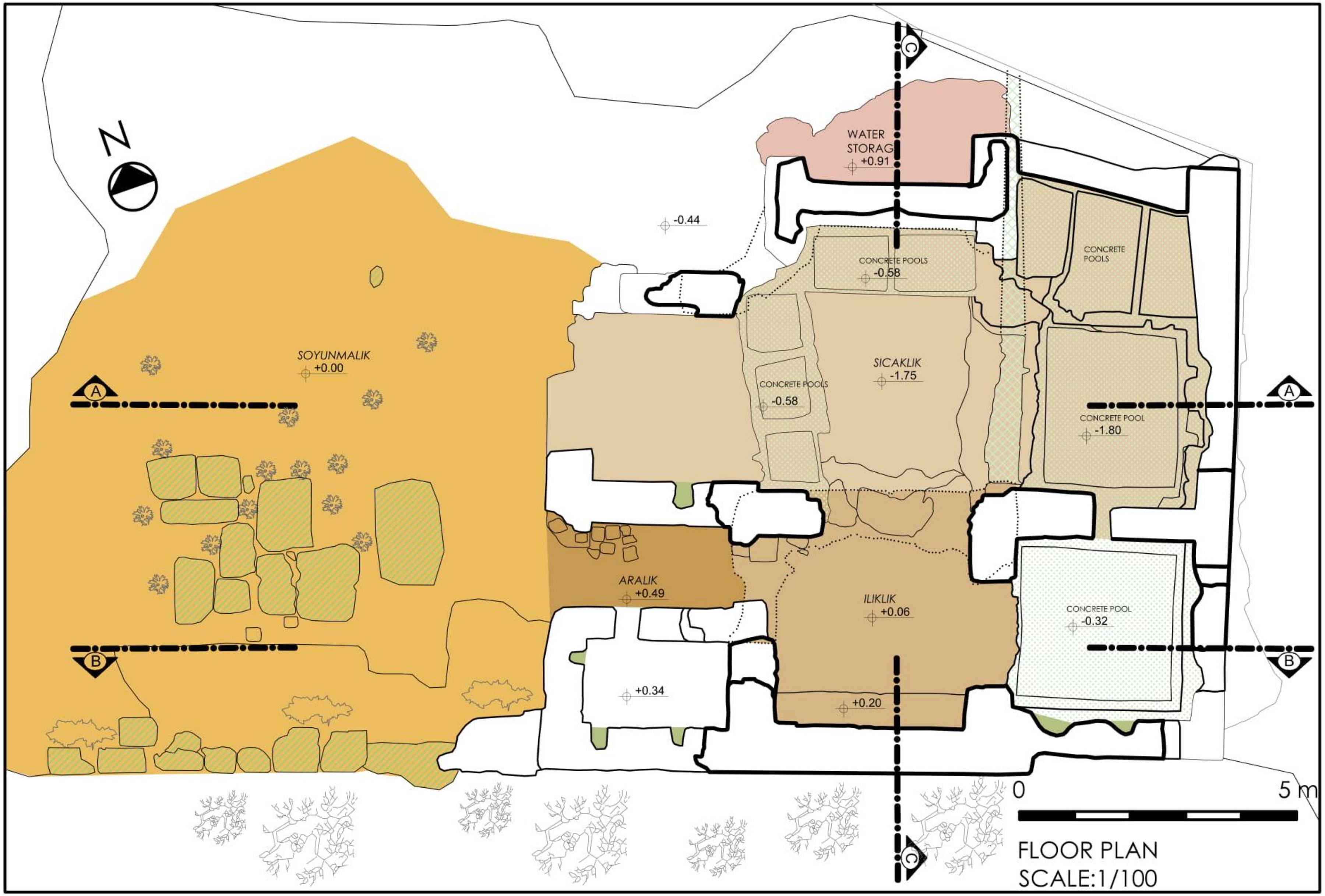


Fig B.1. Spatial Characteristics and Architectural Elements

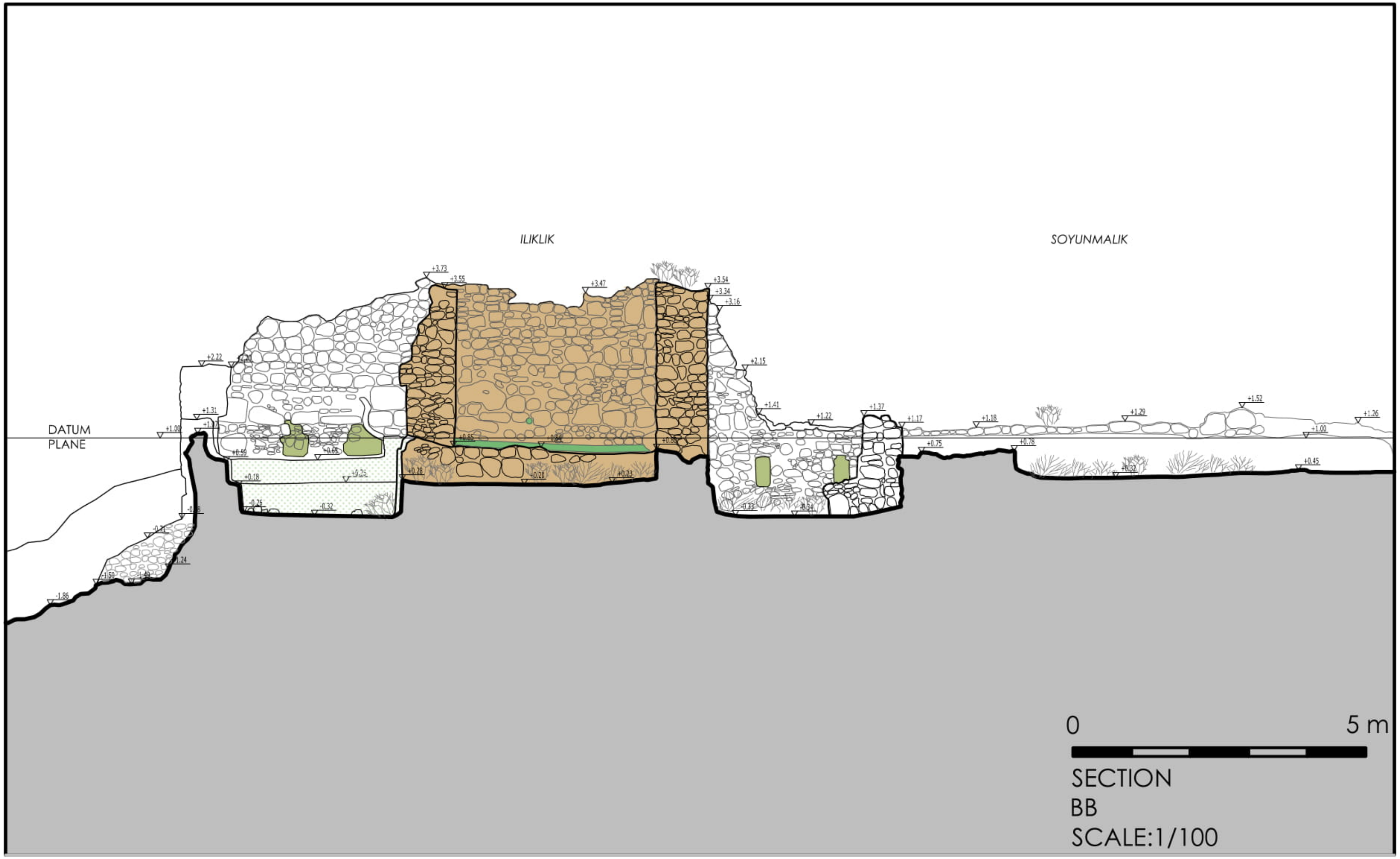


Fig B.2. Spatial Characteristics and Architectural Elements

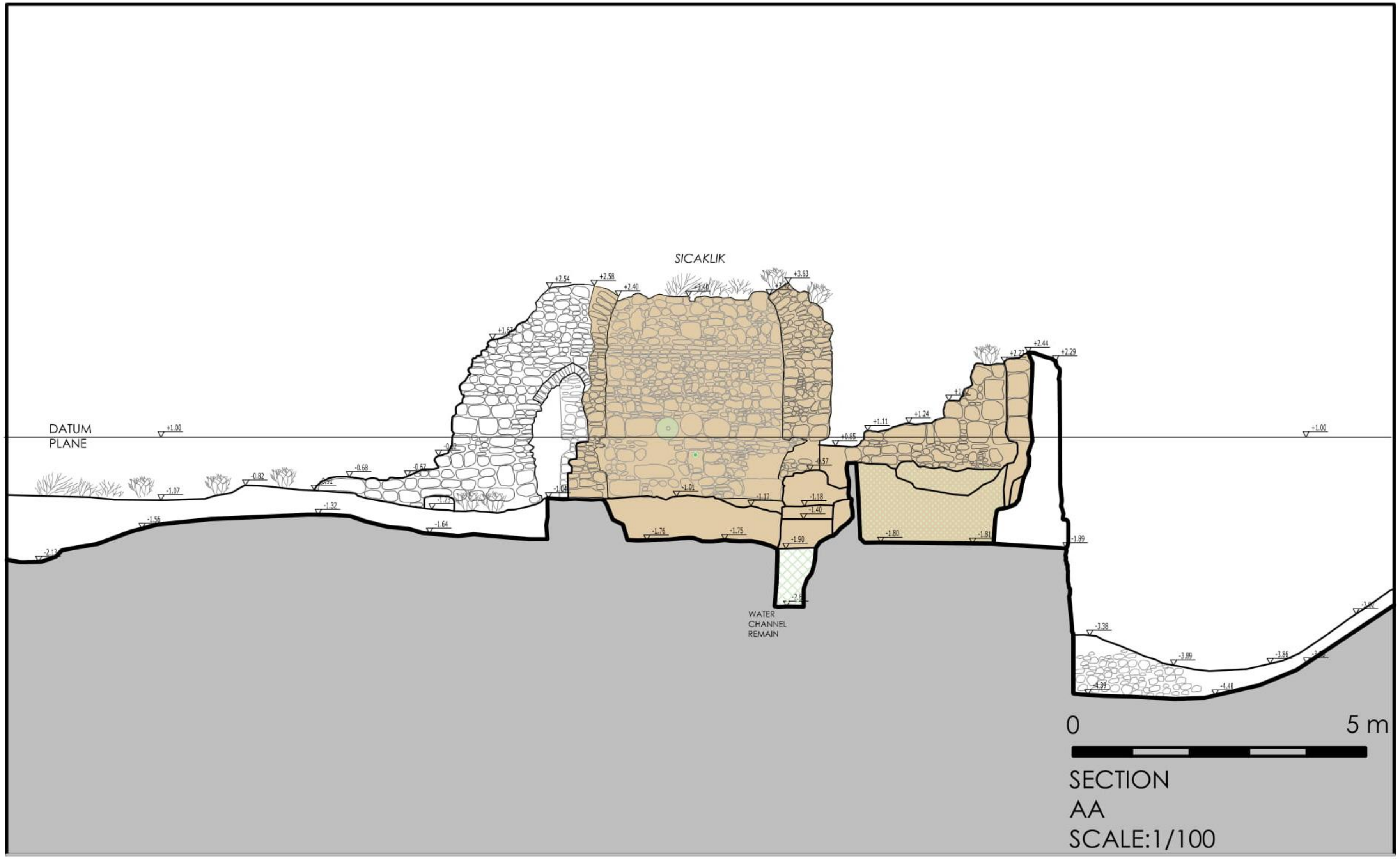


Fig B.3. Spatial Characteristics and Architectural Elements

a. Wash basin remain

b. Niches

c. Horizontal pipe

d. Horizontal pipe

Fig B.4.a Wash basin remain, B.4.b. Niches, B.4.c. Horizontal pipes, B.4.d. Horizontal pipes

APPENDIX C

STRUCTURAL CHARACTERISTICS AND MATERIAL USAGE

In this part of the study, structural characteristics and material usage of the Cevher Paşa Bath are presented.

1. SUPERSTRUCTURE REMAINS	
1.1. Arch remain Brick at both surfaces, rubble stone and lime mortar in between 1.2. Dome remain Brick at both surfaces rubble stone and lime mortar in between 1.3. Squinch remain Brick with lime mortar	
2. WALLS	
2.1. Load bearing walls	
2.1.1. Rough cut stone at both surfaces, rubble stone and lime mortar in between	
2.1.2. Rough cut stone with cement mortar	
2.2. Non-load bearing walls	
Cement interventions	
3. GROUND	
Stone	
Earth	
Concrete	

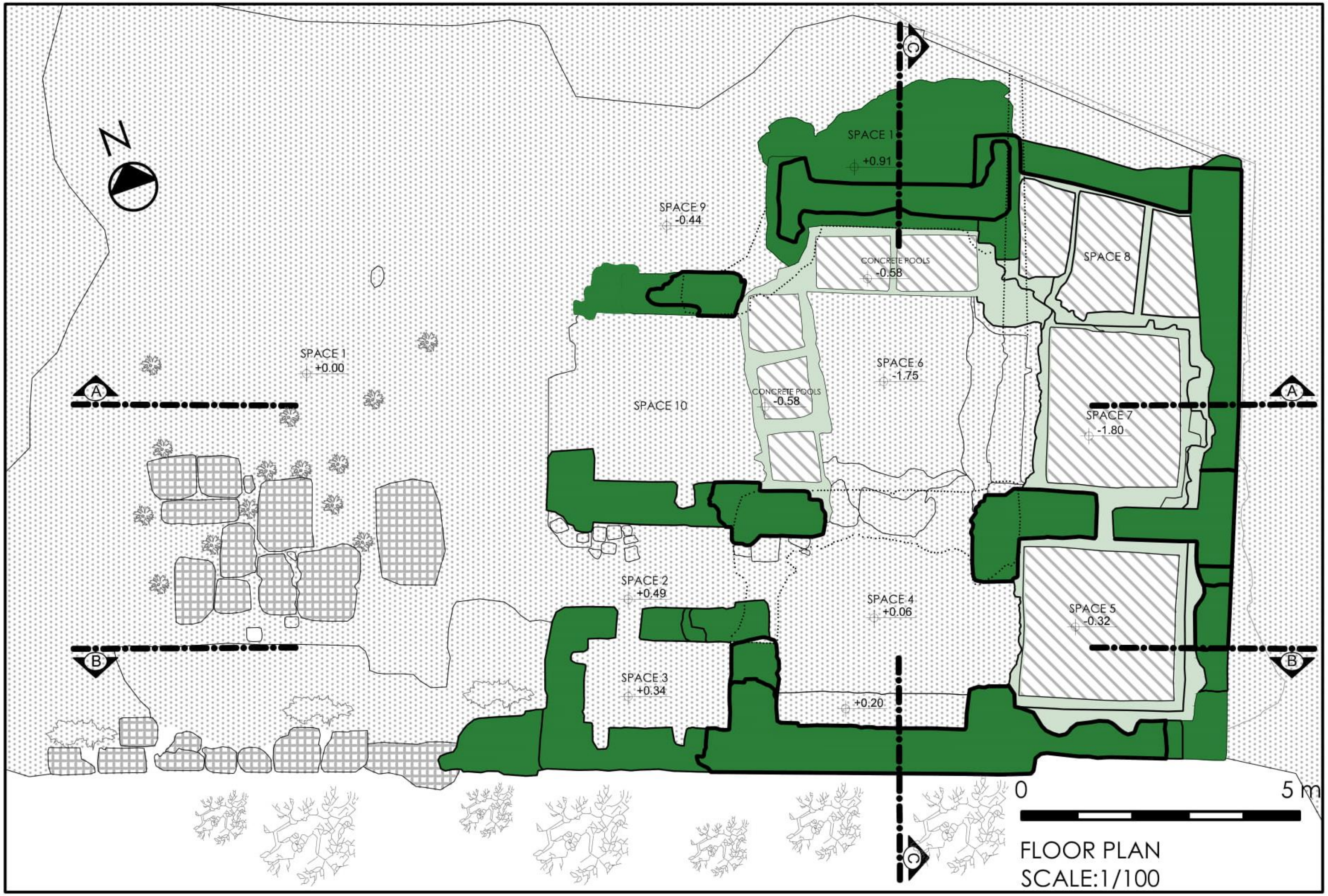


Figure C.1. Construction Technique and Material Usage

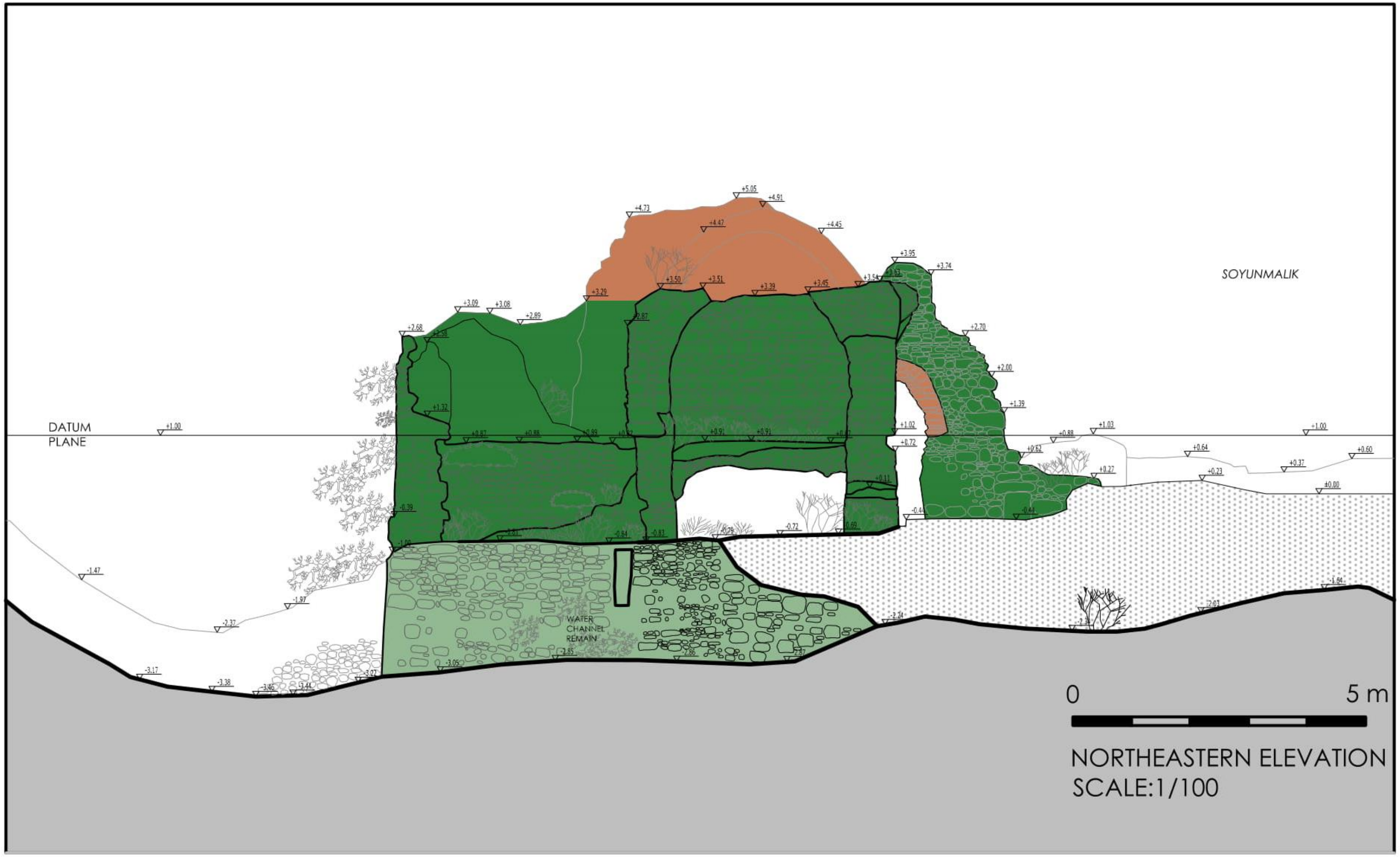


Figure C.2. Construction Technique and Material Usage

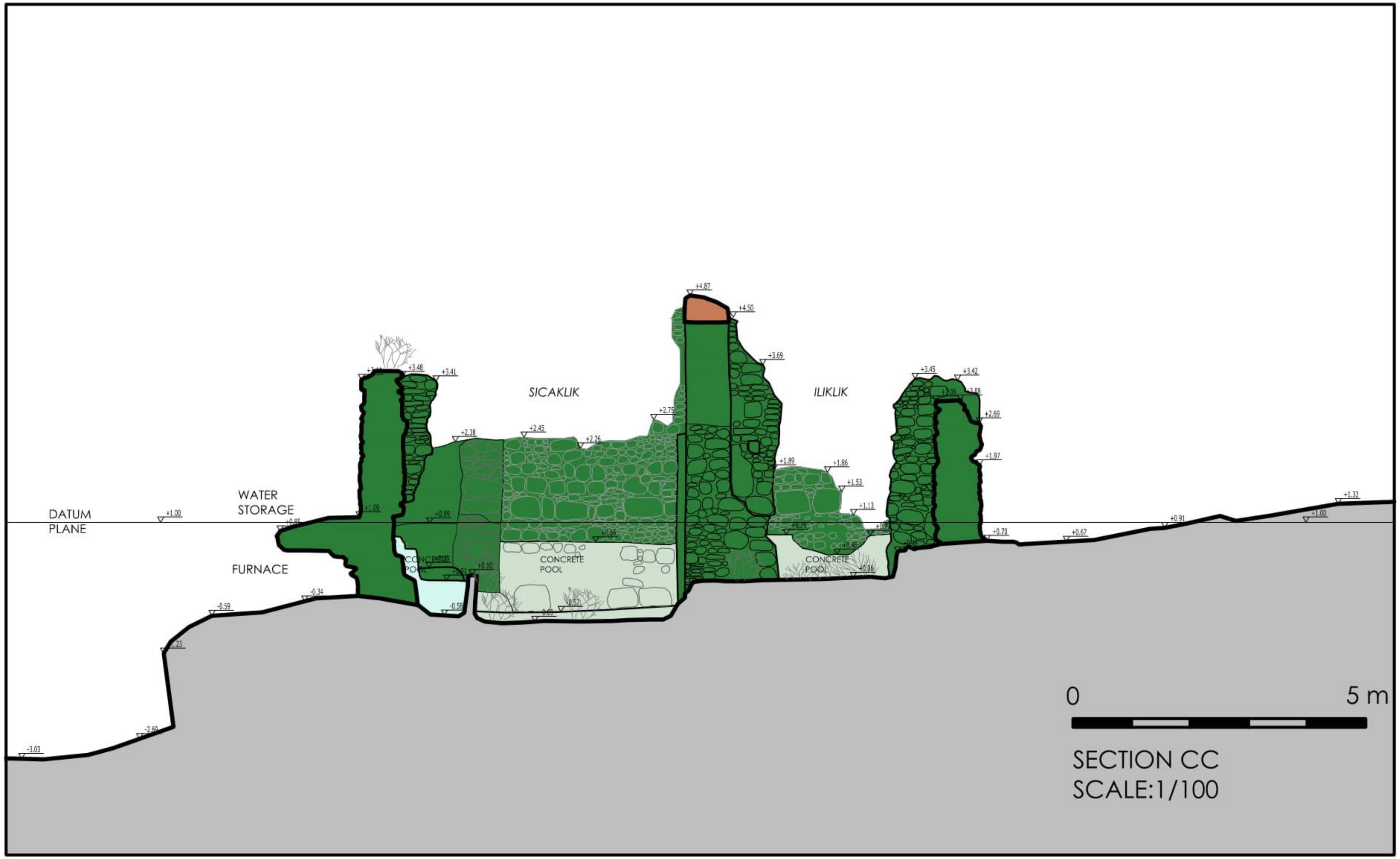


Figure C.3. Construction Technique and Material Usage

a. Load bearing wall: Rough cut stone at both surfaces, rubble stone and lime mortar in between

b. Load bearing wall: Rough cut stone with cement mortar

c. Non-load bearing walls: Cement interventions

Figure C.4.a. Load bearing wall, C.4.b. Load bearing wall, C.4.c. Non-load bearing wall

APPENDIX D

ALTERATION ANALYSIS OF THE BATH

In this part of the study, alteration of the Cevher Paşa Bath including missing spaces, building elements and additions, are presented.

1. PARTIALLY MISSING
1.1. Spaces
1.2. Building Elements
2. ADDITIONS
Stone walls with cement plaster Concrete pools

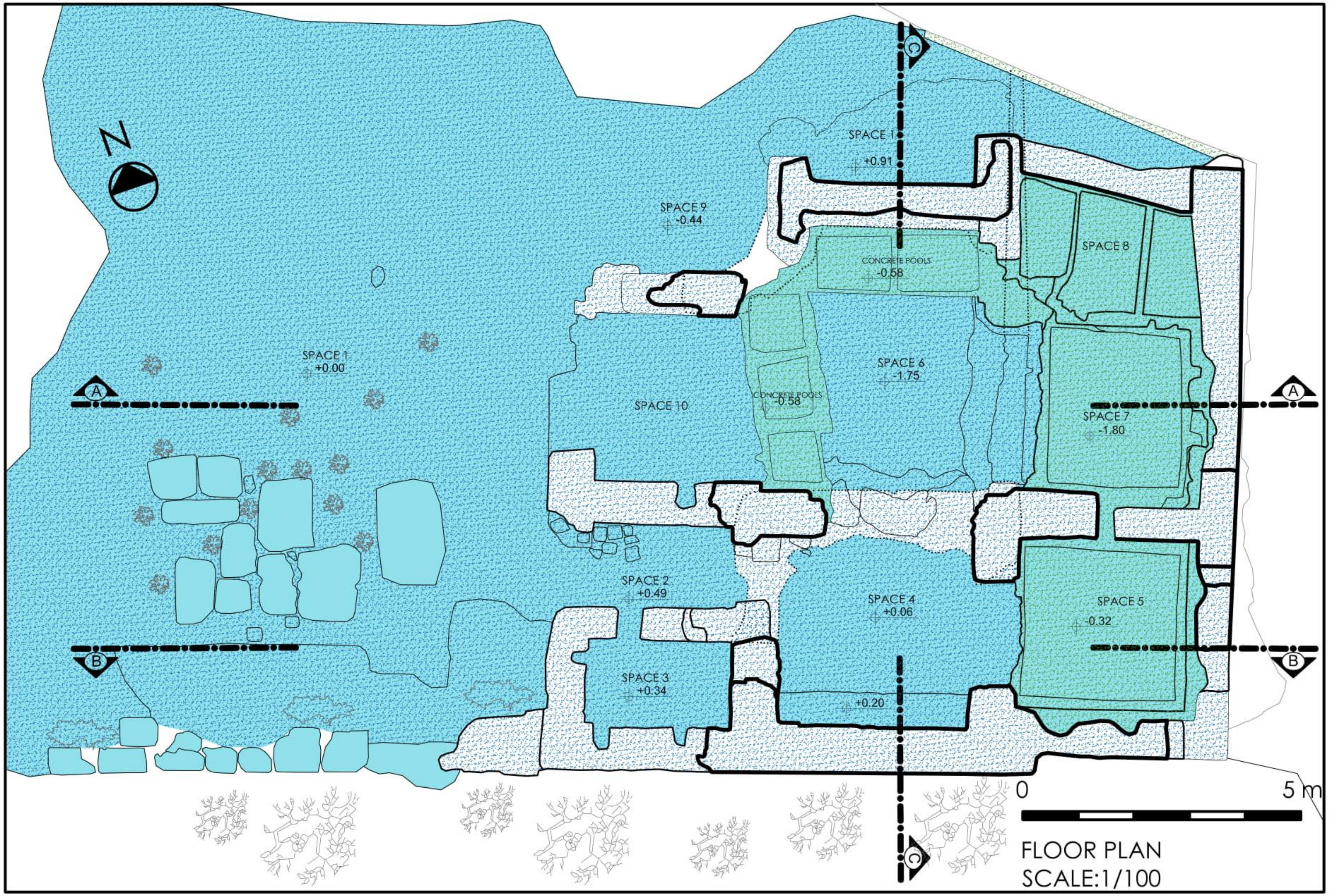


Figure D.1. Alteration Analysis of the Bath

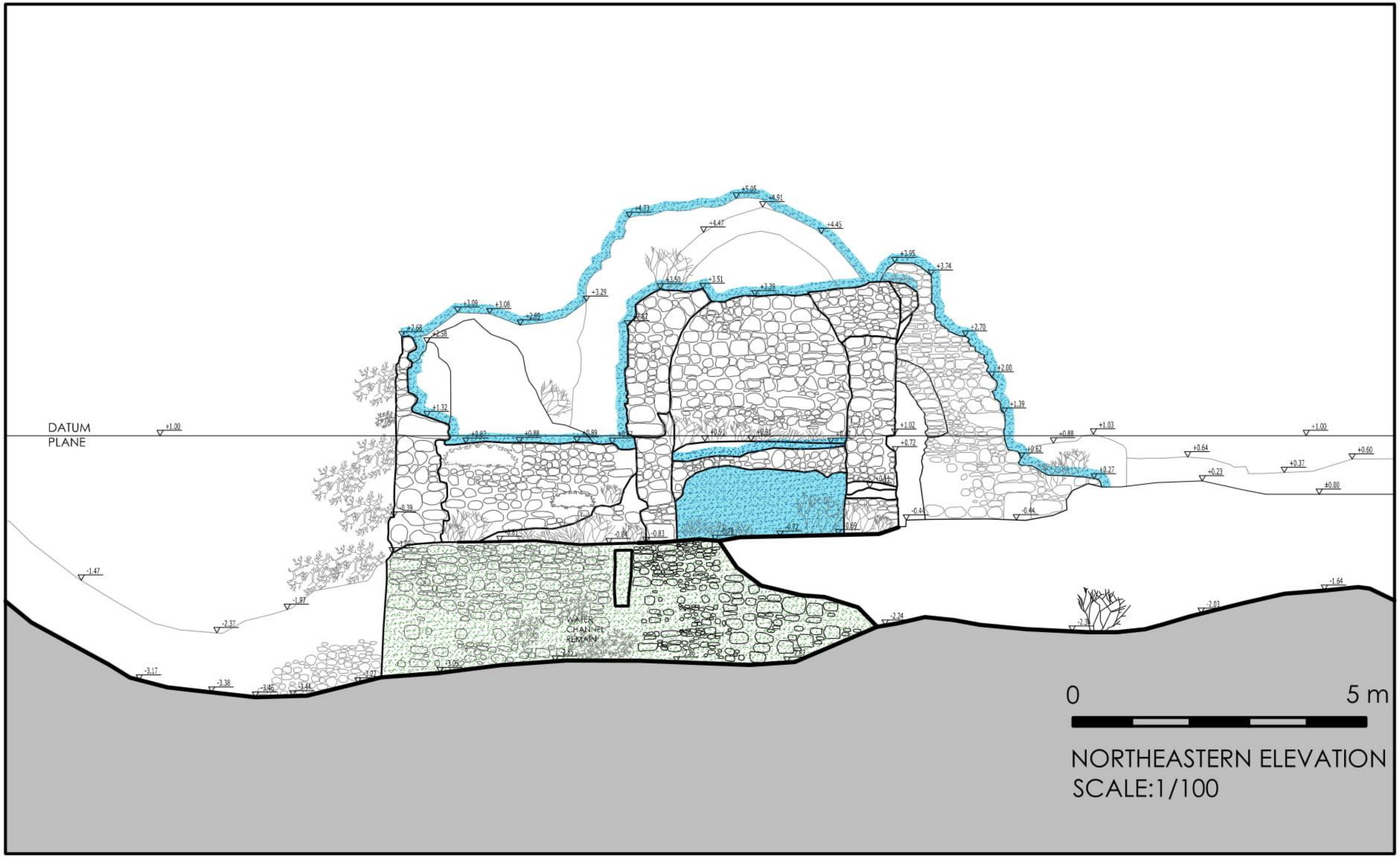


Figure D.2.Alteration Analysis of the Bath

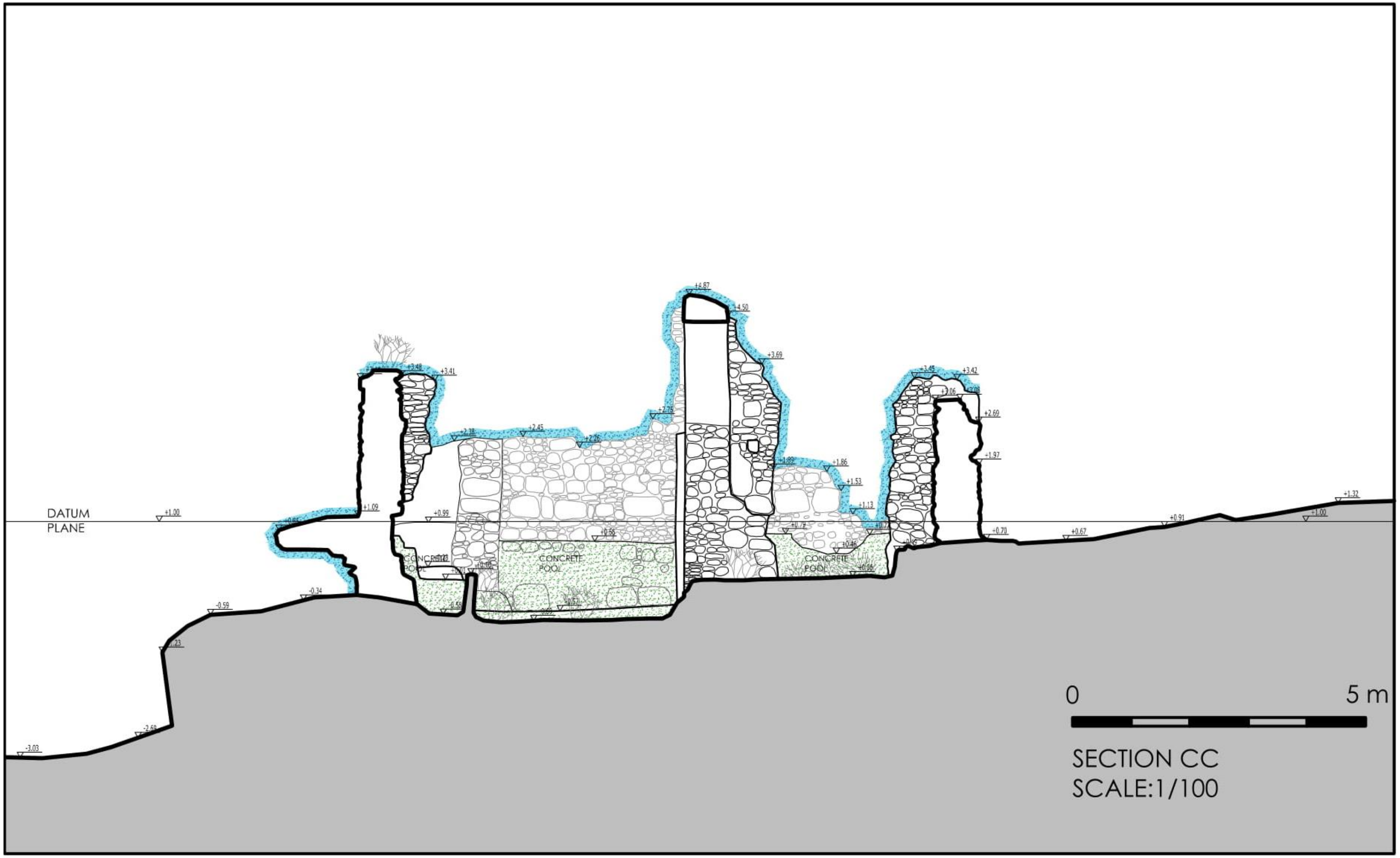


Figure D.3.Alteration Analysis of the Bath

a. Wash basin remain

b. Niches

c. Horizontal pipe

d. Horizontal pipe

Fig B.4.a Wash basin remain, B.4.b. Niches, B.4.c. Horizontal pipes, B.4.d. Horizontal pipes

APPENDIX E

CONDITION REPORT OF THE BATH

In this part of the study, condition report of the Cevher Paşa Bath including symptoms, risk assessment, possible measures and content of possible interventions are presented.

Table E.1 Present Condition of the Bath

SYMPTOMS	RISK ASSESSMENT	POSSIBLE MEASURES	CONTENT OF POSSIBLE INTERVENTIONS
CC1- Local structural failure with local material deterioration Structural failure -Partial collapse Material deterioration -Biological growth -Cement intervention	UC1- Intermediate Potential loss of historical material due to climatic and seismic effects	RC1 Maintenance Simple Repair	Cleaning of biological growth Cleaning of cement capping and provision of new capping compatible with original mortar Removal of concrete pools Periodic Monitoring
CC2- Local structural failure with widespread material deterioration Structural failure -Crack Widespread material deterioration -Crumbling -Discoloration -Biological growth -Cement intervention	UC2- Short Potential deterioration of original material due to cement interventions cement Potential salt crystallization due to cement mortar and plaster	RC2 Maintenance Simple Repair Restoration	Filling the gap with compatible materials Replacement of deteriorated stones with similar new material Cleaning Periodic monitoring Prevention of rising damp Formation of a drainage Removal of concrete pools Consolidation: -Shoring -Cleaning of cement interventions in the walls -Partial reconstruction with original stone and compatible mortar
CC3- Major structural failure with widespread material deterioration Structural failure -Total collapse -Almost collapse Material deterioration -Joint Discharge -Discoloration -Biological Growth	UC3- Urgent, immediate Impact on safety : seismic vulnerability potential Potential salt crystallization under capping	RC3 Maintenance Simple Repair Restoration	Filling the gap with compatible materials Cleaning Peridoic monitoring Cleaning of cement capping with material similar with original mortar No reconstruction Prevention of rain penetration Capping of the remains/traces with material similar with original mortar Consolidation: -Shoring -Supportive elements will be designed

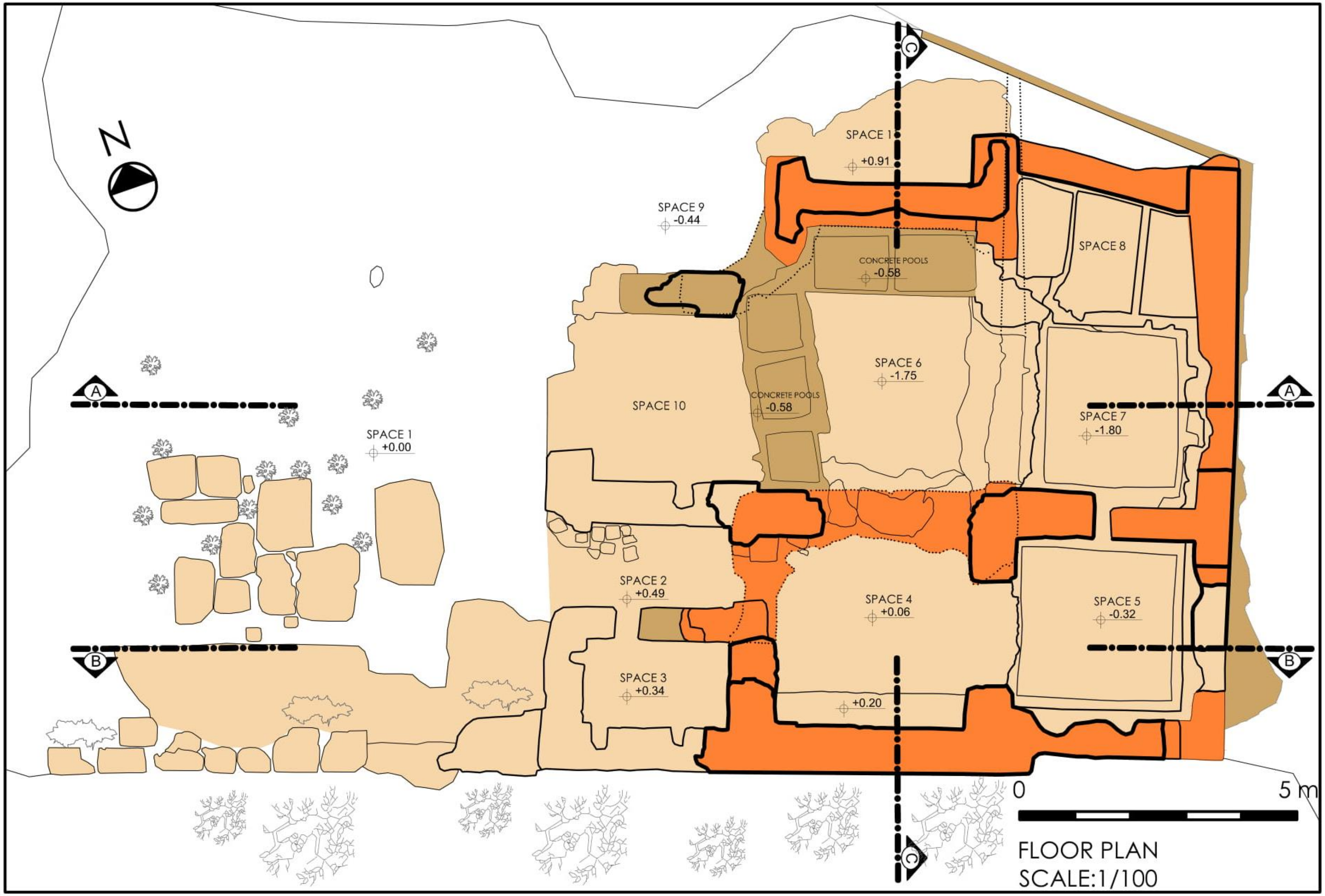


Figure E.1. Present Condition of the Bath: Symptoms

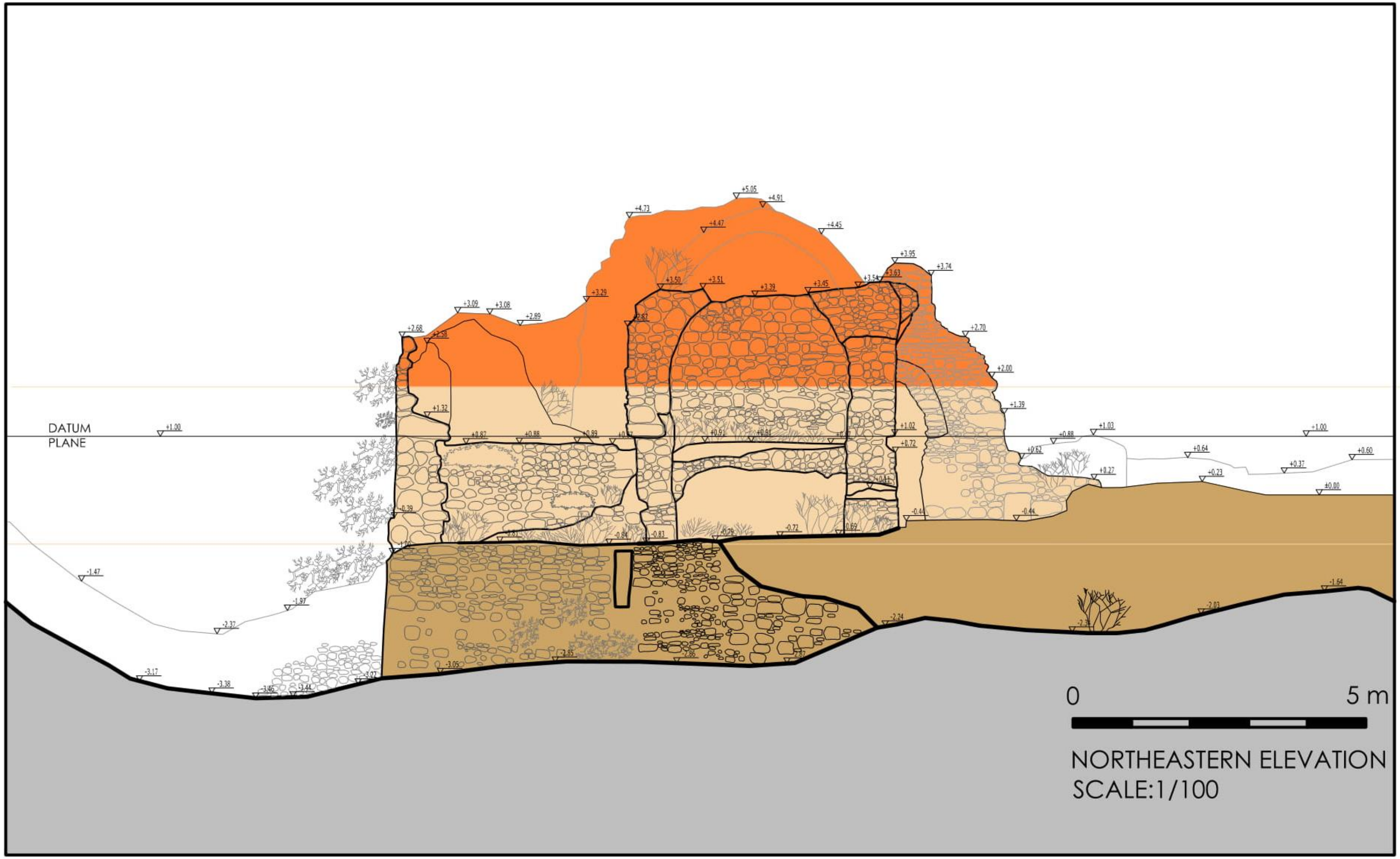
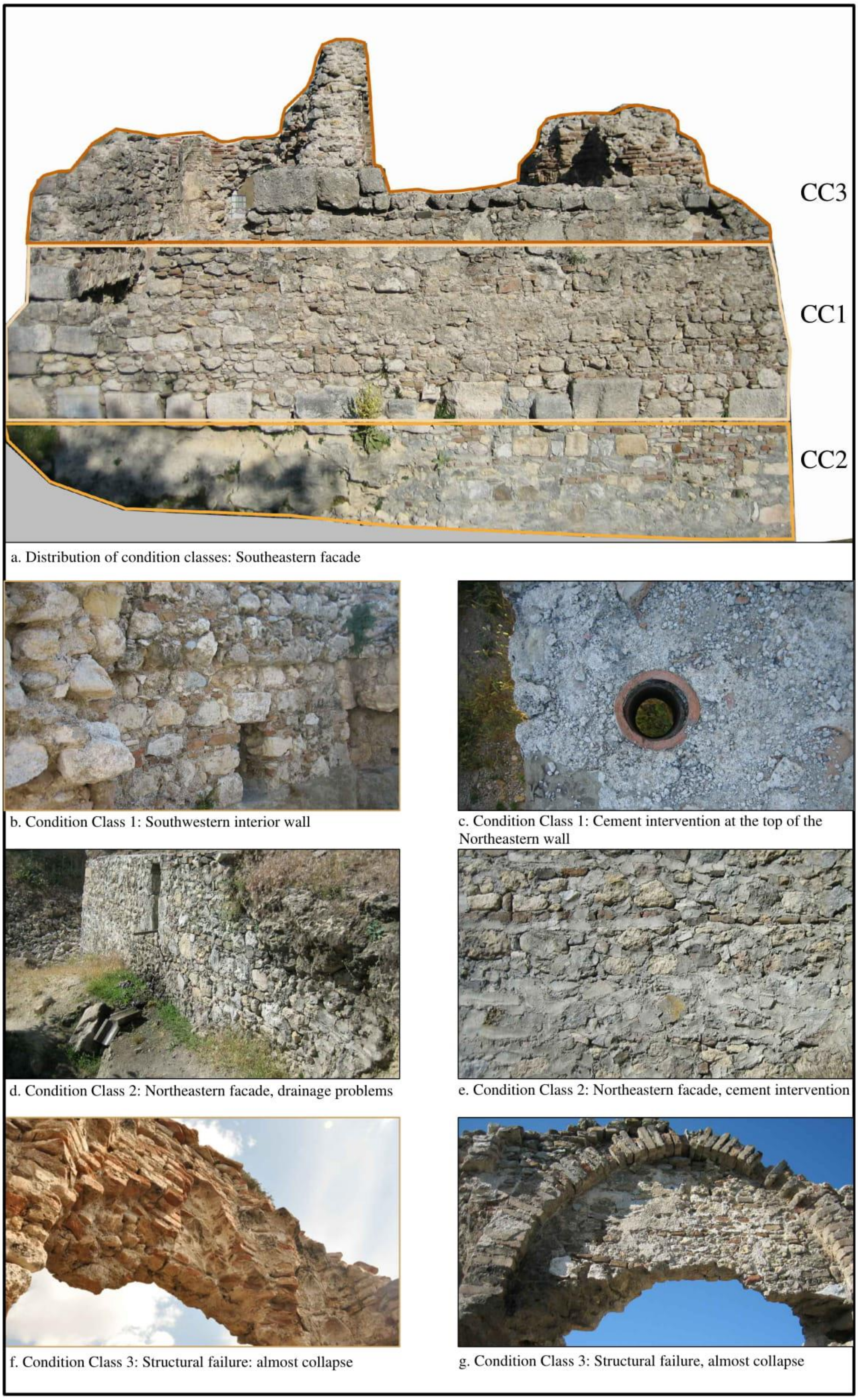


Figure E.2. Present Condition of the Bath: Symptoms



a. Distribution of condition classes: Southeastern facade

b. Condition Class 1: Southwestern interior wall

c. Condition Class 1: Cement intervention at the top of the Northeastern wall

d. Condition Class 2: Northeastern facade, drainage problems

e. Condition Class 2: Northeastern facade, cement intervention

f. Condition Class 3: Structural failure: almost collapse

g. Condition Class 3: Structural failure, almost collapse

Figure E.3.a Distribution of condition classes, E. 3.b. CC1, E. 3.c. CC1, E. 3.d. CC2, E. 3.e. CC2, E.3.f. CC3, E.3.g. CC3

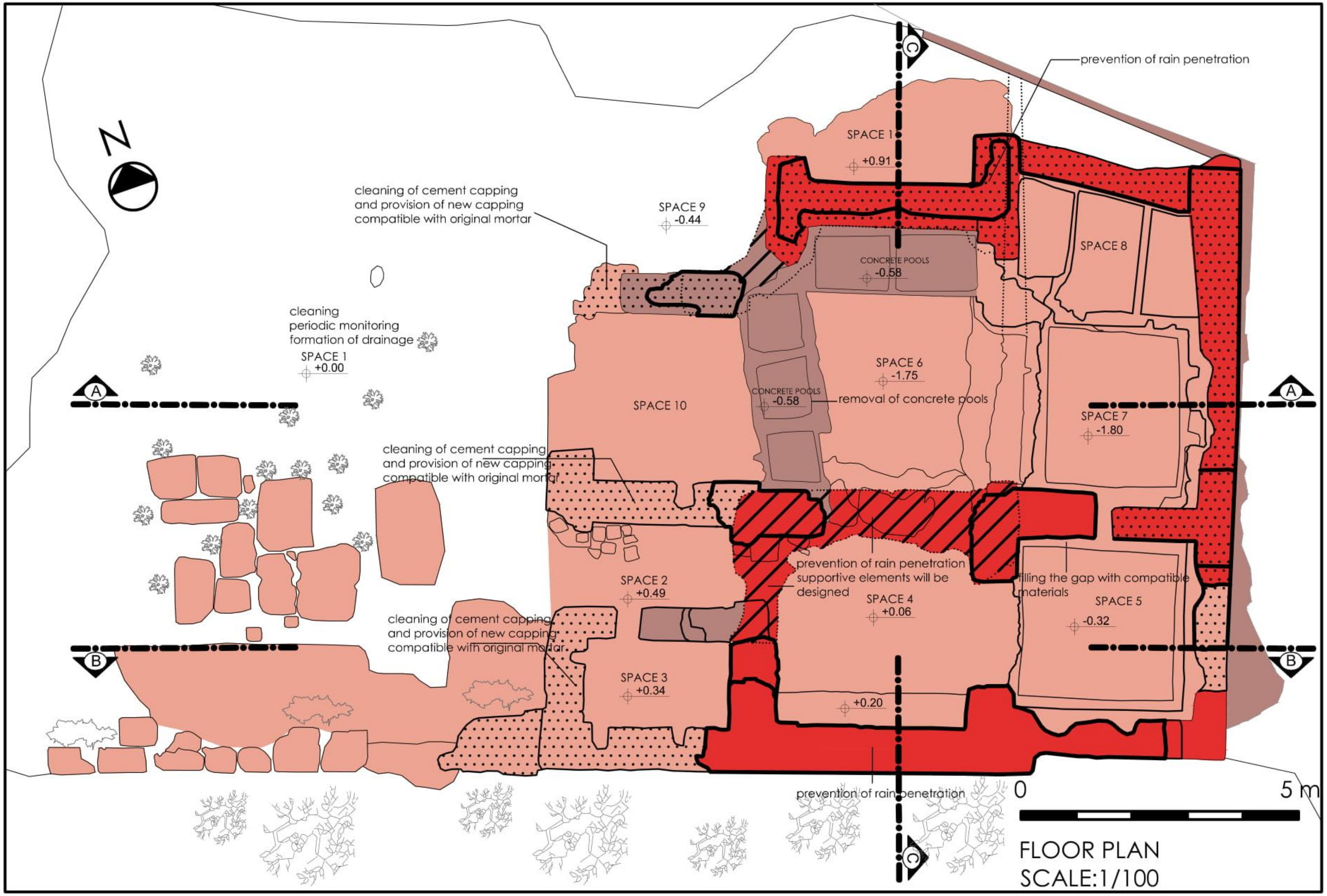


Figure E.4. Present Condition of the Bath: Risk Assessment and Possible Measures of the Bath

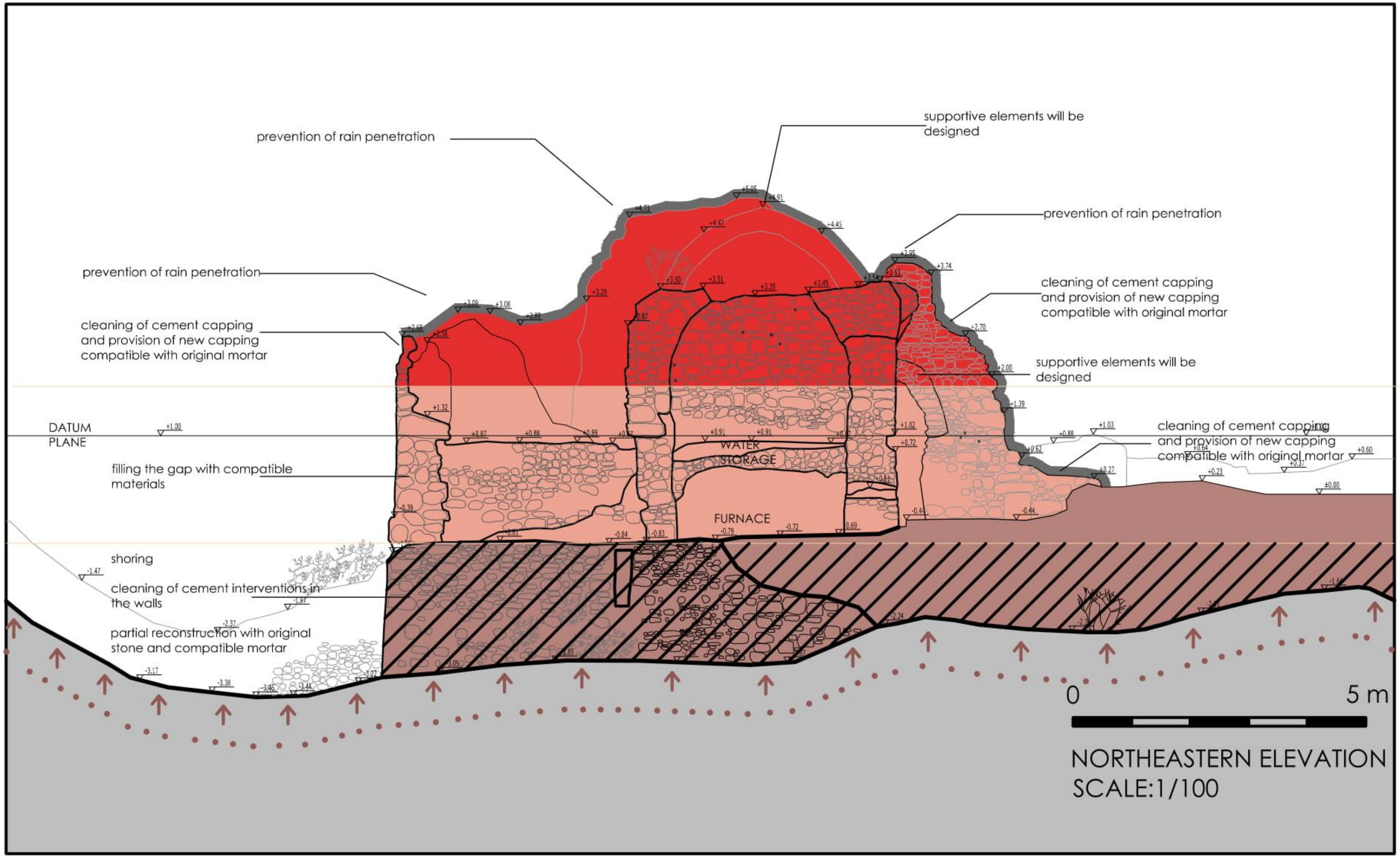


Figure E.5. Present Condition of the Bath: Risk Assessment and Possible Measures of the Bath

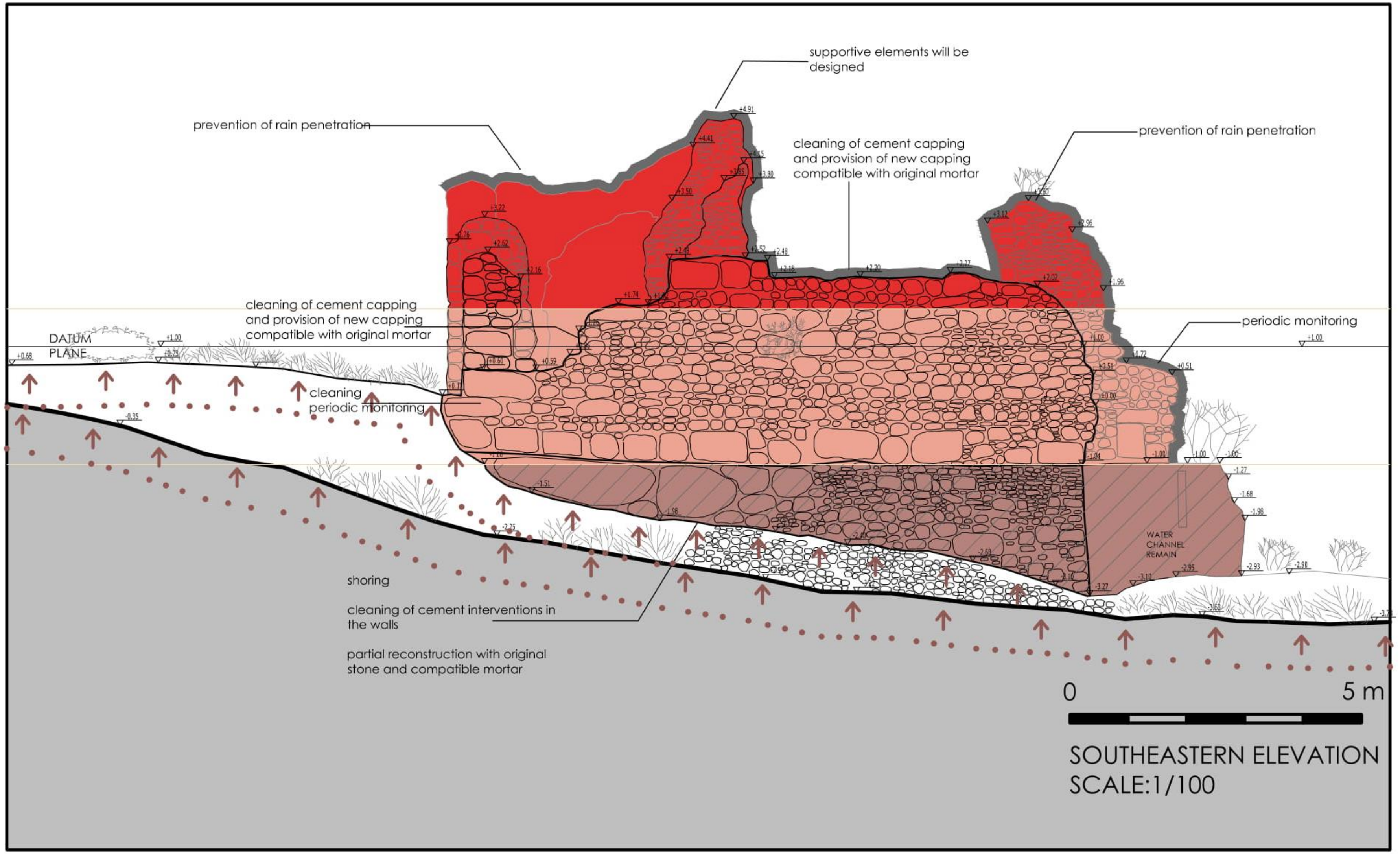


Figure E.6. Present Condition of the Bath: Risk Assessment and Possible Measures of the Bath

APPENDIX F

RESTITUON

In this part of the study, restituted elements of the Cevher Paşa Bath and their sources and their reliability degrees are presented.

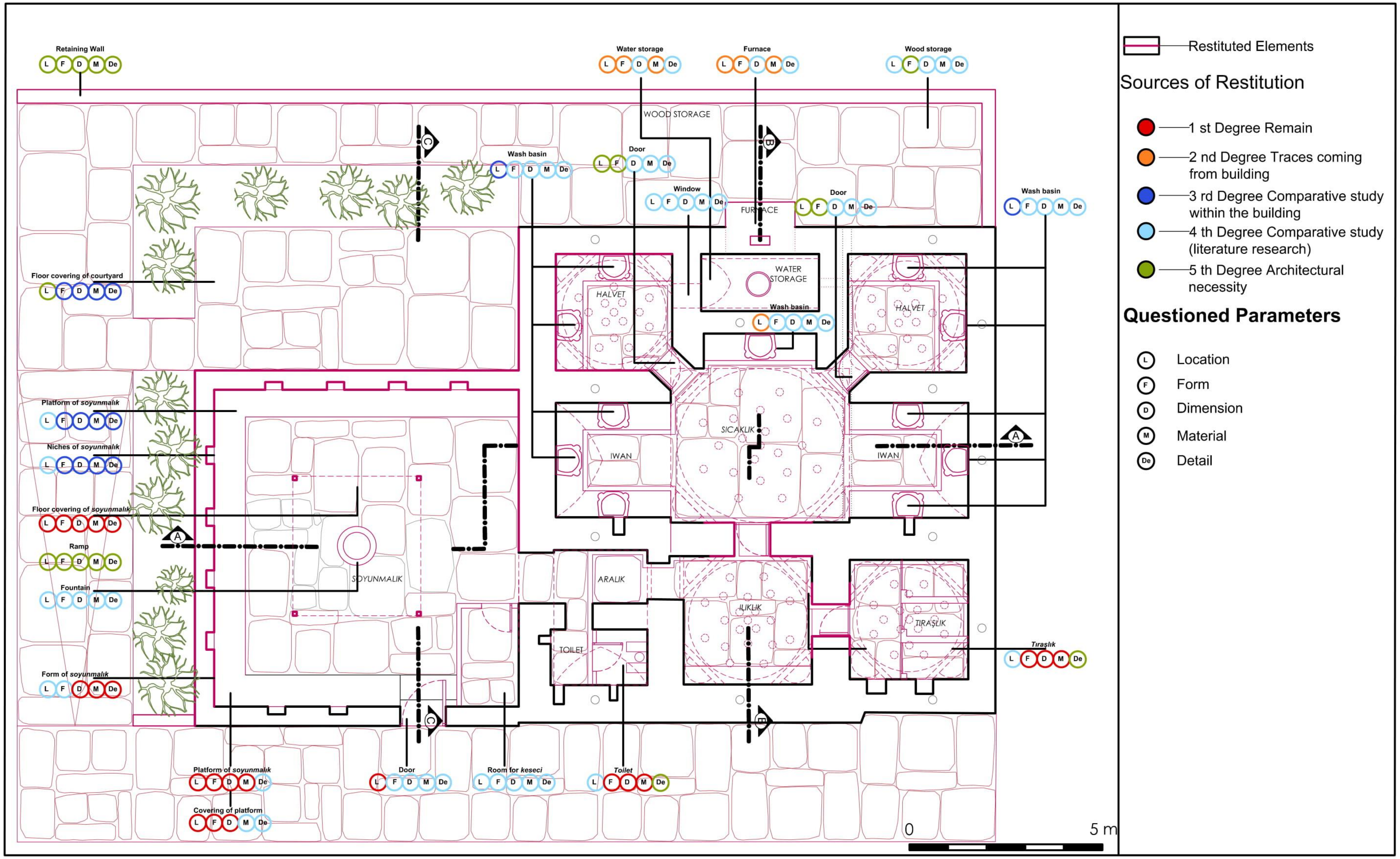


Figure F.1. Ground Floor Plan, Restitution

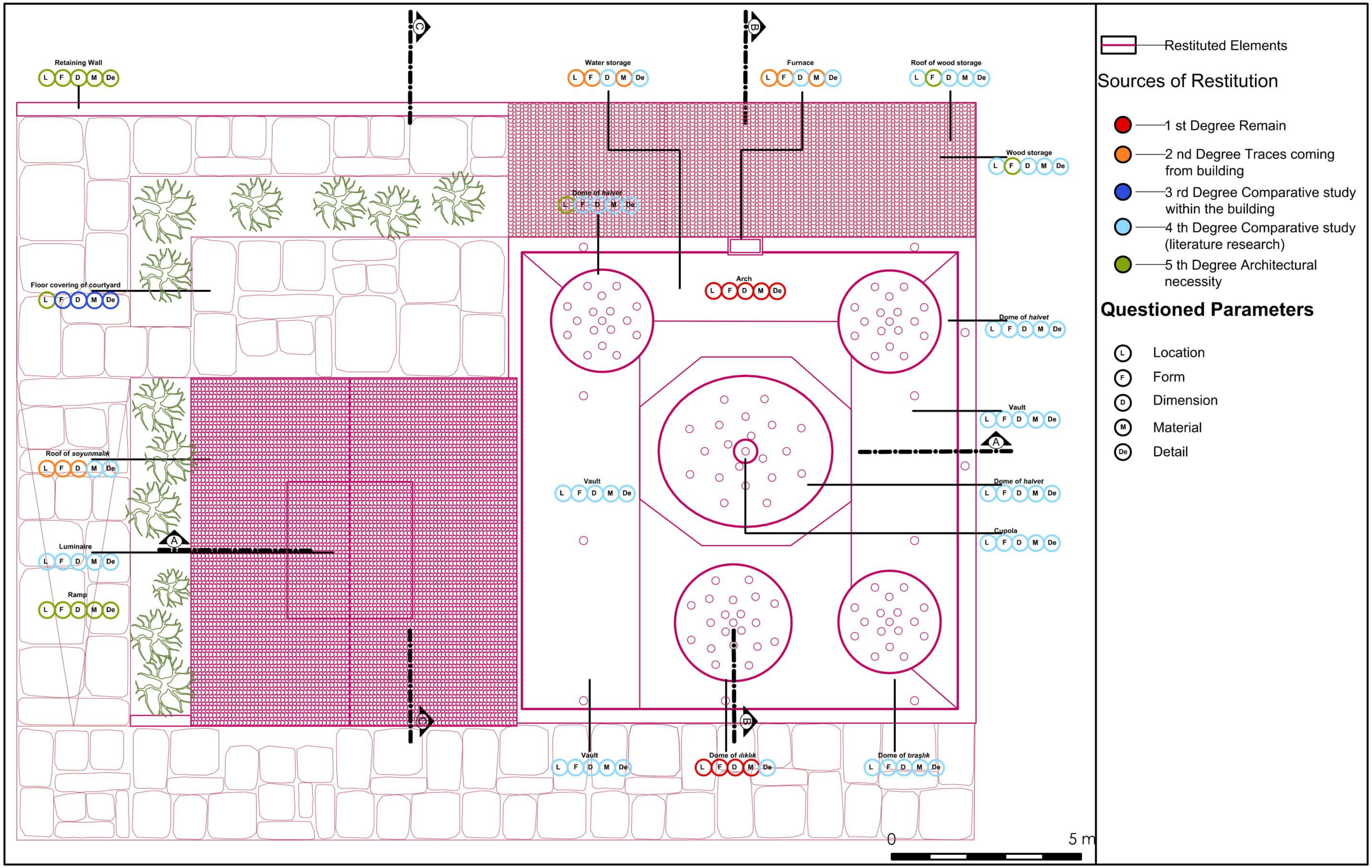


Figure F.2. Roof Plan, Restitution

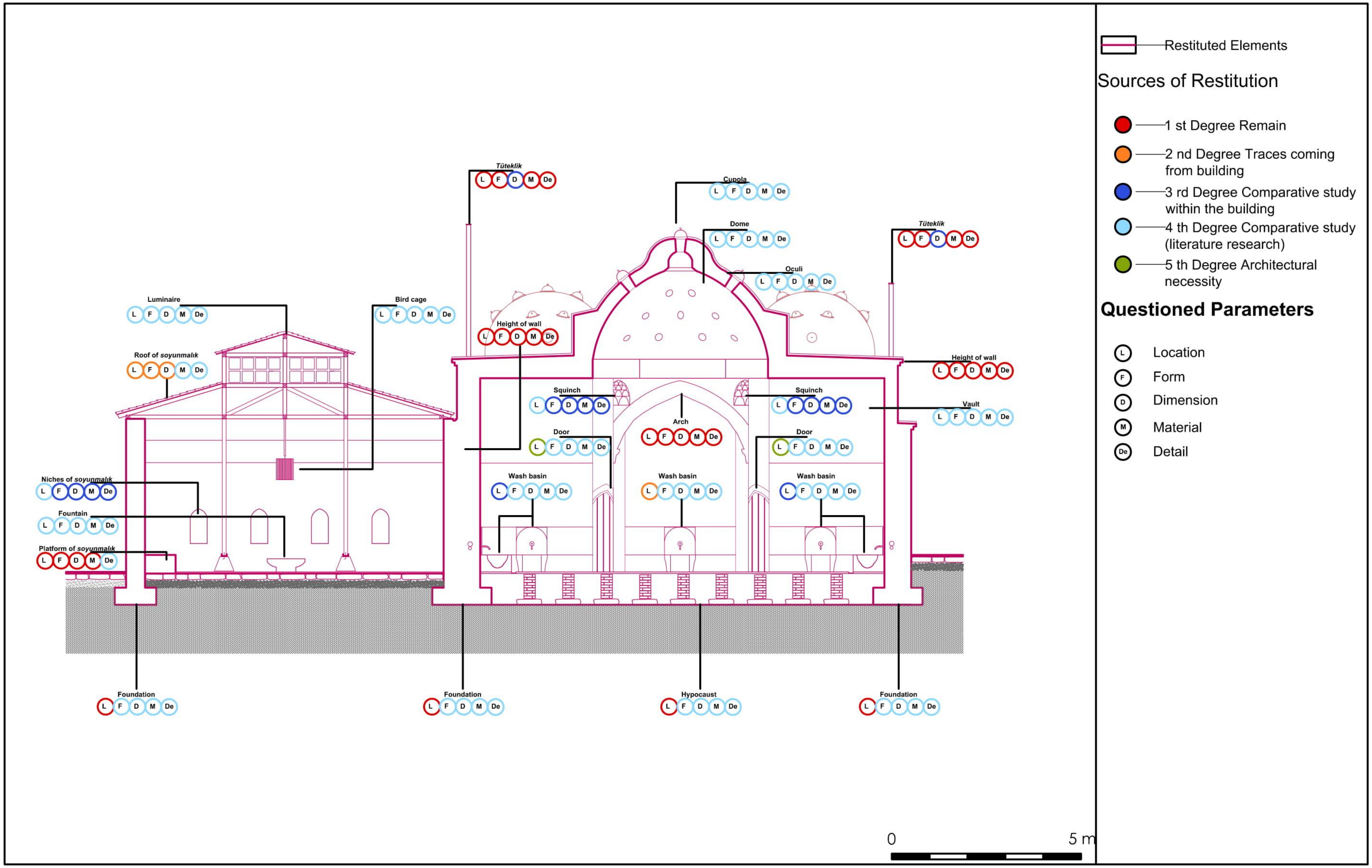


Figure F.3. AA Section, Restitution

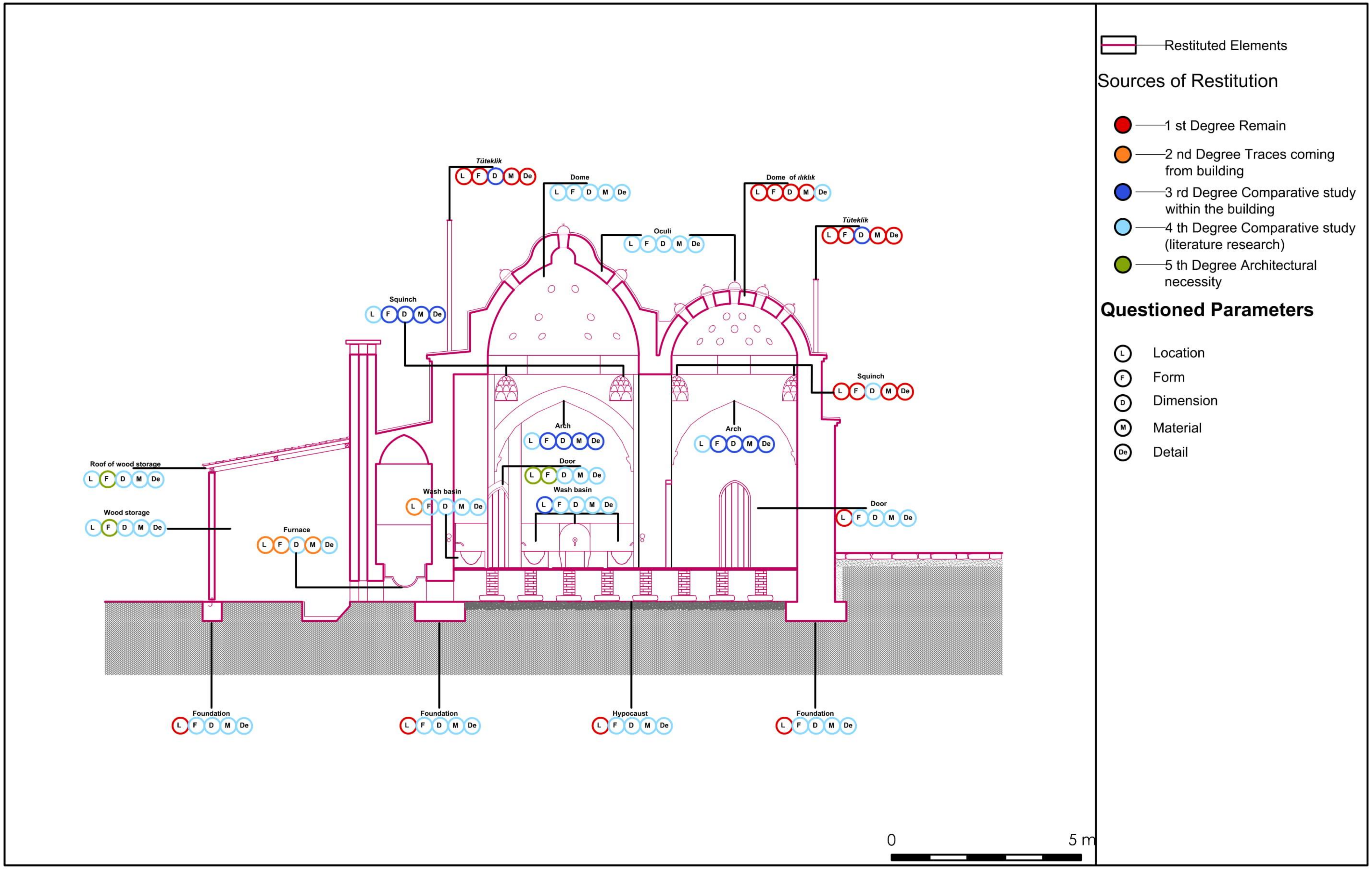


Figure F.4. BB Section, Restitution

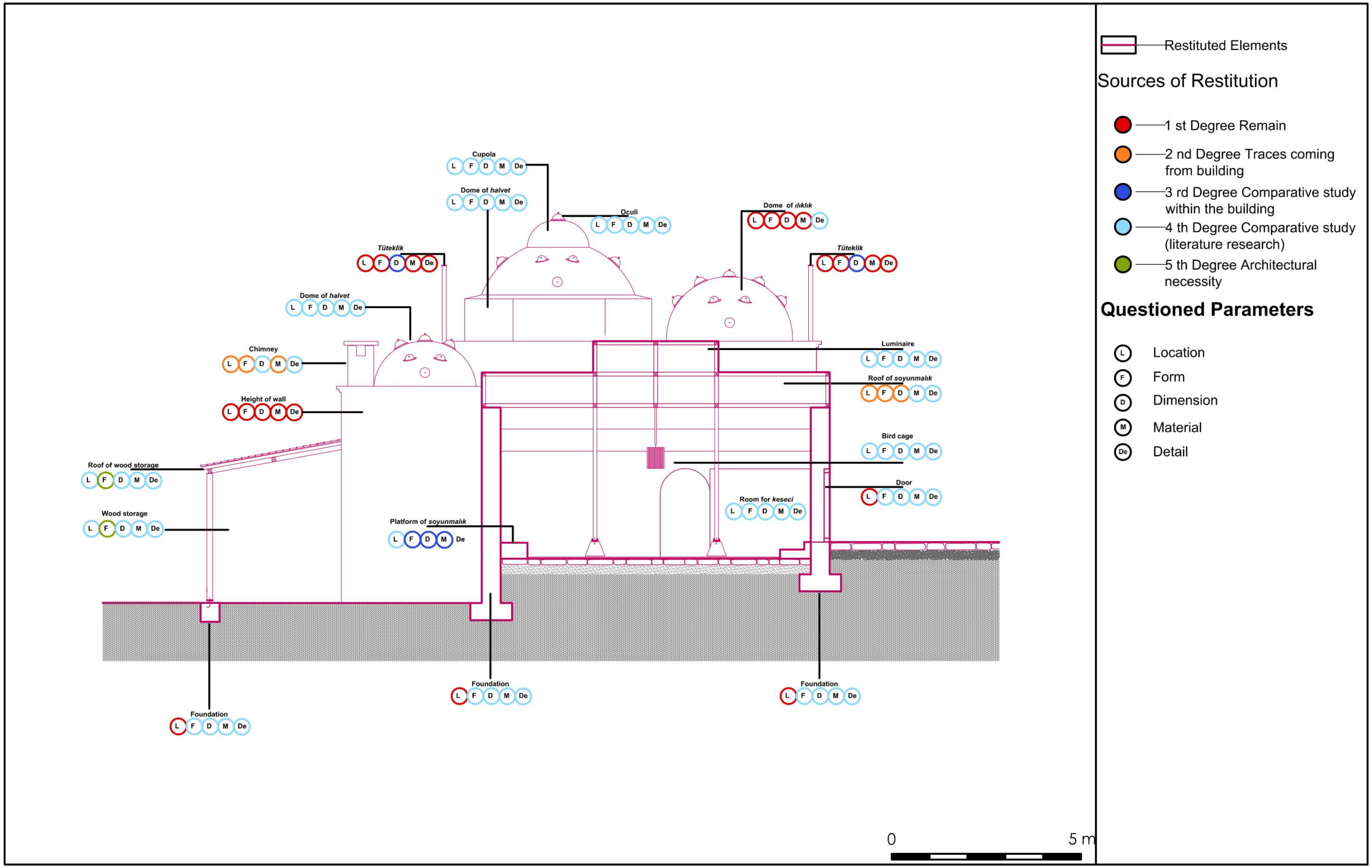
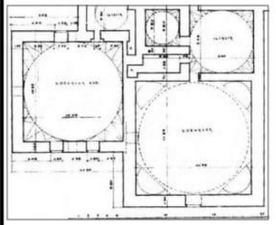
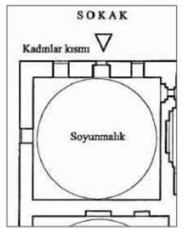
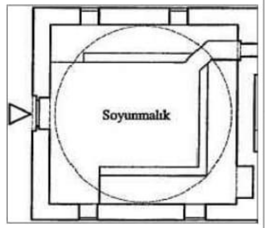
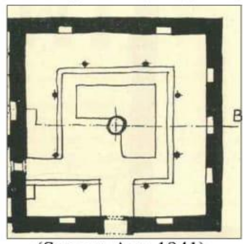
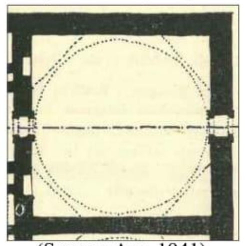
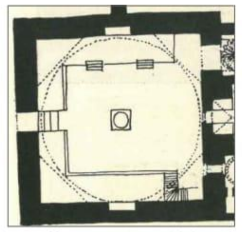
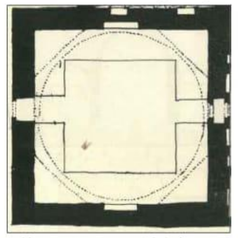
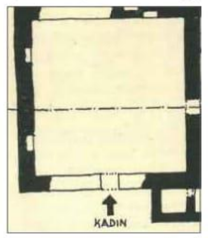
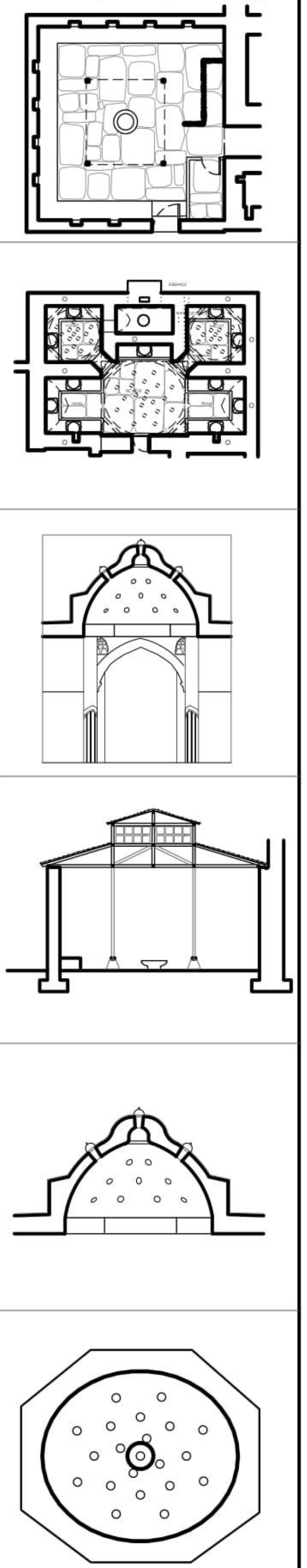
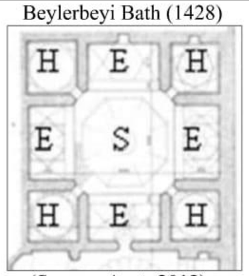
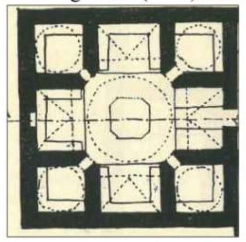
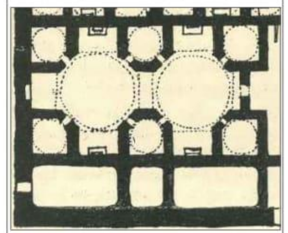
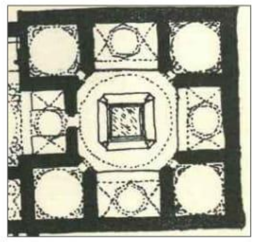
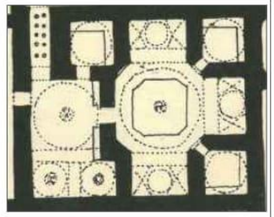
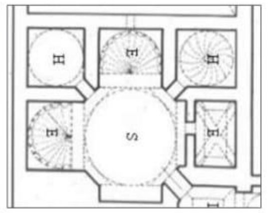
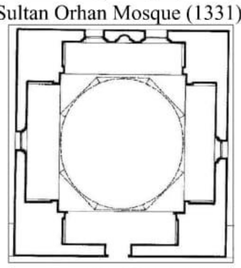
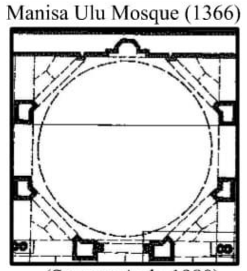
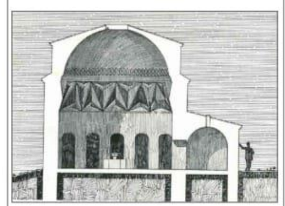
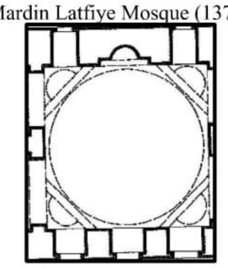
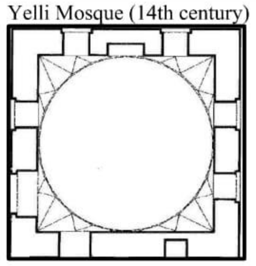
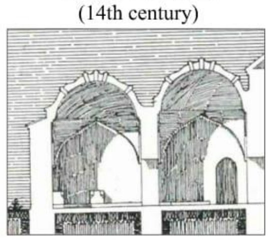
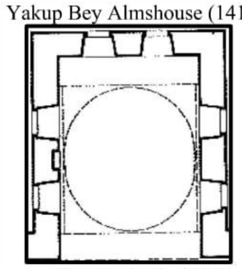
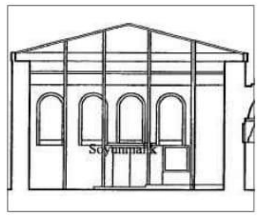
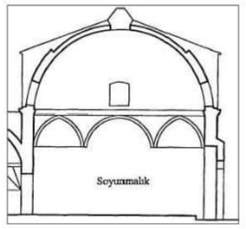
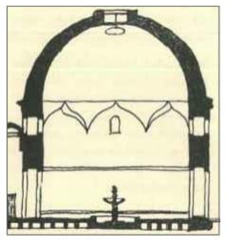
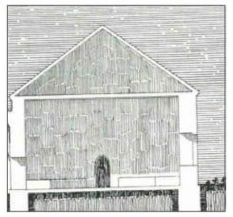
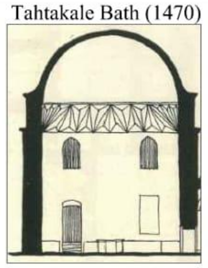
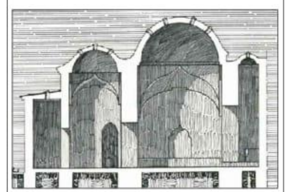
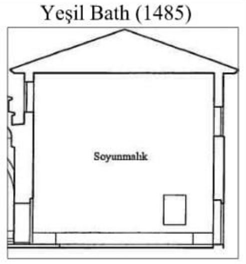
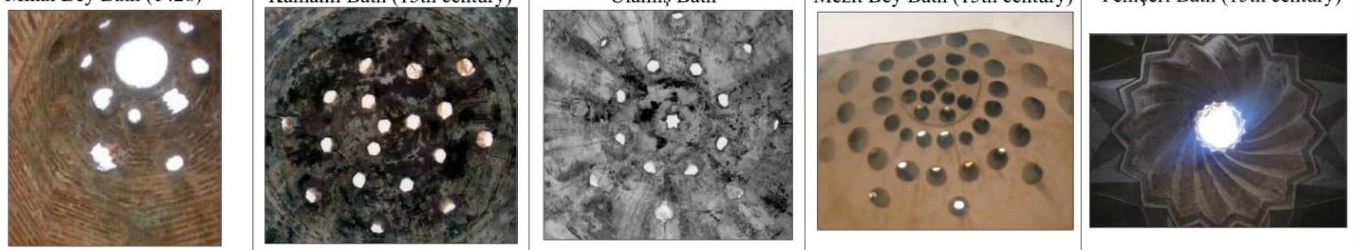


Figure F.5. CC Section, Restitution

Table F.1. Historical Evaluation regarding Plan Scheme and Superstructure

Restitution Problems	Monuments Compared with								Case Study
Form of *Soyunmalık*	Bursa Orhan Gazi Bath (1399)  (Source: Ayverdi, 1976)	Mahkeme Bath (1421)  (Source: Şehitoğlu, 2000)	Hundi Hatun Bath (1426)  (Source: Şehitoğlu, 2000)	Ağa Bath (1462)  (Source: Aru, 1941)	Çukur Bath (1463)  (Source: Aru, 1941)	Gedikpaşa Bath (1475)  (Source: Aru, 1941)	Tahtakale Bath (1470)  (Source: Aru, 1941)	Langa Bath (15th century)  (Source: Aru, 1941)	Cevher Paşa Bath (15th century) 
Superstructure of *soyunmalık*	Bursa Orhan Gazi Bath (1399)  (Source: Şehitoğlu, 2000)		Beylerbeyi Bath (1428)  (Source: Aşut, 2012)	Ağa Bath (1462)  (Source: Aru, 1941)	Çukur Bath (1463)  (Source: Aru, 1941)	Gedikpaşa Bath (1475)  (Source: Aru, 1941)	Langa Bath (15th century)  (Source: Aru, 1941)	Yeniçeri Bath (15th century)  (Source: Aşut, 2012)	
Plan Scheme *Sıcaklık*	Sultan Orhan Mosque (1331)  (Source: Arık, 1980)	Manisa Ulu Mosque (1366)  (Source: Arık, 1980)	Girçık Bath (1366)  (Source: Klinghardt, 1927)	Mardin Latfiye Mosque (1371)  (Source: Arık, 1980)	Yelli Mosque (14th century)  (Source: Arık, 1980)	Yukarı Pazar Bath (14th century)  (Source: Klinghardt, 1927)	Yakup Bey Almshouse (1411)  (Source: Arık, 1980)	Yeşil Bath (1485)  (Source: Şehitoğlu, 2000)	
Central Dome of *Sıcaklık* (ellipse, squinch)	Nalıncılar Bath (1389)  (Source: Şehitoğlu, 2000)	Bursa Orhan Gazi Bath (1399)  (Source: Şehitoğlu, 2000)		Çukur Bath (1463)  (Source: Aru, 1941)	Yukarı Pazar Bath (14th century)  (Source: Klinghardt, 1927)	Tahtakale Bath (1470)  (Source: Aru, 1941)	Menzilhane Bath (14th century)  (Source: Klinghardt, 1927)	Yeşil Bath (1485)  (Source: Şehitoğlu, 2000)	
Dome covering	Tire Hekim Bath (13th century)  (Source: Reyhan, 2011)	Bursa Orhan Gazi Bath (1399)  (Source: Kültür Envanteri, 2018)	Gazi Mihal Bey Bath (1422)  (Source: Kültür Envanteri, 2018)	Bey Bath (1429)  (Source: Kültür Envanteri, 2018)	Kurdunus Bath  (Source: Kültür Envanteri, 2018)	İbrahim Paşa Bath (1480)  (Source: Kültür Envanteri, 2018)	Tahtakale Bath (15th century)  (Source: Kültür Envanteri, 2018)	Yalınayak Bath (16th century)  (Source: Kültür Envanteri, 2018)	
Details of Domes				Mihal Bey Bath (1428) 	Kamanlı Bath (15th century)	Ulamış Bath	Mezit Bey Bath (15th century)	Yeniçeri Bath (15th century)	

APPENDIX G

PROPOSAL

In this part of the study, interventions decisions, emergency interventions and restoration of the Cevher Paşa Bath are presented.

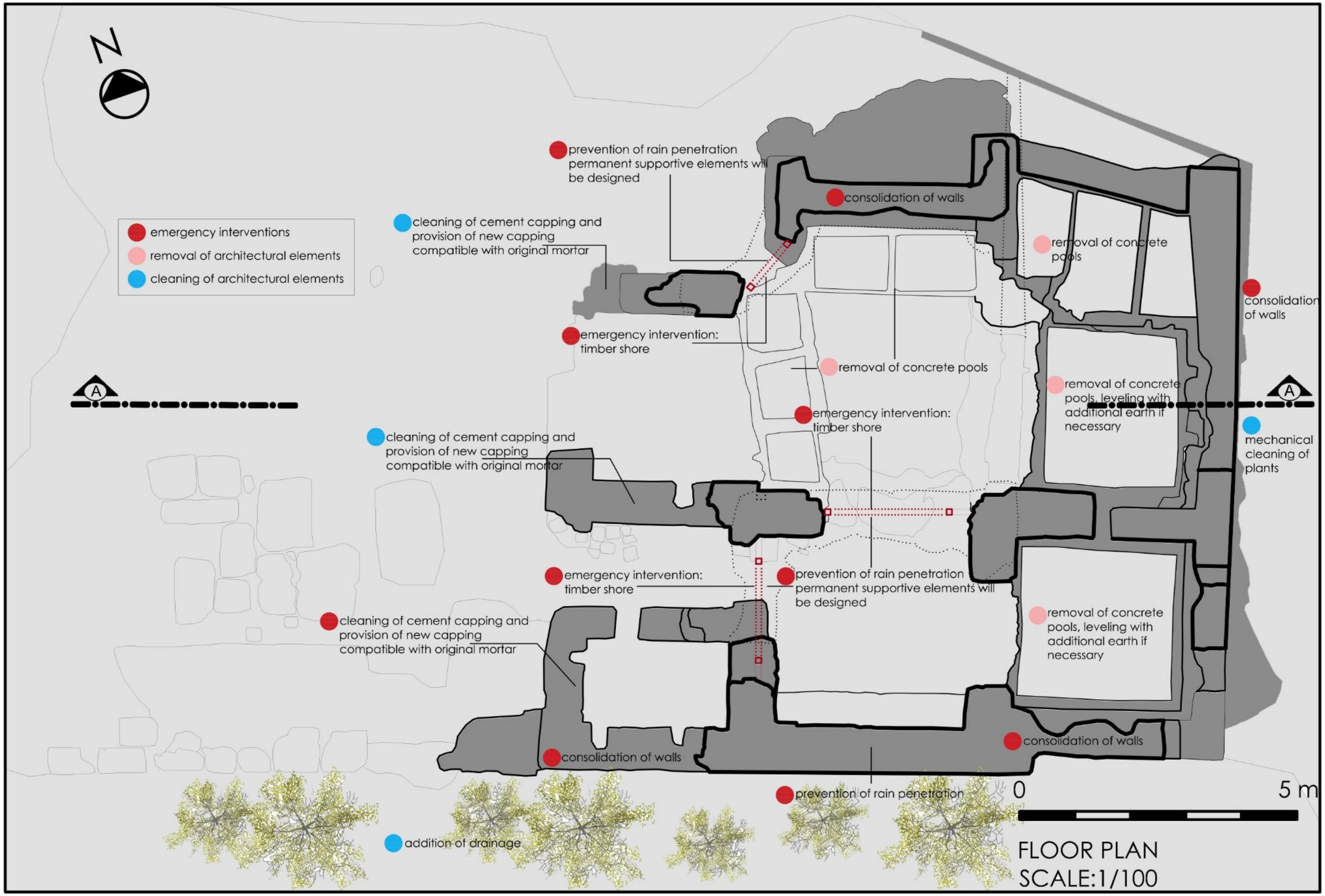


Figure G.1. Intervention Decisions, Floor Plan

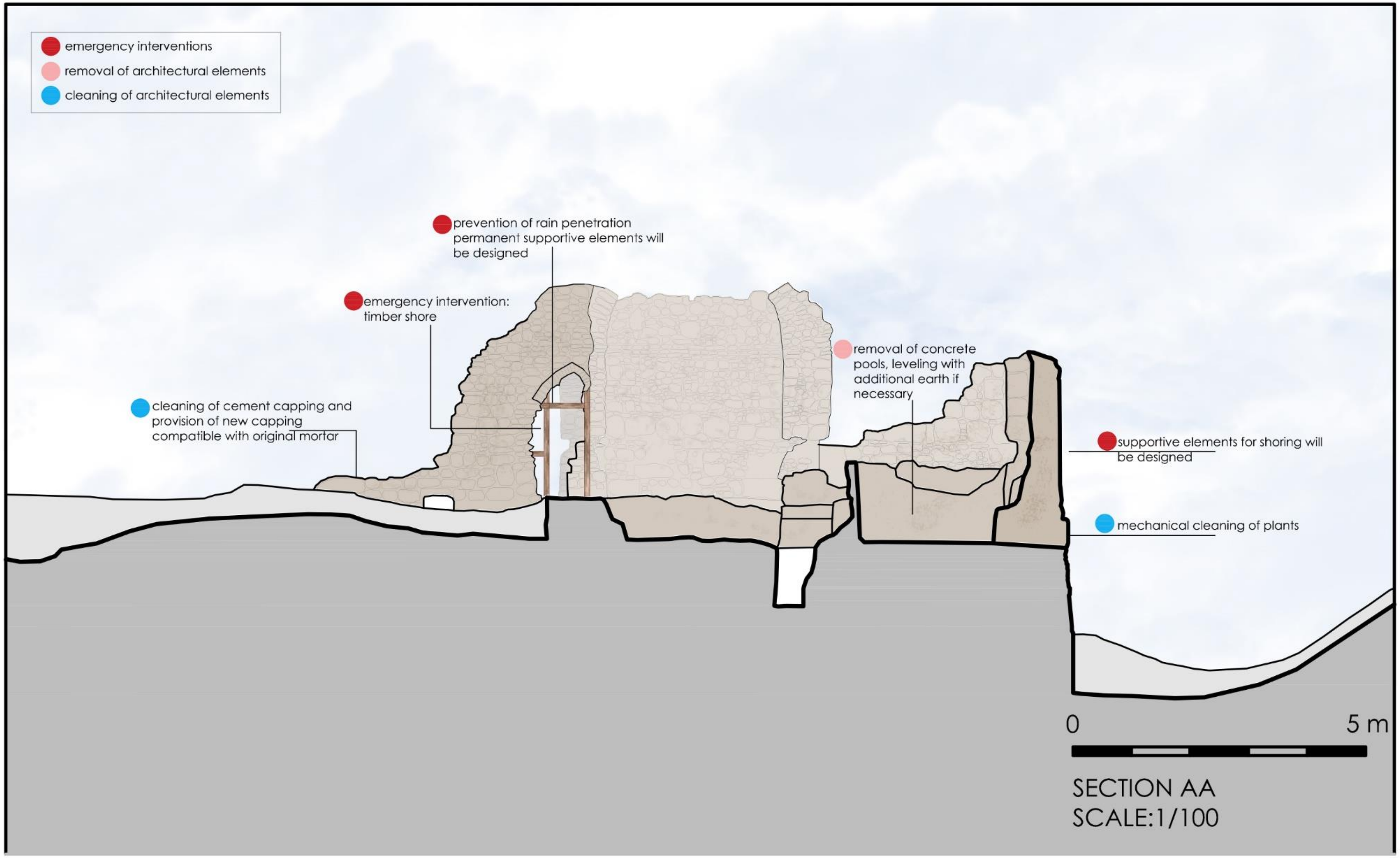


Figure G.2. Intervention Decisions, Section AA

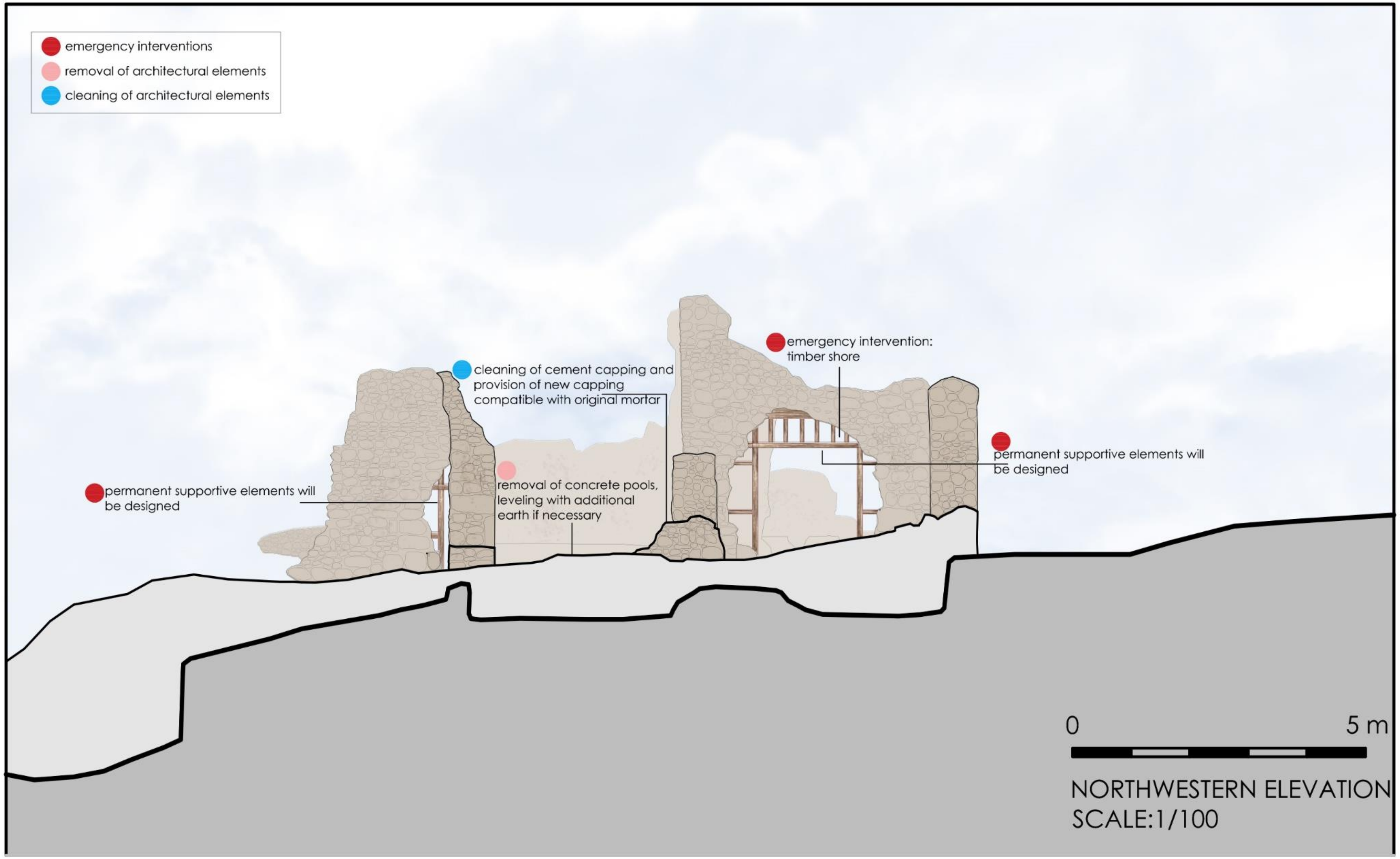


Figure G.3. Intervention Decisions, Northwestern Elevation

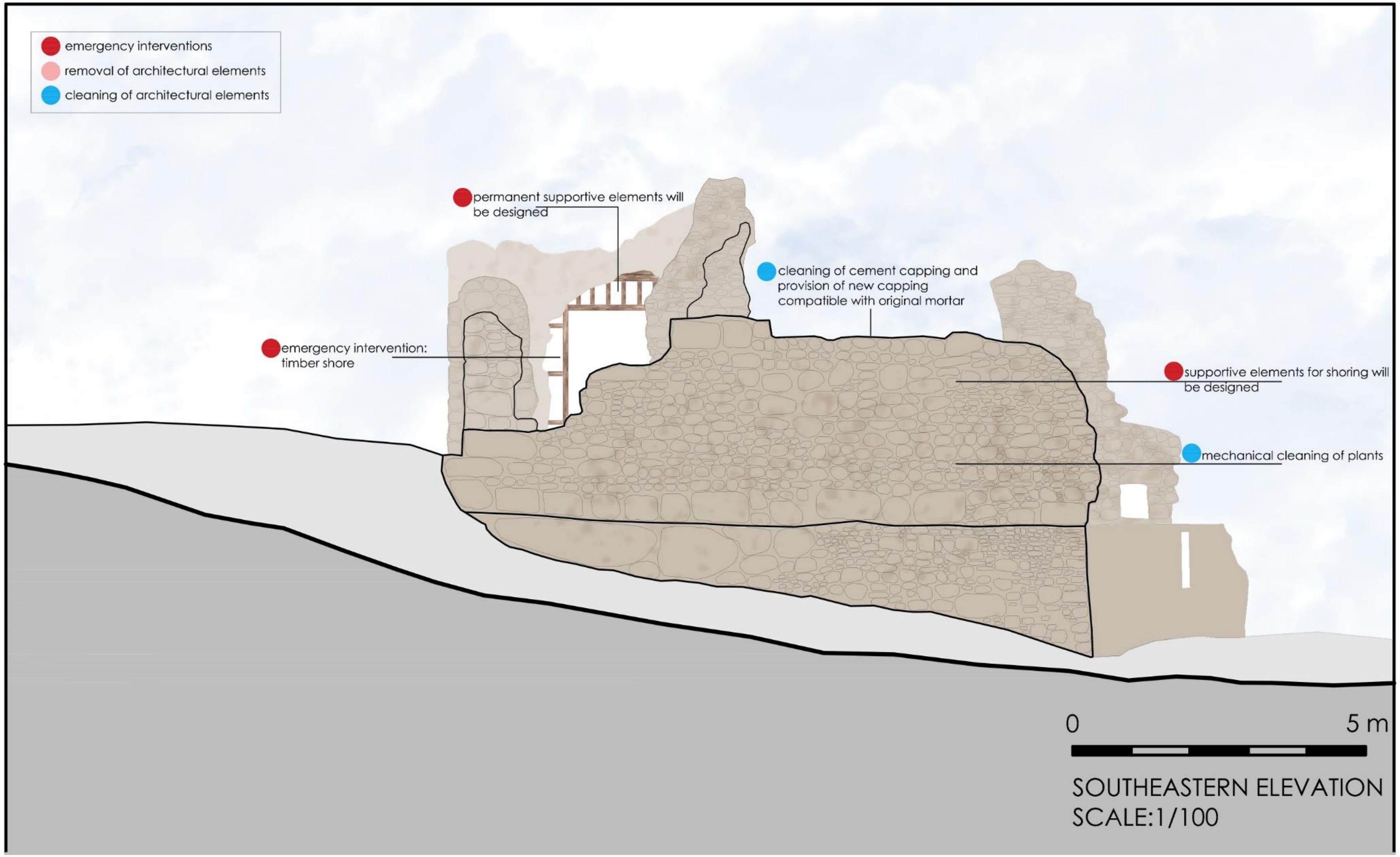


Figure G.4. Intervention Decisions, Southeastern Elevation

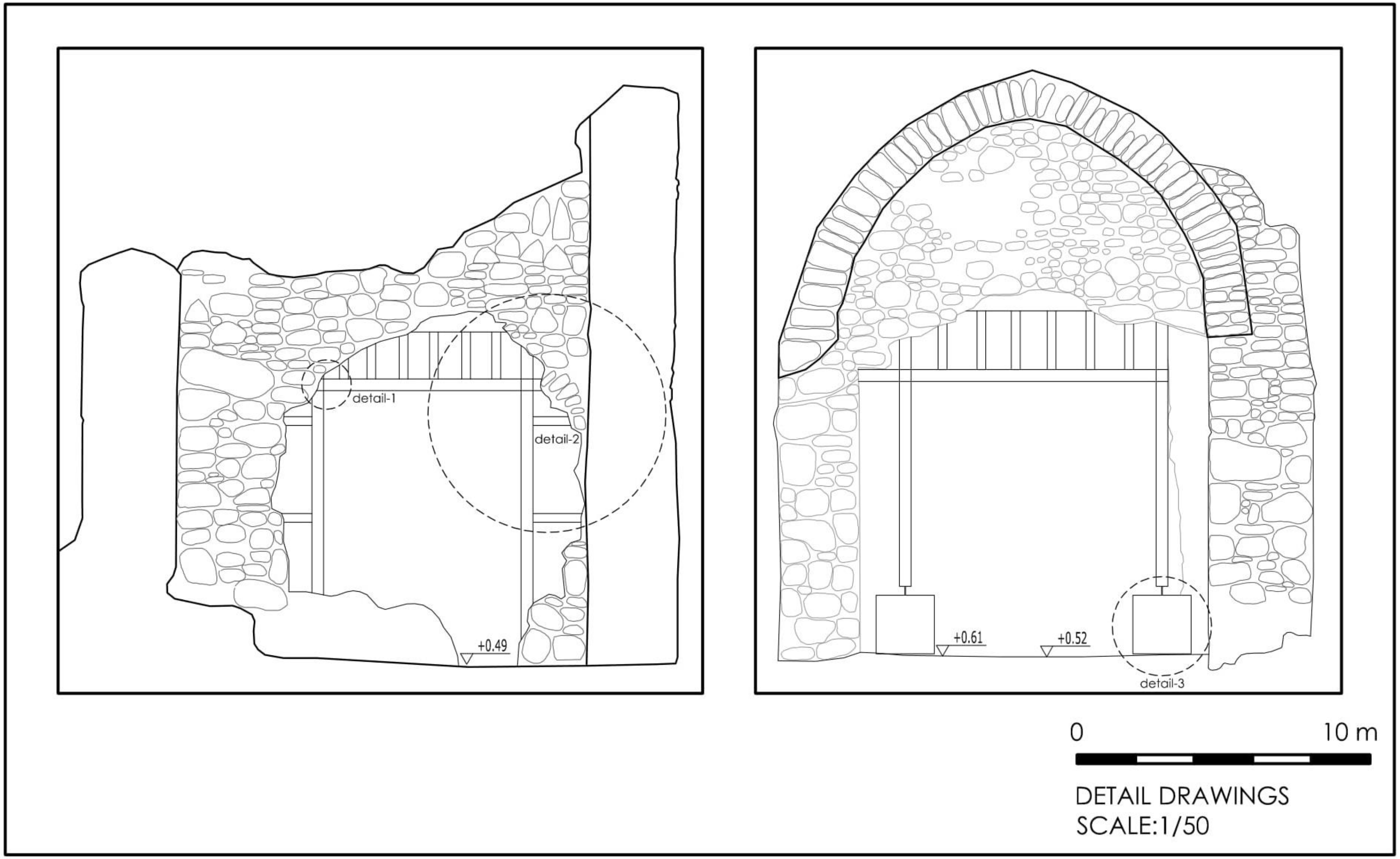


Figure G.5. Intervention Decisions, Details

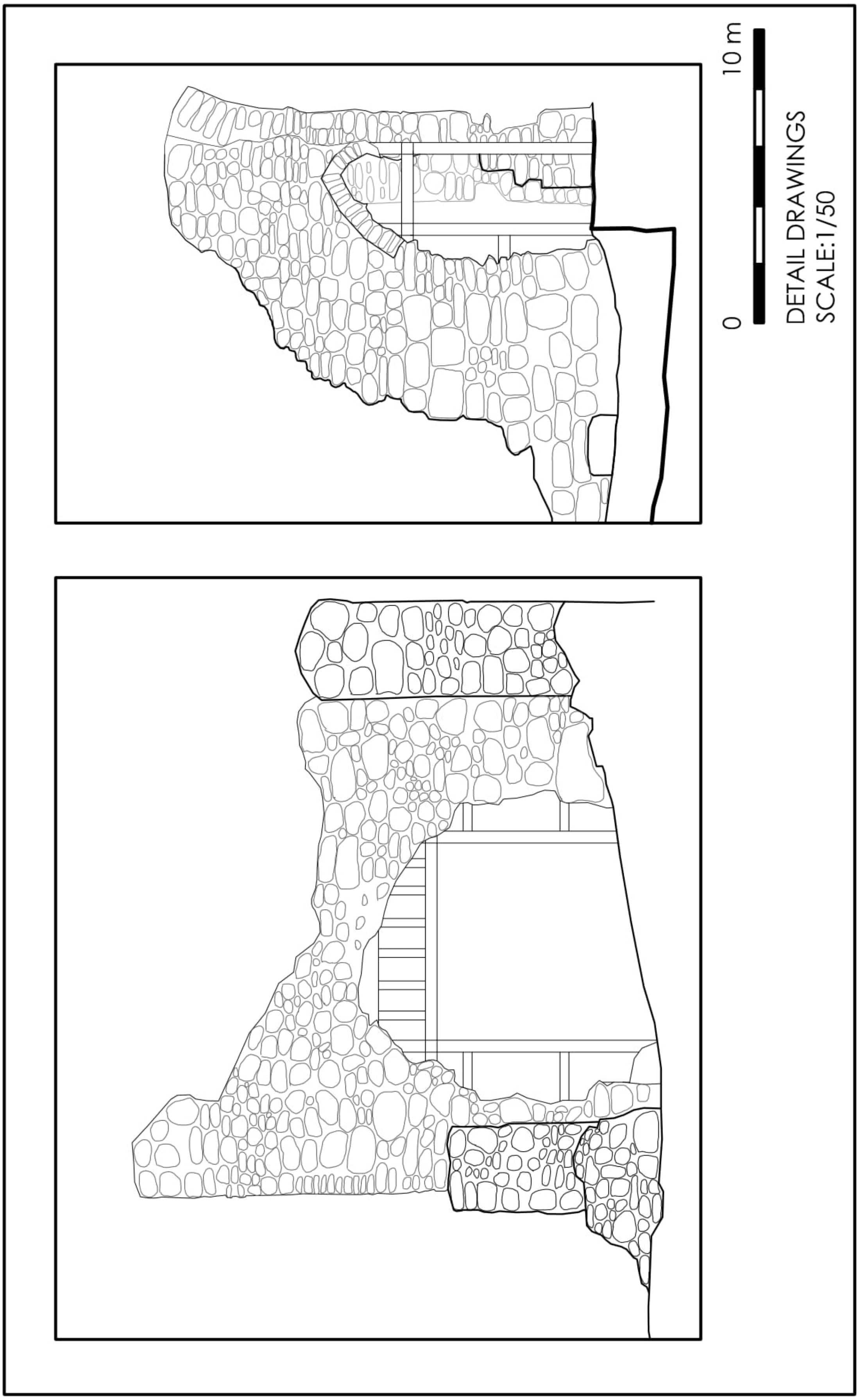


Figure G.6. Intervention Decisions, Details

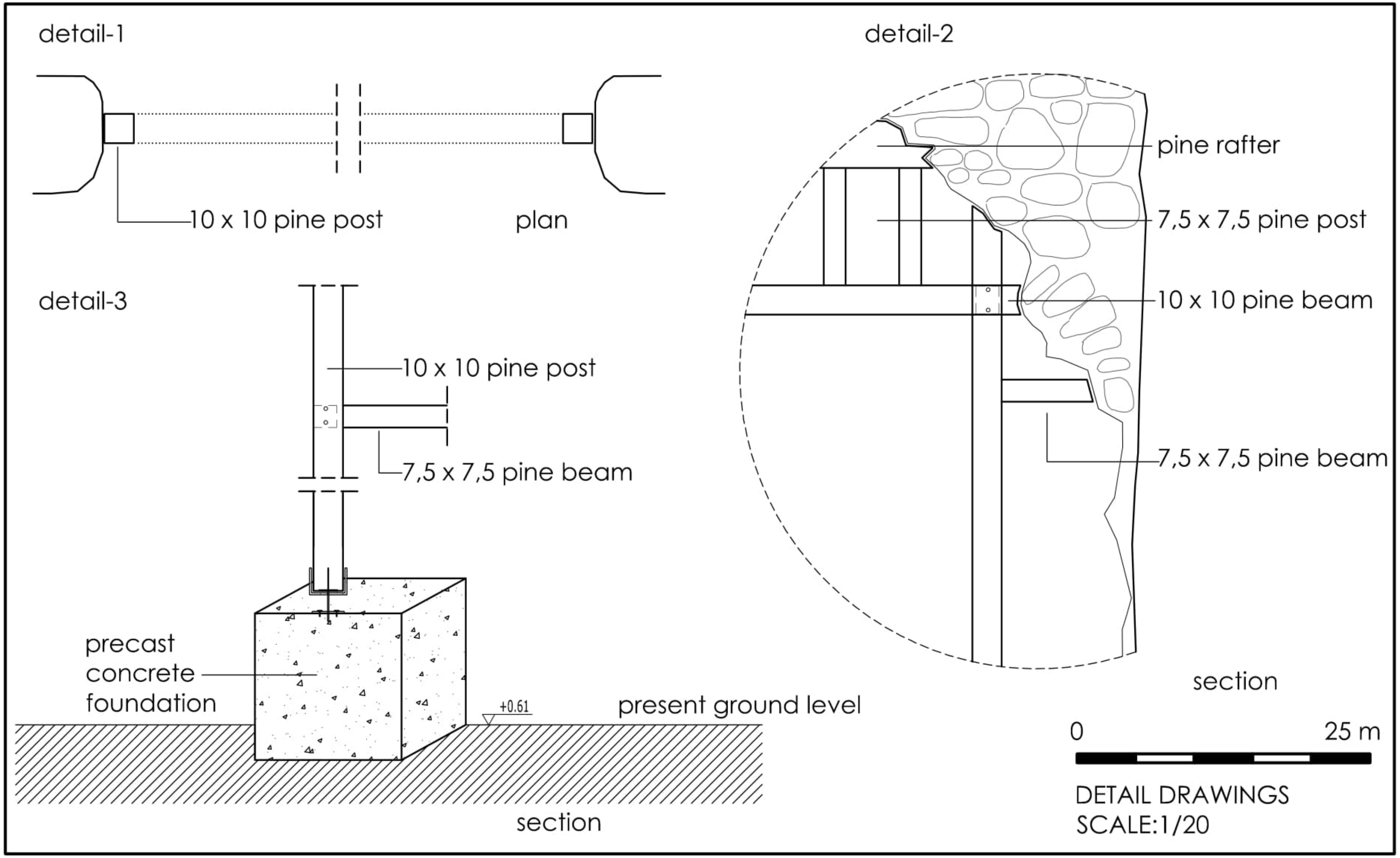


Figure G.7. Intervention Decisions, Details

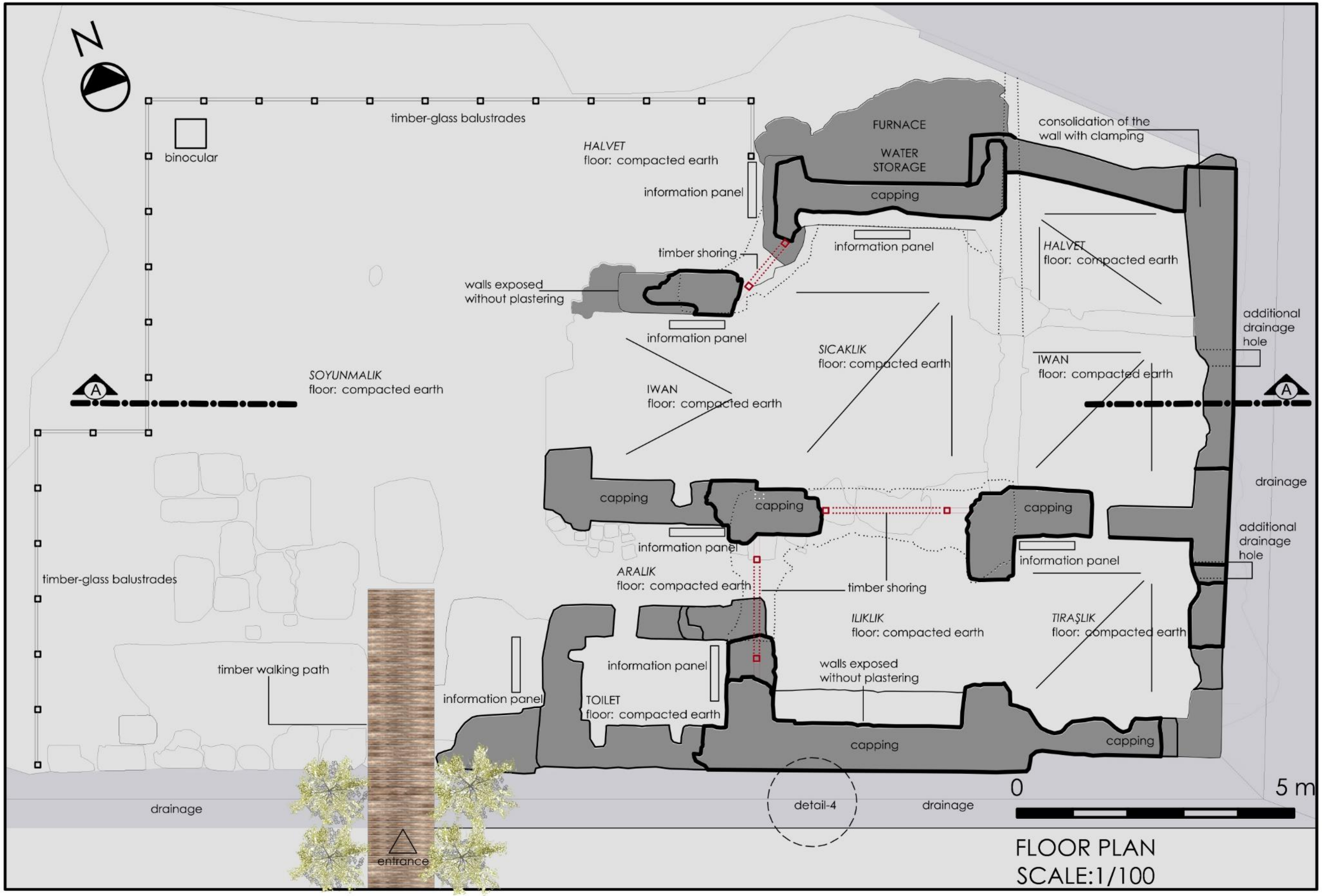


Figure G.8. Restoration, Floor Plan

Figure G.9. Restoration, Section AA

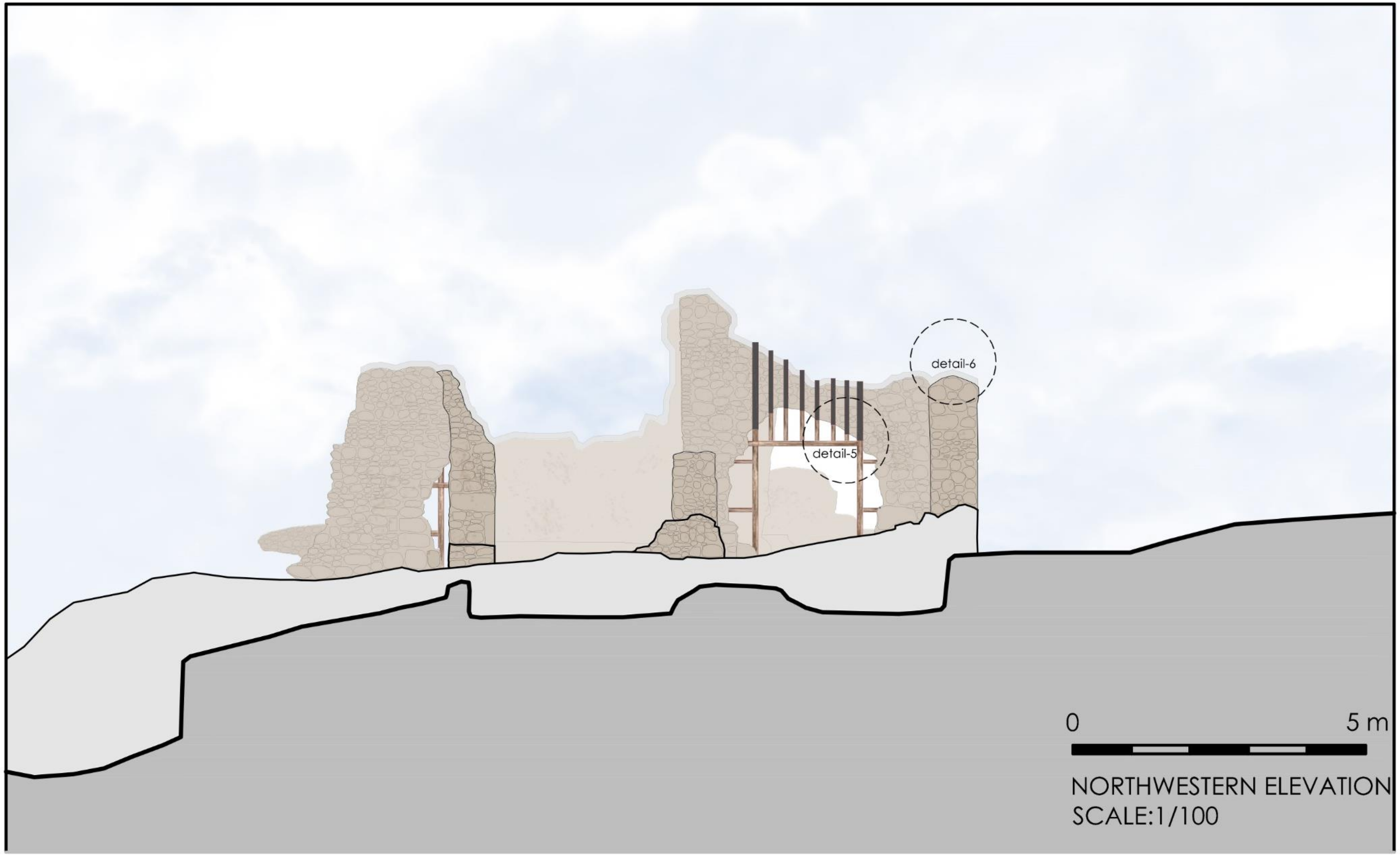


Figure G.10. Restoration, Northwestern Elevation

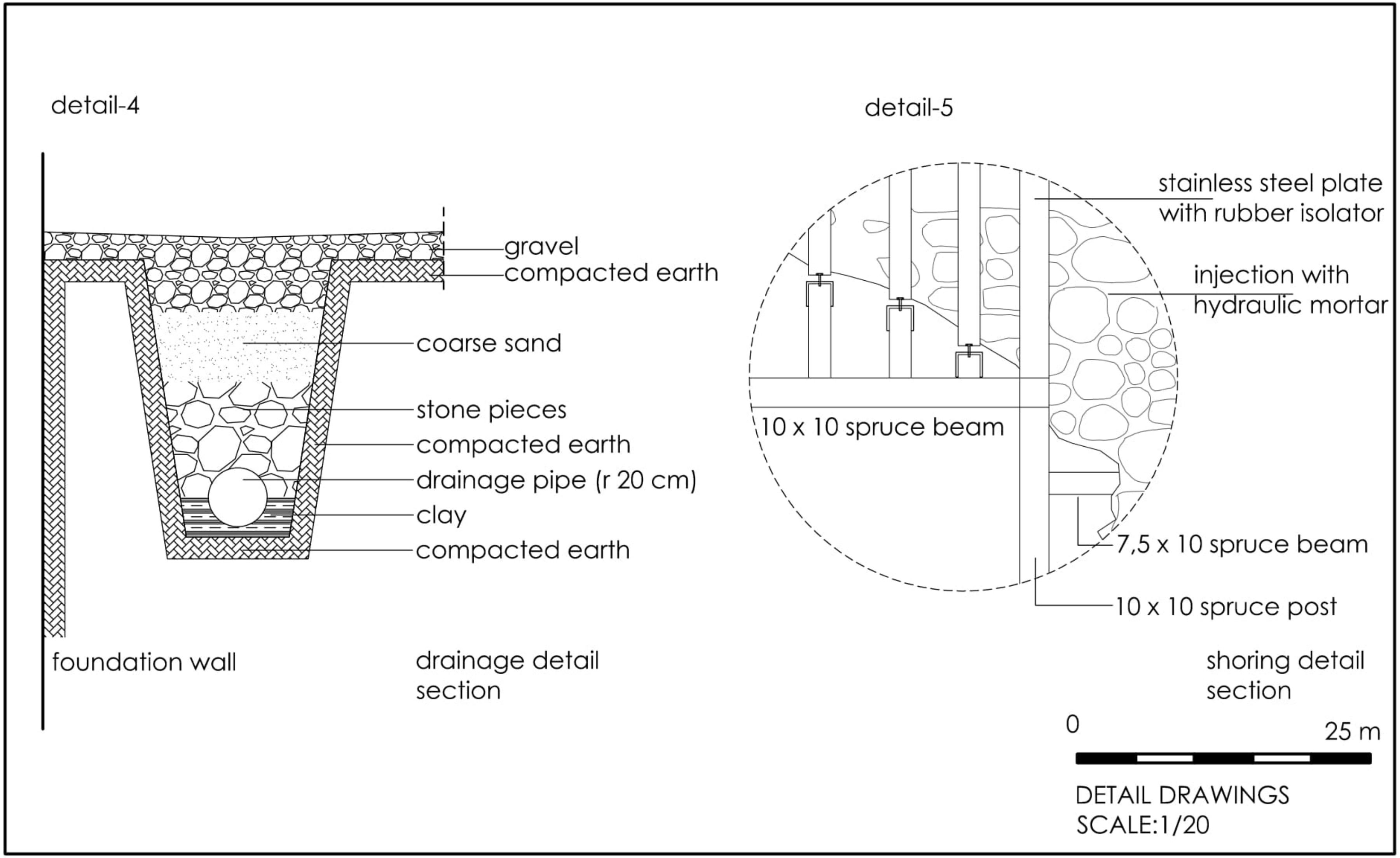


Figure G.11. Restoration, Details

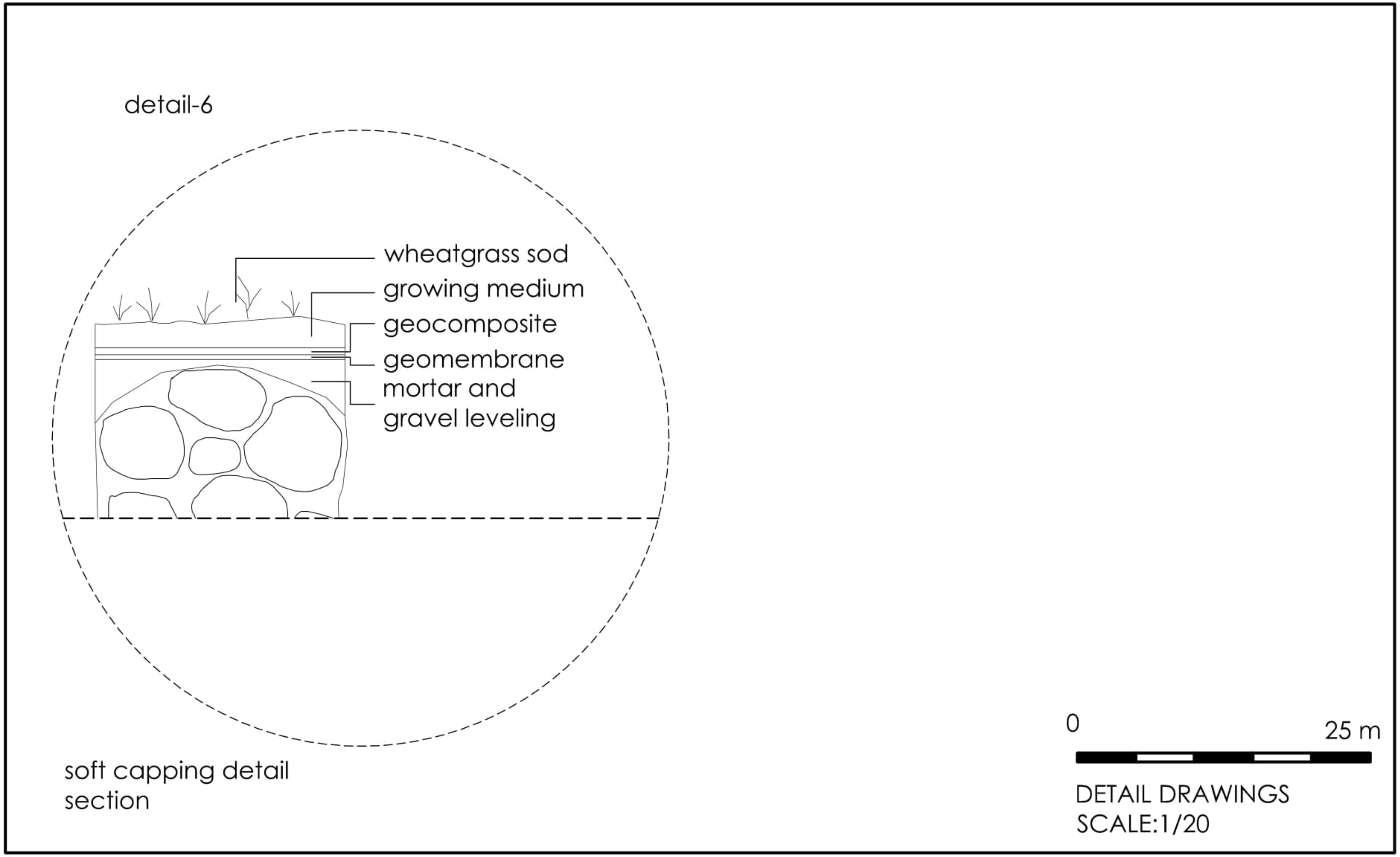


Figure G.12. Restoration, Details

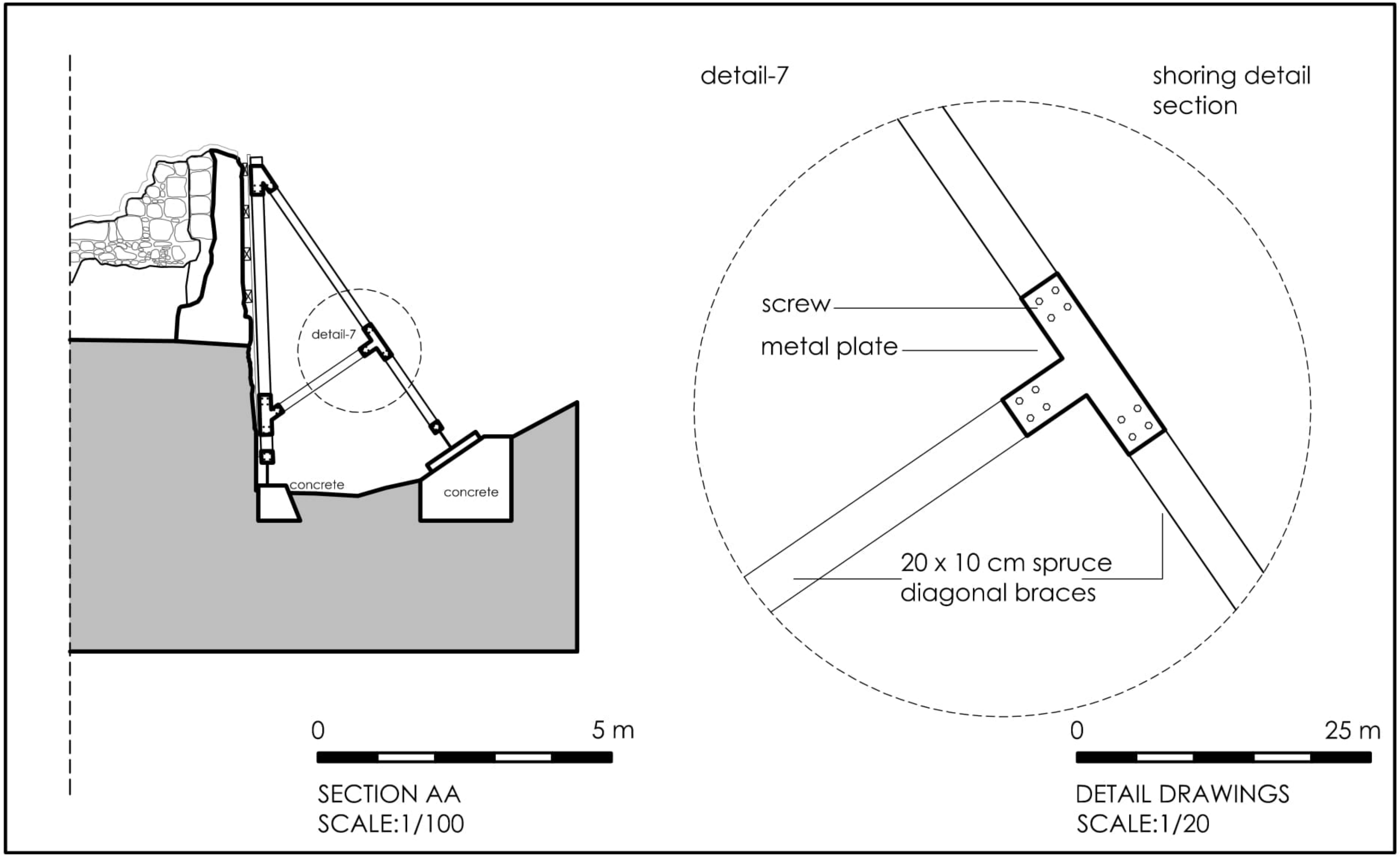
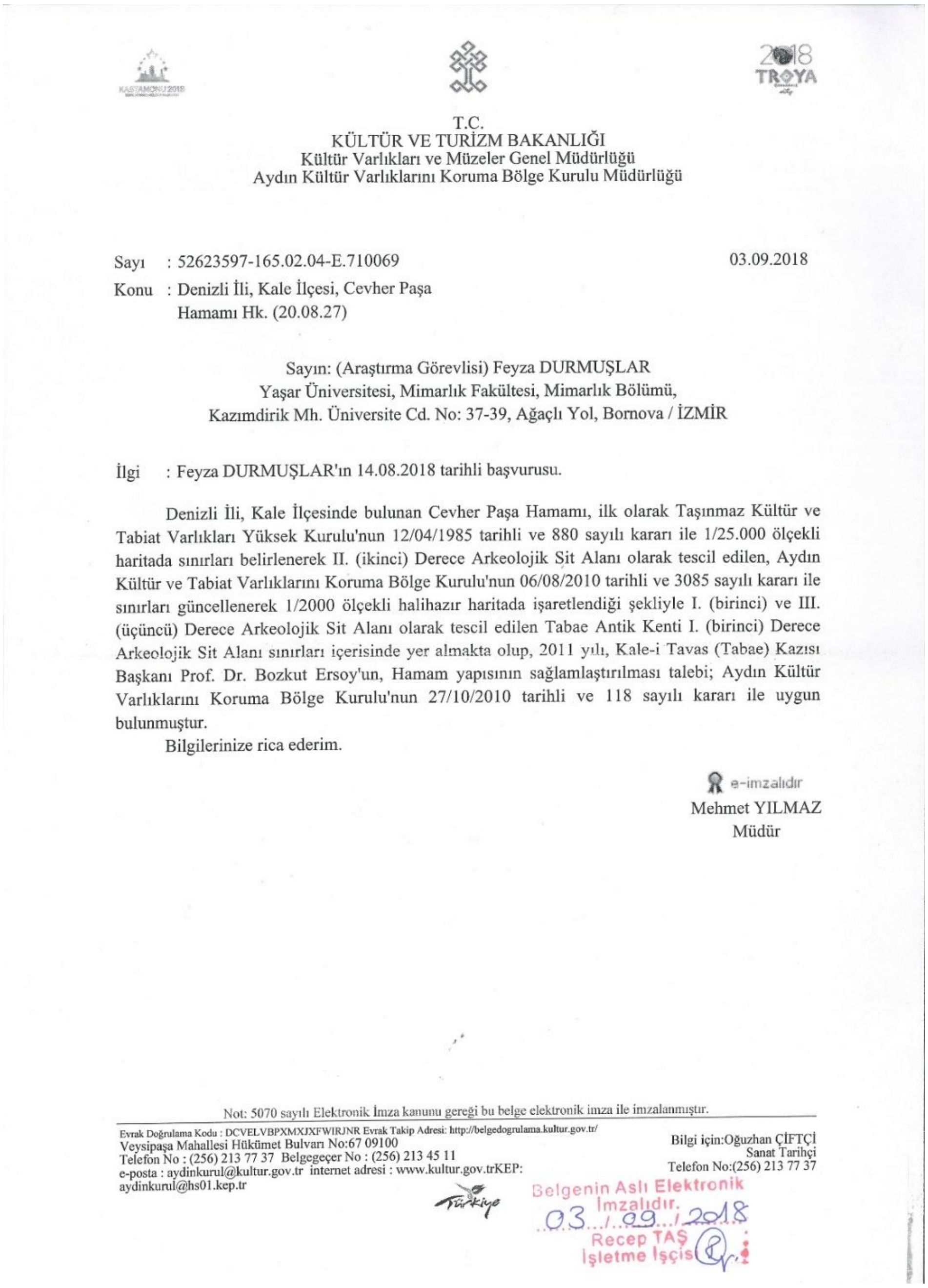


Figure G.13. Possible structure

APPENDIX H

CONSERVATION DECISIONS OF THE SITE



T.C.
KÜLTÜR VE TURİZM BAKANLIĞI
Kültür Varlıkları ve Müzeler Genel Müdürlüğü
Aydın Kültür Varlıklarını Koruma Bölge Kurulu Müdürlüğü

Sayı : 52623597-165.02.04-E.710069 03.09.2018

Konu : Denizli İli, Kale İlçesi, Cevher Paşa Hamamı Hk. (20.08.27)

Sayın: (Araştırma Görevlisi) Feyza DURMUŞLAR
Yaşar Üniversitesi, Mimarlık Fakültesi, Mimarlık Bölümü,
Kazımdirik Mh. Üniversite Cd. No: 37-39, Ağaçlı Yol, Bornova / İZMİR

İlgi : Feyza DURMUŞLAR'ın 14.08.2018 tarihli başvurusu.

Denizli İli, Kale İlçesinde bulunan Cevher Paşa Hamamı, ilk olarak Taşınmaz Kültür ve Tabiat Varlıkları Yüksek Kurulu'nun 12/04/1985 tarihli ve 880 sayılı kararı ile 1/25.000 ölçekli haritada sınırları belirlenerek II. (ikinci) Derece Arkeolojik Sit Alanı olarak tescil edilen, Aydın Kültür ve Tabiat Varlıklarını Koruma Bölge Kurulu'nun 06/08/2010 tarihli ve 3085 sayılı kararı ile sınırları güncellenerek 1/2000 ölçekli halihazır haritada işaretlendiği şekliyle I. (birinci) ve III. (üçüncü) Derece Arkeolojik Sit Alanı olarak tescil edilen Tabae Antik Kenti I. (birinci) Derece Arkeolojik Sit Alanı sınırları içerisinde yer almakta olup, 2011 yılı, Kale-i Tavas (Tabae) Kazısı Başkanı Prof. Dr. Bozkut Ersoy'un, Hamam yapısının sağlamlaştırılması talebi; Aydın Kültür Varlıklarını Koruma Bölge Kurulu'nun 27/10/2010 tarihli ve 118 sayılı kararı ile uygun bulunmuştur.

Bilgilerinize rica ederim.

e-imzalıdır
Mehmet YILMAZ
Müdür

Not: 5070 sayılı Elektronik İmza kanunu gereği bu belge elektronik imza ile imzalanmıştır.

Evrak Doğrulama Kodu : DCVELVBPXMXJXFWIRJNR Evrak Takip Adresi: http://belgedogrulama.kultur.gov.tr/
Veysipaşa Mahallesi Hükümet Bulvarı No:67 09100
Telefon No : (256) 213 77 37 Belgegeçer No : (256) 213 45 11
e-posta : aydinkurul@kultur.gov.tr internet adresi : www.kultur.gov.trKEP: aydinkurul@hs01.kep.tr

Bilgi için:Oğuzhan ÇİFTÇİ
Sanat Tarihçi
Telefon No:(256) 213 77 37

Belgenin Aslı Elektronik İmzalıdır.
03/09/2018
Recep TAŞ
İşletme İşçisi

Figure H.1. Conservation decisions of the site