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M.Sc. in Civil Engineering

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HASAN KALYONCU UNIVERSITY
GRADUATE SCHOOL OF
NATURAL AND APPLIED SCIENCES

EVALUATION OF STRUCTURAL PROBLEMS OF GEBEN CASTLE AND RECOMMENDATIONS FOR STRUCTURAL SOLUTION

M.Sc. THESIS
IN
CIVIL ENGINEERING

Ali FIRAT

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Evaluation Of Structural Problems Of Geben Castle And Recommendations For Structural Solution

M.Sc. Thesis

In

Civil Engineering

Hasan Kalyoncu University

Supervisor

Prof. Dr. Mehmet KARPUZCU

Ali FIRAT

April 2020

	GRADUATE SCHOOL OF NATURAL & APPLIED SCIENCES INSTITUTE **M.Sc. ACCEPTANCE AND APPROVAL FORM**

Civil Engineering Department, Civil Engineering M.Sc. (Master of Science) programme student **Ali FIRAT** prepared and submitted the thesis titled **Evaluation Of Structural Problems Of Geben Castle And Recommendations For Structural Solution** defened successfully on the date of 15/04/2020 and accepted by the jury as a M.Sc. thesis.

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This thesis is accepted by the jury members selected by the institute management board and approved by the institute management board.

Prof. Dr. Mehmet KARPUZCU
Director

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Ali FIRAT

ABSTRACT

EVALUATION OF STRUCTURAL PROBLEMS OF GEBEN CASTLE AND RECOMMENDATIONS FOR STRUCTURAL SOLUTION

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M.Sc. in Civil Engineering
Supervisor: Prof. Dr. Mehmet KARPUZCU
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The structural problems of the Geben Castle in the rural area of the Andırın District of Kahramanmaraş Province were discussed in this study. Within the scope of this report, a detailed structural evaluation of the castle is carried out based on on-site inspection, systematic photographic documents and survey drawings.

As a result of the evaluation, data is provided as a basis for the structural intervention decisions required to protect the structure and transfer it to future generations. In the next step, the results of these preliminary assessments, which will be supported by structural analysis and calculations, are presented as guiding preliminary information in the stage of making structural decisions.

The structural problem areas in the structure are described. These regions are given systematic definitions of practical solutions for practical applications that may be made as a result of preliminary observation.

Keywords: Structural Problems, Systematic Photography, Structural Analysis, Protection Solutions, Practical Applications

ÖZET

GEBEN KALESİNİN YAPISAL SORUNLARININ DEĞERLENDİRİLMESİ VE YAPISAL ÇÖZÜM İÇİN ÖNERİLER

FIRAT, Ali
Yüksek Lisans, İnşaat Mühendisliği Bölümü
Tez Danışmanı: Prof. Dr. Mehmet KARPUZCU
Nisan 2020
92 sayfa

Kahramanmaraş İli, Andırın İlçesi kırsal alanında yer alan, Geben Kalesi'nin yapısal sorunları bu incelemede ele alınmıştır. Bu rapor kapsamında kalenin yerinde inceleme, sistematik fotoğraflama belgeleri ve rölöve çizimlerine bağlı olarak ayrıntılı yapısal değerlendirmesi yapılmaktadır.
Değerlendirme sonucunda, yapının korunabilmesi ve gelecek nesillere aktarılması için gereken yapısal müdahale kararlarına altlık olacak veri sağlanmaktadır. Bir sonraki adımda yapısal analiz ve hesaplarla desteklenerek sorgulanacak bu ön değerlendirme sonuçları, yapısal kararların verilmesi aşamasında yönlendirici ön bilgi olarak sunulmaktadır.
Yapıda ki yapısal sorun bölgeleri tariflenmektedir. Bu bölgelere ön gözlem sonucunda yapılması mümkün olabilecek koruma çözümlerinin, pratik uygulamaya yönelik, sistemli tanımları verilmektedir.

Anahtar Kelimeler: Yapısal Sorunlar, Sistematik Fotoğraflama, Yapısal Analiz, Koruma Çözümleri, Pratik uygulamalar

To My Wife

ACKNOWLEDGEMENTS

During my thesis study, I would like to express my thanks and respect to my dear professor Doctor Mehmet KARPUZCU, who is my guide and support with his valuable knowledge and experience. I offer my endless thanks and respect to Doctor Faculty Member Adem YURTSEVER, who does not hesitate to show his interest and suggestions.

I would like to thank my wife, who always supported me throughout my studies, and my family, who never left me alone with her material and spiritual.

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LIST OF SYMBOLS AND ABBREVIATIONS

GD	South Exterior
GI	Southern Interior
KD	North Exterior
DD	East Exterior
BD	Western Exterior
n	Sample Locations
DBYBHY	Implementing Regulation on Buildings to be Built in Earthquake Zones
HCL	Hydrochloric acid

CHAPTER 1

INTRODUCTION

The structure located in the borders of Geben Town of Andırın, Kahramanmaraş Province is the Treasury which is registered in 107 Island, parcel no. Geben Castle, Andırın-Göksun road between the town of Geben 6km. north. The castle is one of the most grueling mountains of the Southeastern Taurus Kayranlı and Deli Höbek mountains located at the only passage point of about 150m. high steep rocky hill. The castle is located at a very strategic point of the wide Geben Valley and also controls the very important trade route that provides access to Çukurova (Kılikya). The building is 13km from Andırın Kaleboynu Castle. Göksun Red Castle is 20km. Away. It is understood that Meryemçil Castle was planned to provide connection with the surrounding castles and provide them with the necessary logistical support.

Figure 1.1: View of Geben Castle

1.1. Intent

Andırın, Geben Castle Located in the boundaries of Geben Town, Andırın district of Kahramanmaraş province; This report, which is prepared within the scope of the work of building surveying, restitution, restoration, static consolidation and electrical (lighting) projects of Geben (Meryemçil) Castle, is a survey report that explains the current status of the castle. In this context, the aim of the study is to reveal the data that will contribute to the restoration phase by revealing the situation of Geben Castle at the time it was used.

1.2. Scope

This report Pregnant (Meryemçil) Castle of information about the current situation, comprises drawings and photographs, detailed descriptions belonging to the restitution which will be formed after the operation and restoration projects (history, old documents and photos, protection recommendations etc.) beyond this report scope It was maintained.

1.3. Method

Distance Focus3D X 330 : 0.6 – 330m

Measuring speed: up to 976,000 points per second

Distance error : ± 2mm

Integrated color camera: 70 mio. up to pixels

Laser class : Laser class 1

Weight : 5,2kg

Multi-Sensor : GPS, Compass, Height Sensor, Dual Axis Compensator

Size : 240 x 200 x 100mm

Browser control : Via Touch Screen and WLAN

In the study, the structure was measured with a team of 4 people using 136 3D sessions using 3D Optical Scanner (LaserScanner-Faro). Point clouds are combined with an average margin of error of 75% of the scanning points below 4 mm. From the obtained point cloud, 2D plan, section and views were created in Png format using FaroSceneve Pointcab program. 2-D plan, façade and section lines were drawn over this point cloud and the outlines of the drawings were created. Then, using Pointcab program, orthophotos of sections and views were created from this point cloud. These orthophotos were placed on the main lines drawn on AutoCAD, and all the detail, appearance and distortions were added and the main drawings were completed. Because of the rocky terrain, the parts that could not be scanned were photographed with the help of drone and the missing wall orthophotos were taken by using Agisoft program and the drawings were completed to the extent allowed by the land.

CHAPTER 2

ARCHITECTURE OF THE CASTLE

In order to provide the defense and security of a region, fortresses with thick walls, towers, crenellated and durable structures are built in passage routes, strategically important cities, passages and narrow straits where any enemy attacks can occur. It was built on hills that were strategically important and defensive. The fortresses within the defense architecture are the city walls surrounding the cities, bastions, gorges, passages, watch towers that guard the roads and the structures that protect the settlements and monasteries of feudal lords. In the early periods, feudal lords built castles for themselves, their families and warriors in rocky high and hard-to-reach places near rivers. Generally, inside the castles, there is a chapel or church, multi-storey buildings for living or living, and the places where the warriors and t”heir commanders live. The walls of the fortress are generally built with uniform rows of stones of equal size and are also reinforced with semicircular supports and square-plan multi-storey towers. The entrance openings are small, sometimes protected from the outside by a second wall. The fortresses within the defense architecture are the city walls surrounding the cities, bastions, gorges, passages, watch towers that guard the roads and the structures that protect the settlements and monasteries of feudal lords.

2.1. Andırın Geben (Meyremçil) Castle

37.46 latitude and 36.26 longitude of the castle, starting from the port of Ayas (Yumurtalik) and Toprakkale, Bodrum Castle (Hieropolis-Kastabala), Ak Kale, Azgit, Geben, Göksun East Anatolia, Armenia and Iran to the trade This medieval castle is surrounded by a row of rock layers on the east side just before the road ascends towards the Meryemçil pass in the north. This passage is quite wide and climatic conditions in this region are quite difficult as it is understood from the erosion on the steep rock. Another path from the Rifatiye and Mazdaç pass, north of the Meryemçil pass, joins the Göksun road at 9 km south of Findikli. To the northeast of the castle, there is a second narrow passage that can be crossed by climbers, where it is not possible to drive. After this passage passes a certain distance, it joins with Göksun Kahramanmaraş via Şadalak. The Geben valley covers an area of 130 square kilometers and passes through two more roads, one in the east and the other in the west. The western line starts from the Geben neighborhood and passes through a narrow passageway to the southwest until it is cut in the Çokak valley. The eastern line leaves the main north-south road 7 km south of Geben castle and exits the valley through a wide passage. In this passage, the road is divided into two. One line goes south to Kahramanmaraş and the other joins directly via northeastern Şadalak between Kahramanmaraş Göksun.

Both lines in the Geben valley are not protected by the castles. At the southern end of the valley is the Azgit Fortress, a small garrison located on the west wing of the north-south road. All three roads are largely covered with snow in winter. Melting snows in spring and summer rains provide water to the fertile valley. The streams around Geben merge with Andırın Water and flow south and form the tributaries of Ceyhan River. These waterways also intersect the strategic route between the plain and Göksun.

The current topography of the castle of Geben shows an extraordinary view. There are fertile fields in the south and near the rocks. It turns pinkish-gray limestone cliffs forming almost steep walls in the north, east and west. The spooky visual effect of these slopes is interrupted only by pine trees clinging to the rocks rising locally. On this line where Geben Castle is located, there are Fındıklı in the north, Azgit, Ak Kale and Anacık castles in the south.

Figure 2.1: Andırın District Location Map

CHAPTER 3

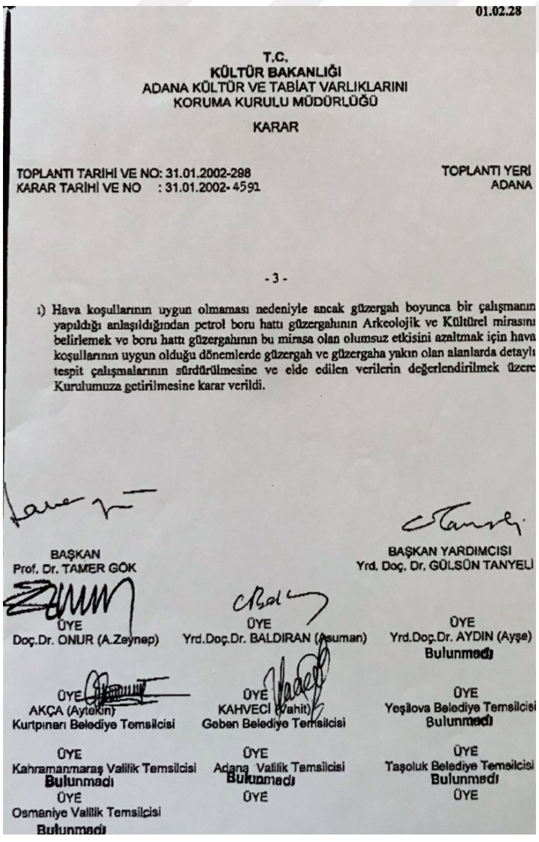
SURVEY ANALYSIS REPORT

3.1. Location

Geben Castle, Kahramanmaraş province, Andırın district, Geben (Meryemçil) within the town limits, Andırın district 29km. 1 parcel away, 107ada is also located. It was built on a hill made of natural rock and was built in accordance with the topography.

3.2. Registration Status

It was registered with the decision of the Regional Board of Adana Conservation of Cultural and Natural Assets dated 28.07.2005 and numbered 4591. Inventory Number: KVE-TR-46-03-25



01.02.28

T.C.
KÜLTÜR BAKANLIĞI
ADANA KÜLTÜR VE TABİAT VARLIKLARINI
KORUMA KURULU MÜDÜRLÜĞÜ

KARAR

TOPLANTI TARİHİ VE NO: 31.01.2002-298
KARAR TARİHİ VE NO : 31.01.2002-4591

TOPLANTI YERİ
ADANA

- 3 -

1) Hava koşullarının uygun olmaması nedeniyle ancak güzergah boyunca bir çalışmanın yapıldığı anlaşıldığından petrol boru hattı güzergahının Arkeolojik ve Kültürel mirasını belirlemek ve boru hattı güzergahının bu mirasa olan olumsuz etkisini azaltmak için hava koşullarının uygun olduğu dönemlerde güzergah ve güzergaha yakın olan alanlarda detaylı tespit çalışmalarının sürdürülmesine ve elde edilen verilerin değerlendirilmek üzere Kurulumuza getirilmesine karar verildi.

BAŞKAN
Prof. Dr. TAMER GÖK

BAŞKAN YARDIMCISI
Yrd. Doç. Dr. GÜLSÜN TANYELİ

ÜYE
Doç.Dr. ONUR (A.Zeynep)

ÜYE
Yrd.Doç.Dr. BALDIRAN (Asuman)

ÜYE
Yrd.Doç.Dr. AYDIN (Ayşe)
Bulunmadı

ÜYE
AKÇA (Aytekin)
Kurtpınarı Belediye Temsilcisi

ÜYE
KAHVECİ (Vahit)
Geben Belediye Temsilcisi

ÜYE
Yeşilova Belediye Temsilcisi
Bulunmadı

ÜYE
Kahramanmaraş Valilik Temsilcisi
Bulunmadı

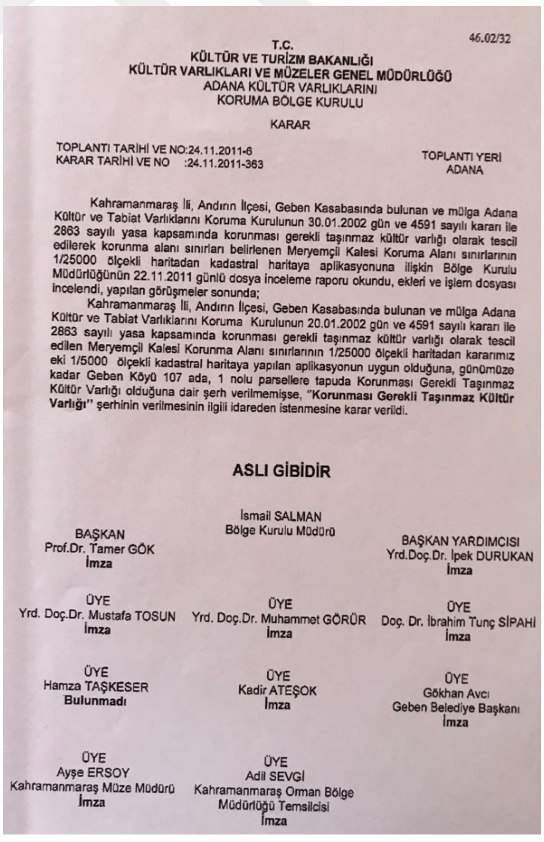
ÜYE
Adana Valilik Temsilcisi
Bulunmadı

ÜYE
Taşoluk Belediye Temsilcisi
Bulunmadı

ÜYE
Osmaniye Valilik Temsilcisi
Bulunmadı

ÜYE

ÜYE



46.02/32

T.C.
KÜLTÜR VE TURİZM BAKANLIĞI
KÜLTÜR VARLIKLARI VE MÜZELER GENEL MÜDÜRLÜĞÜ
ADANA KÜLTÜR VARLIKLARINI
KORUMA BÖLGE KURULU

KARAR

TOPLANTI TARİHİ VE NO:24.11.2011-6
KARAR TARİHİ VE NO :24.11.2011-363

TOPLANTI YERİ
ADANA

Kahramanmaraş İli, Andırın İlçesi, Geben Kasabasında bulunan ve mülga Adana Kültür ve Tabiat Varlıklarını Koruma Kurulunun 30.01.2002 gün ve 4591 sayılı kararı ile 2863 sayılı yasa kapsamında korunması gerekli taşınmaz kültür varlığı olarak tescil edilerek korunma alanı sınırları belirlenen Meryemçil Kalesi Koruma Alanı sınırlarının 1/25000 ölçekli haritadan kadastral haritaya aplikasyonuna ilişkin Bölge Kurulu Müdürlüğünün 22.11.2011 günlü dosya inceleme raporu okundu, ekleri ve işlem dosyası incelendi, yapılan görüşmeler sonunda;

Kahramanmaraş İli, Andırın İlçesi, Geben Kasabasında bulunan ve mülga Adana Kültür ve Tabiat Varlıklarını Koruma Kurulunun 20.01.2002 gün ve 4591 sayılı kararı ile 2863 sayılı yasa kapsamında korunması gerekli taşınmaz kültür varlığı olarak tescil edilen Meryemçil Kalesi Korunma Alanı sınırlarının 1/25000 ölçekli haritadan kararımız eki 1/5000 ölçekli kadastral haritaya yapılan aplikasyonun uygun olduğuna, günümüze kadar Geben Köyü 107 ada, 1 nolu parsellere tapuda Korunması Gerekli Taşınmaz Kültür Varlığı olduğuna dair şerh verilmemişse, **"Korunması Gerekli Taşınmaz Kültür Varlığı"** şerhinin verilmesinin ilgili idareden istenmesine karar verildi.

ASLI GİBİDİR

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ÜYE
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İmza

ÜYE
Hamza TAŞKESER
Bulunmadı

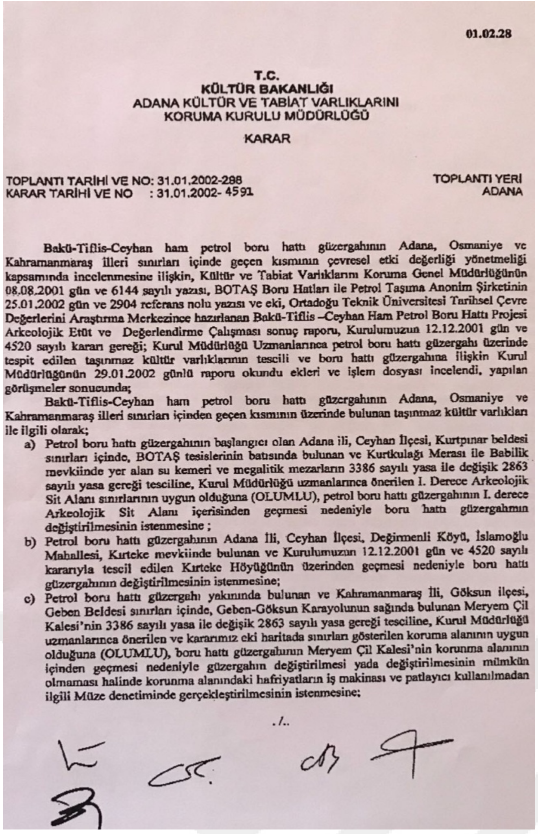
ÜYE
Kadir ATEŞOK
İmza

ÜYE
Gökhan Avcı
Geben Belediye Başkanı
İmza

ÜYE
Ayşe ERSOY
Kahramanmaraş Müze Müdürü
İmza

ÜYE
Adil SEVGİ
Kahramanmaraş Orman Bölge
Müdürlüğü Temsilcisi
İmza

Figure 3.1: Registration Slip **Figure 3.2:** Decision Record



01.02.28

T.C.
KÜLTÜR BAKANLIĞI
ADANA KÜLTÜR VE TABİAT VARLIKLARINI
KORUMA KURULU MÜDÜRLÜĞÜ

KARAR

TOPLANTI TARİHİ VE NO: 31.01.2002-298 — TOPLANTI YERİ
KARAR TARİHİ VE NO : 31.01.2002- 4591 — ADANA

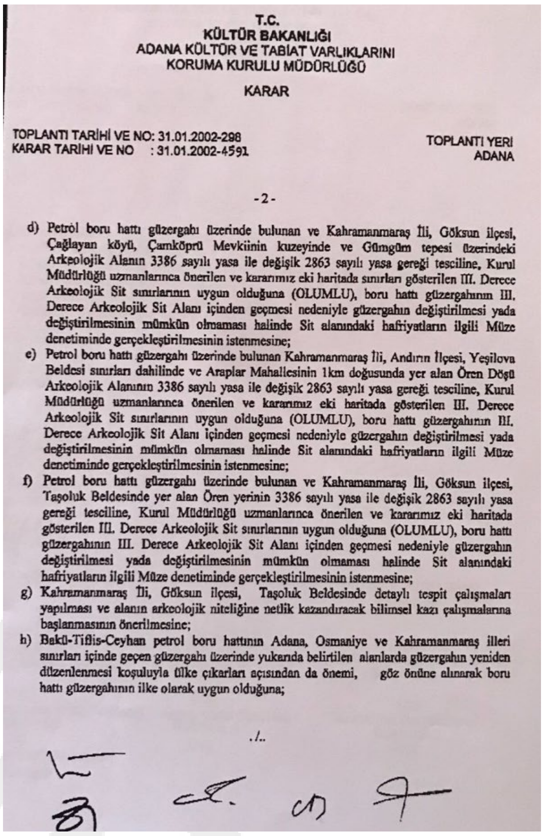
Bakü-Tiflis-Ceyhan ham petrol boru hattı güzergahının Adana, Osmaniye ve Kahramanmaraş illeri sınırları içinde geçen kısmının çevresel etki değerliği yönetmeliği kapsamında incelenmesine ilişkin, Kültür ve Tabiat Varlıklarını Koruma Genel Müdürlüğünün 08.08.2001 gün ve 6144 sayılı yazısı, BOTAŞ Boru Hatları ile Petrol Taşıma Anonim Şirketinin 25.01.2002 gün ve 2904 referans nolu yazısı ve eki, Ortadoğu Teknik Üniversitesi Tarihsel Çevre Değerlerini Araştırma Merkezince hazırlanan Bakü-Tiflis –Ceyhan Ham Petrol Boru Hattı Projesi Arkeolojik Etüt ve Değerlendirme Çalışması sonuç raporu, Kurulumuzun 12.12.2001 gün ve 4520 sayılı kararı gereği; Kurul Müdürlüğü Uzmanlarınca petrol boru hattı güzergahı üzerinde tespit edilen taşınmaz kültür varlıklarının tescili ve boru hattı güzergahına ilişkin Kurul Müdürlüğünün 29.01.2002 günlü raporu okundu ekleri ve işlem dosyası incelendi, yapılan görüşmeler sonucunda;

Bakü-Tiflis-Ceyhan ham petrol boru hattı güzergahının Adana, Osmaniye ve Kahramanmaraş illeri sınırları içinden geçen kısmının üzerinde bulunan taşınmaz kültür varlıkları ile ilgili olarak;

a) Petrol boru hattı güzergahının başlangıcı olan Adana ili, Ceyhan İlçesi, Kurtpınar beldesi sınırları içinde, BOTAŞ tesislerinin batısında bulunan ve Kurtkulağı Merası ile Babilik mevkiinde yer alan su kemeri ve megalitik mezarların 3386 sayılı yasa ile değişik 2863 sayılı yasa gereği tesciline, Kurul Müdürlüğü uzmanlarınca önerilen I. Derece Arkeolojik Sit Alanı sınırlarının uygun olduğuna (OLUMLU), petrol boru hattı güzergahının I. derece Arkeolojik Sit Alanı içerisinden geçmesi nedeniyle boru hattı güzergahının değiştirilmesinin istenmesine ;
b) Petrol boru hattı güzergahının Adana İli, Ceyhan İlçesi, Değirmenli Köyü, İslamoğlu Mahallesi, Kırteke mevkiinde bulunan ve Kurulumuzun 12.12.2001 gün ve 4520 sayılı kararıyla tescil edilen Kırteke Höyüğünün üzerinden geçmesi nedeniyle boru hattı güzergahının değiştirilmesinin istenmesine;
c) Petrol boru hattı güzergahı yakınında bulunan ve Kahramanmaraş İli, Göksun ilçesi, Geben Beldesi sınırları içinde, Geben-Göksun Karayolunun sağında bulunan Meryem Çil Kalesi'nin 3386 sayılı yasa ile değişik 2863 sayılı yasa gereği tesciline, Kurul Müdürlüğü uzmanlarınca önerilen ve kararımız eki haritada sınırları gösterilen koruma alanının uygun olduğuna (OLUMLU), boru hattı güzergahının Meryem Çil Kalesi'nin korunma alanının içinden geçmesi nedeniyle güzergahın değiştirilmesi yada değiştirilmesinin mümkün olmaması halinde korunma alanındaki hafriyatların iş makinası ve patlayıcı kullanılmadan ilgili Müze denetiminde gerçekleştirilmesinin istenmesine;

./..

Figure 3.3: Decision Record 2



T.C.
KÜLTÜR BAKANLIĞI
ADANA KÜLTÜR VE TABİAT VARLIKLARINI
KORUMA KURULU MÜDÜRLÜĞÜ

KARAR

TOPLANTI TARİHİ VE NO: 31.01.2002-298 — TOPLANTI YERİ
KARAR TARİHİ VE NO : 31.01.2002-4591 — ADANA

-2-

d) Petrol boru hattı güzergahı üzerinde bulunan ve Kahramanmaraş İli, Göksun ilçesi, Çağlayan köyü, Çamköprü Mevkiinin kuzeyinde ve Gümgüm tepesi üzerindeki Arkeolojik Alanın 3386 sayılı yasa ile değişik 2863 sayılı yasa gereği tesciline, Kurul Müdürlüğü uzmanlarınca önerilen ve kararımız eki haritada sınırları gösterilen III. Derece Arkeolojik Sit sınırlarının uygun olduğuna (OLUMLU), boru hattı güzergahının III. Derece Arkeolojik Sit Alanı içinden geçmesi nedeniyle güzergahın değiştirilmesi yada değiştirilmesinin mümkün olmaması halinde Sit alanındaki hafriyatların ilgili Müze denetiminde gerçekleştirilmesinin istenmesine;
e) Petrol boru hattı güzergahı üzerinde bulunan Kahramanmaraş İli, Andırın İlçesi, Yeşilova Beldesi sınırları dahilinde ve Araplar Mahallesinin 1km doğusunda yer alan Ören Döşü Arkeolojik Alanının 3386 sayılı yasa ile değişik 2863 sayılı yasa gereği tesciline, Kurul Müdürlüğü uzmanlarınca önerilen ve kararımız eki haritada gösterilen III. Derece Arkeolojik Sit sınırlarının uygun olduğuna (OLUMLU), boru hattı güzergahının III. Derece Arkeolojik Sit Alanı içinden geçmesi nedeniyle güzergahın değiştirilmesi yada değiştirilmesinin mümkün olmaması halinde Sit alanındaki hafriyatların ilgili Müze denetiminde gerçekleştirilmesinin istenmesine;
f) Petrol boru hattı güzergahı üzerinde bulunan ve Kahramanmaraş İli, Göksun ilçesi, Taşoluk Beldesinde yer alan Ören yerinin 3386 sayılı yasa ile değişik 2863 sayılı yasa gereği tesciline, Kurul Müdürlüğü uzmanlarınca önerilen ve kararımız eki haritada gösterilen III. Derece Arkeolojik Sit sınırlarının uygun olduğuna (OLUMLU), boru hattı güzergahının III. Derece Arkeolojik Sit Alanı içinden geçmesi nedeniyle güzergahın değiştirilmesi yada değiştirilmesinin mümkün olmaması halinde Sit alanındaki hafriyatların ilgili Müze denetiminde gerçekleştirilmesinin istenmesine;
g) Kahramanmaraş İli, Göksun ilçesi, Taşoluk Beldesinde detaylı tespit çalışmaları yapılması ve alanın arkeolojik niteliğine netlik kazandıracak bilimsel kazı çalışmalarına başlanmasının önerilmesine;
h) Bakü-Tiflis-Ceyhan petrol boru hattının Adana, Osmaniye ve Kahramanmaraş illeri sınırları içinde geçen güzergahı üzerinde yukarıda belirtilen alanlarda güzergahın yeniden düzenlenmesi koşuluyla ülke çıkarları açısından da önemi, göz önüne alınarak boru hattı güzergahının ilke olarak uygun olduğuna;

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Figure 3.4: Decision Record 3

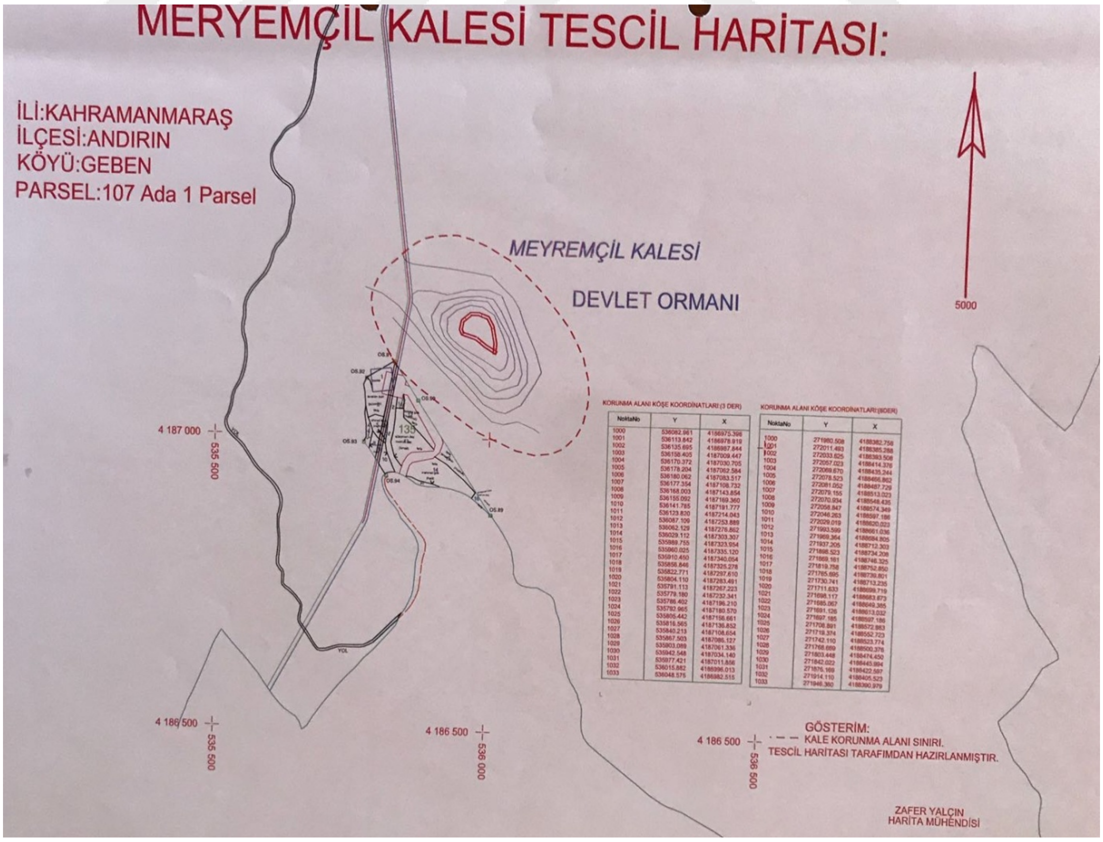
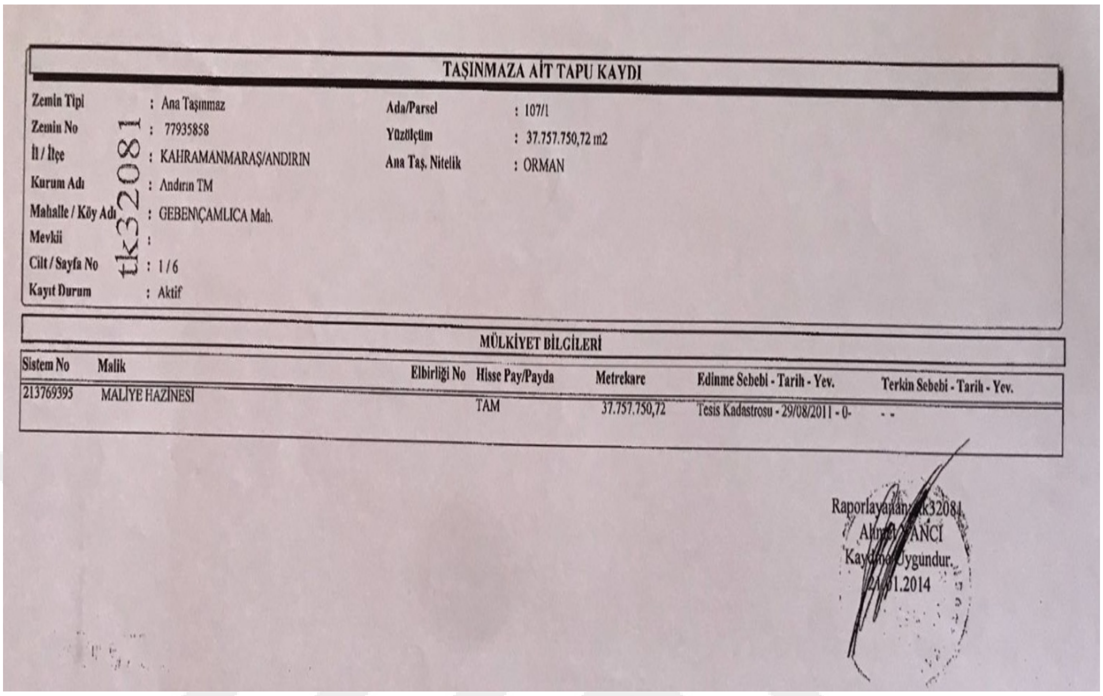


Figure 3.5: Registration Map

3.3. Ownership

It is the immovable property of the Treasury.



TAŞINMAZA AİT TAPU KAYDI

Zemin Tipi	: Ana Taşınmaz	Ada/Parsel	: 107/1
Zemin No	: 77935858	Yüzölçüm	: 37.757.750,72 m2
İl / İlçe	: KAHRAMANMARAŞ/ANDIRIN	Ana Taş. Nitelik	: ORMAN
Kurum Adı	: Andırın TM		
Mahalle / Köy Adı	: GEBENÇAMLICA Mah.		
Mevkii	:		
Cilt / Sayfa No	: 1/6		
Kayıt Durum	: Aktif		

tk32081

MÜLKİYET BİLGİLERİ

Sistem No	Malik	Elbirliği No	Hisse Pay/Payda	Metrekare	Edinme Sebebi - Tarih - Yev.	Terkin Sebebi - Tarih - Yev.
213769395	MALİYE HAZİNESİ		TAM	37.757.750,72	Tesis Kadastrosu - 29/08/2011 - 0-	- -

Figure 3.6: Land Registry of the immovable

3.4. General Definition of Structure; Interior and Exterior

3.4.1. Plan Scheme and Indoor Features

Constructed on a sloping rocky area in the north-south direction, the structure consists of an inner castle and an outer castle on its south side. According to the topography of the terrain shaped skewed castle, approximately 65.00x80.00m. in sizes. The stream flows from the north of the hill where the castle is located and it is understood that the water need is met from here. In the construction of the castle, lime mortar fine, coarse and rubble stone materials were used. The thickness of the walls is 1.30m. to 4.80m. ranged between. The construction of the building is very careful.

The castle has survived to the present day and has been destroyed by treasure seekers. In the same way, in the Yearbook of Aleppo Province dated 1309 H. / 1892 M., it is stated that the Meryemçil Castle was in ruins. (1309 dated Aleppo Province Yearbook, 156). The city walls and the inner parts of the building have been demolished and some parts have survived. Some walls and foundation remains of the destroyed volumes have survived. The current status of the structure provides information about the plan scheme. The interior of the castle is a sloping rocky area and covered with grass and trees.

The north, east and west sides of the castle are steep rocky and can only be reached from the south side. The outer castle, which is placed in the south direction of the building, is entered through the door opening in the middle of the south wall. The destroyed door is reinforced with a semi-circular bushing on the west side. It has a crooked layout and is approximately 28.00x72.00m. the outer castle is surrounded by fortifications supported by two semi-circular towers; The bush near the door is substantially intact, while the other is collapsed. Since the west side of the fortress is steep rocky, the city wall was not included and it was left as a rock. The walls are demolished in general and the height of the existing walls is 1.30m. and 6.00m. The fenced wall railings of the city walls have not survived. Since the structure has a sloping terrain, there are remains of stair steps with stone steps. 7.00x14.00m in the southeast corner of the outer castle. There is a single nave chapel. The chapel system is completely destroyed and the northern wall is destroyed to half height and the chapel is entered through the door opening at the northern corner of the western wall. It is understood that the structure was originally closed with a barrel vault. The illumination of the interior is provided through a loophole in the southwest corner and the apse with a width of 0.90m is placed in the middle of the eastern wall. The crooked inner castle, placed in the middle of the rocky hill, measures approximately 40.00x70.00m. The inner fortress is entered through the door that was opened in the middle of the southern city wall and is now destroyed. While the south and west sides of the fortress are surrounded by a fortification wall, these parts are left as rocky as the east and north sides are steep rocky. The fortifications, which were demolished to a height of about half, were fortified with two semi-circular bushings in the south and west. Since the inner castle has a sloping and rocky terrain, stone stepped stairs were built in certain places. There are structures constructed in various plans and sizes in the northern direction of the inner castle. Only the rooms located in the western corner were partially intact and the others were destroyed. The structure on the western corner was built on a three-storey slope in the east-west direction using the topography of the land. Approximately half of the volumes on the ground floor have been destroyed and 5.90x10.00m. and 2.50x3.30m.2.50x3.30 m. It consists of two interconnected rooms.

The front room opens out with a door and a small window. The first floor consists of three parts. 6.90x25.00m with transverse rectangular plan. dimensions of the main space, supported by four buttresses in the middle of the 1.30x2.40m opened in the middle of the flat arched door is entered. This place was closed with a barrel vault in the east-west direction supported by a reinforcing belt and the western wall was demolished. The illumination of the inner volume was provided by a large window opening to the valley in the middle of the north wall of 4.80m thick and two small windows placed on the upper part of the south wall. 3.80x6.90m. Covered with flat vaulted door on the eastern wall of the large room and barrel vault. size room is entered. This volume is illuminated by a small window that opens above the south wall. Again, the large room has a volume of 2.00x4.50m with a semi-circular plan in the northwest direction and 1.30x1.50m. There is also a caveat of measures. These volumes were covered with barrel vaults and a small loophole was placed on the upper part of the walls. The semicircular planned space was built as a watchtower to watch the valley. The building is about 10.00x28.00m. II. and only a small part of the northern wall is present. There is also a window on the northern wall opening to the valley. It was originally thought to have been covered with a barrel vault and the windows on the north and west walls were used to keep the valley under control. The second floor of the building makes use of the slope of the land and exits the rocky area to the east. The three-storey building was built for shelter and storage purposes. The three-storey structure is approximately 8.00m east side, 4.20x9.80m from the inside. There are two rooms in size. It is understood that these volumes were closed with barrel vaults and there are two windows opening to the valley on the eastern wall of the eastern corner. The two rooms, probably built as warehouses and shelters, were accessed through doors opening on the south wall. The castle is simply built.

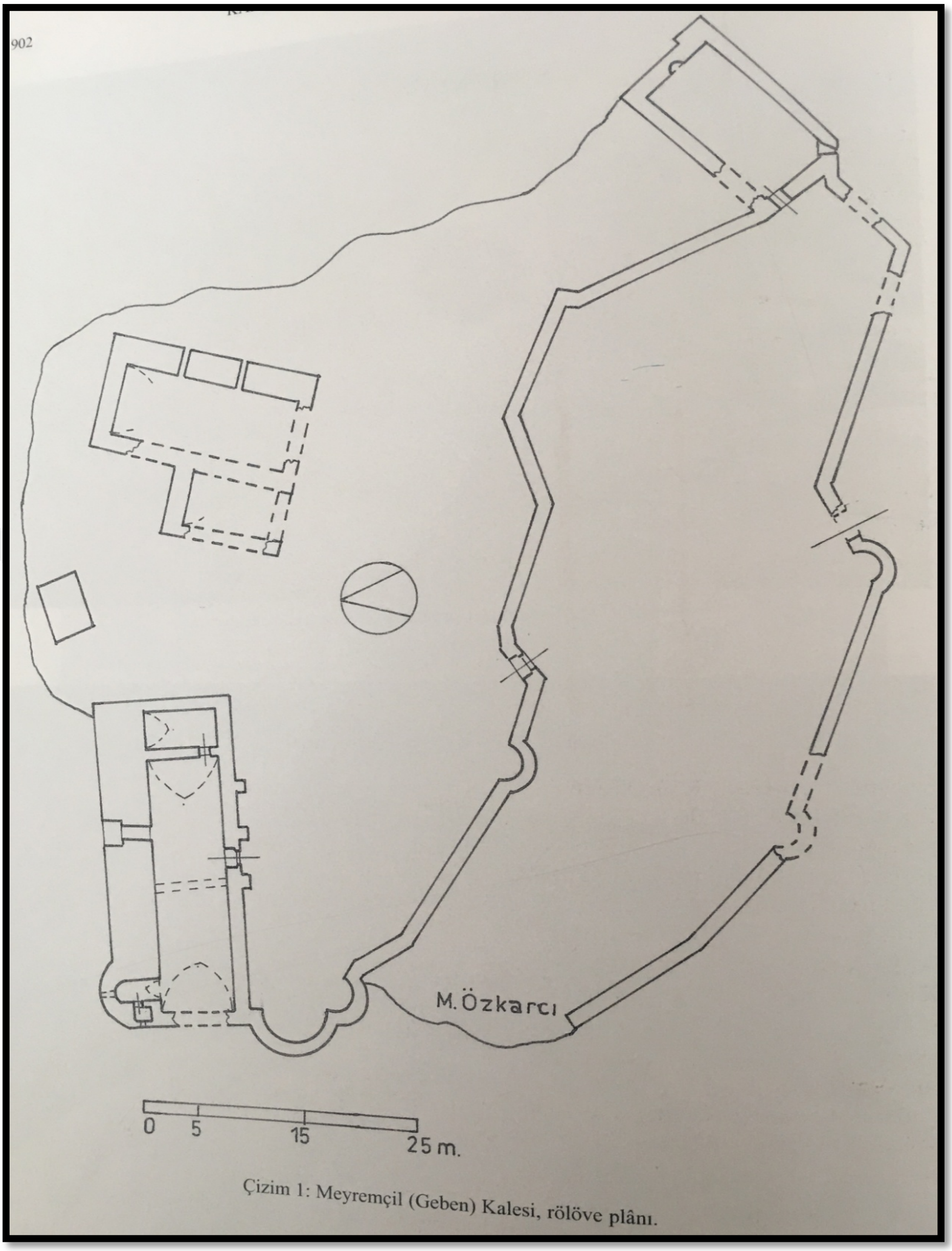


Figure 3.7: Geben (Meryemçil) Fortress, Building Survey Plan

3.4.2. Supply of First Sample

Samples related to the castle were obtained from the places shown in the following plan. The materials that were brought to the laboratory after the first supply of the samples were recorded as follows. The sampling locations are shown in the attached plan.

Figure 3.8: First Samples

In the first samples obtained as shown above it has brought to the laboratory and have been recorded. Then the assay was initiated in the appropriate size for treatment to be subjected to the tests.

Figure 3.9: Mortar Sample

Figure 3.10: Stone Sample

Figure 3.11: Stone Sample 2

Figure 3.12: Stone Sample 3

Figure 3.13: Mortar Sample

Figure 3.14: Mortar Sample

Figure 3.15: Mortar Sample

Figure 3.16: Mortar Sample

Figure 3.17: Sampled Places

3.4.3 Fronts

3.4.3.1. Southern Front Exterior Fortification Walls:

This façade, which is shaped according to the topography of the land, is located on a sloping land.

Figure 3.18: Southern Front General Appearance

1. Courtyard Inner Fortification Walls - GD1, GD2, GD3, GD4, GD5, GD6, GD7, GD8, GD9, GD10, GD11, GD12 Walls

Figure 3.19: 1. Courtyard Inner Fortification Walls -1

In the south direction, 94m long city walls are completely demolished from the base level and from the top and are shaped according to the topography of the land.

The GD1 wall is 8.43m long and the highest wall is 4.70m. The wall of GD1 has been demolished from the east and the upper part and the upper part is full of rubble. In addition to the internal rubble filling, a small portion of the wall covering stones remained. The connection wall between the GD1 and GD2, which is 18m long, has not survived. The GD2 wall can be traced at two levels of foundation. It continues unevenly to take the form of rocks. At the end point of the GD2 wall, the wall is connected to the GD4 wall in the form of an arc. The semicircular part forms the GD3 wall. The GD3 wall is largely demolished and can be traced at the foundation level. Today, a tree rises where the wall remains. The wall is flooded to the outside. The GD4 fortification wall, which is located between two circular outward floods, is 11.25m long and 4.77m high. The wall lattice system is made of chest wall technique and the outer side is covered with rustic stones while the inner filling is mortar and rubble.

Stones of the GD4 wall were poured from place to place. Moss and vegetation can be seen on the wall surface. At the end of the GD4 wall, the wall proceeds as an arc. The GD5 wall, which shows an uneven plan due to the rocky ground, is 6.75x3.27m. The wall height is 7.37m. Since the wall covering stones on the south-facing side of the GD5 wall were largely poured, the wall fill of this section was exposed. There is an aperture of 4.70m between the walls of GD5 and GD6. The GD6 wall lies in the northeast direction. This wall, which is 4.47m long, 1.20m wide and 8.10m high, has an opening of 0.66x0.95m which is 6.20m high from the base level. Since the end of GD6 wall GD7 wall is located. The city wall, which runs towards southeast, takes the form of rocks and continues for 6.60m. The GD7 wall with a height of 4.95m is located on the rock mass and is shaped according to this rocky area. Most of the walls have been demolished and in some places are followed at a basic level. Although the GD8 wall continues on a rocky ground with dimensions of 9.53x7.10m, the wall is highly damaged. Paving stones were cast and rubble wall filling was revealed. At the end of the GD8 wall, a semicircle that is not smooth enough to take the form of rocks forms the GD9 wall. Today, it is largely destroyed and can only be traced at the basic level. Today, a tree rises where the wall is located. The south facing direction of the GD9 wall measures 3.44x4.13m. As the pavement stones of the GD10 wall measuring

2.54x6.27m were poured to a great extent, the wall fill of this section was exposed. The GD11 wall is 7.87m long and 6.70m high. This wall, which is covered with trees and plants, is largely demolished and constructed with rough stone. The GD12 wall is shaped on a rocky ground and measures 4.85x2.20m. A significant part of the wall has been demolished and there is extensive vegetation on the surface of the wall. The GD12 wall joins with the rock mass in the east direction and the “A” structure can be reached after a continuation of 1.90m.

1. Courtyard Inner Fortification Walls - GD15, GD16, GD17, GD18, GD19, GD20, GD21, GD22, GD23, GD24, GD25, GD26, GD27, GD28-29-30):

Figure 3.20: 1. Courtyard Inner Fortification Walls -2

The city walls forming the second courtyard (inner castle) started from the GD15 fortification wall and continued uninterrupted by drawing the shape of the rocks and continued uninterruptedly by a 1.90 m long opening.

Starting in the eastern direction with the GD15 fortification wall, this section rests on the rock mass and is 2.55 m long and 1.73 m high.

The GD16 fortification wall, which is located in the following section, is shaped according to the topography of the rock mass and its height is 3.15 m and its length is 3.83 m. Rough stones were used on the wall. The surface of the wall covered with plants and moss has gradually collapsed from the upper part.

GD17 fortification wall is reached by breaking towards the interior. This section, 0.75m long and 2.30m high, rests on a rock mass on the ground. It is seen that the fortification wall was collapsed from the upper section.

The next section is the GD18 fortification wall. The height of the wall is 6.95m and the length is 7.04m. Cut stones were used on the wall. At the end of the GD18 wall, the fortification wall protrudes 1.80m south and this area forms the GD19 wall. Its height is 1.93m.

The GD20 fortification wall is integrated with the rock mass in the east direction and has been demolished from the upper part. On the surface of the wall, it is observed that the pavement stones move from place to place. Plants and mosses are seen on the wall surface. The wall measures 4.30x6.80 meters.

Then the GD21 fortification wall continues 6.10m straight according to the topography of the rock structure. The GD21 wall, which is 9.70m in height, is completely demolished and devastated from the upper section. Especially from the upper part, it is seen that the paving stones are poured intensely. Intense vegetation is seen on the wall surface.

The GD22 city wall, which continues on the rock mass, breaks 1.05m. The fortification wall is 4.45m high. Demolitions are seen at the basement level and at the top. It is seen that the stones were poured from place to place on the wall surface and the wall surface was covered with trees and shrubs.

The wall structure continues straight after breaking. The GD23 fortification wall is 5.30m high and 5.05m long. Outwardly flooded, in accordance with the rock structure of 9.73m height and 12.30m length of the wall joins the GD24. Moss and vegetation can be seen on the wall surface which is in good condition.

The GD25 wall is 4.98m high and 2.18m long. A small part of the wall, which was gradually demolished in the west direction, has survived. Coarse stone and rustic forum stones were used together as cladding.

Between the walls of GD25-GD27 there is a wide opening of 1.90m. (GD26-GI3) The opening between the GI3 wall remains GD25, which is 8m towards the interior, forms the GD26 wall. This opening is completely destroyed. The aperture, which is 1.04m wide, consists of a jamb in the east and west directions.

The GD27 fortification wall, which is located in the continuation of the opening, has a length of 7.98m, a width of 1.95m and a height of 6.80m. The city wall was completely demolished from the upper part and it was demolished gradually from the east. The material of the fortification wall which joins with the rock mass at the basic level in the west direction is the lime mortar cut stone seen throughout the structure. On the surface of the wall, vegetation and moss are noticeable.

The GD27 Wall runs symmetrically towards the south. The GD28 wall, which is located next, is 2.57m. width and 3.27 m high, the cladding stones of the wall were poured from place to place and the city wall was completely demolished from the upper part. Coarse stone and rustic forum stones were used together as cladding. The inner filling is in the form of mortar and rubble filling. Small coarse stones were used on the inner side of the wall.

Further, the GD29 wall, which runs in the northwest direction, continues slightly above the foundation level towards the rocks and the destruction in these parts is significant. The length of the walls is 11.00m and the highest part is 7.50m. The wall was built with large coarse stones and rustic stones. On the surface of the wall, vegetation and moss can be seen.

The GD30 wall, which is 10.40m in length, continues on a rocky ground at an altitude of 2.90m. This section has been severely damaged.

South Front, 1. Courtyard Inner Fortification Walls GI1-GI2):


Figure 3.21: 1. Courtyard Inner Fortification Walls

1. The courtyard entrance is in this direction and has a width of 1.04m. The GI1 wall to the west of the opening is 4.30x3.60m. in the form of a pile of rubble. The GI2 wall, which is in the eastern direction of the opening, is more robust and is inclined according to the topography of the rocky area. 5.40m in length and 5.80m in height. There is a clearance of 0.66x0.95m close to the square at the height of 6.37m from the base level. The interior, which is covered with bushes and trees, also covers the city

walls. The joints in the wall surface discharges in places, plants, moss and trees are seen.

South Front, 2. Courtyard Inner Fortification Walls (GI3)

Figure 3.22: 2. Courtyard Inner Fortification Walls

The city walls forming the second courtyard started from the east direction and continued uninterrupted by drawing zigzags taking the shape of the rocks and were divided near the center. This part of the entrance to the second courtyard has been severely damaged. There are jamb remains on the wall. The material is in the form of large coarse stone and the inner filling is mortar and rubble filling. The interior, which is covered with bushes and trees, prevents the perception of the ground. The bushes and trees in the interior are covered with walls. Joint discharges, plants, moss, herbaceous and woody plants can be seen on the wall surfaces. Its length is 8.00m and its height is 6.70 meters.

3.4.3.2. North Front Exterior Fortification Walls

Figure 3.23: North Front General Appearance

2. Courtyard Exterior Fortification Walls - KD1, C-KD2, C-KD3, C-KD4, KD5, KD6, KD7, KD8, KD9 Exterior Fortification Walls:

Figure 3.24: 2. Courtyard Exterior Fortification walls

As seen throughout the fortress, the gaps between the rocky areas were also closed here. The walls of the walls, which are observed to continue on the rock structure, are shaped according to the topography of the rocky area. Today, most of the city wall is collapsed. The remains of the walls are compatible with the general architecture of the castle. The KD1 wall is 6.00 m long and has survived to the present day as a pile of debris.

The section C-KD2, which is located in the continuation of the wall of KD1, was built with rustic stone masonry and has a circular plan of approximately 3.50m in diameter and 13.36m in height. From the base level up to 7.50m outer cladding stones are strong and after this height 5.85m outer cladding stones poured rubble stone fillings can be seen. At the same time the level of 9.65 0.30x0.65m on the wall. It is located in a rectangle measuring aperture.

In the continuation of the circular section, the C-KD3 building wall is 15.12m high and 13.72m width, the wall structure is completely demolished in the upper part, and cracks and paving stones are seen on the wall surface. To the east of the wall is an aperture of 1.12m in width and 1.70m in height. This opening continues 2.35m towards the interior. Above this opening there is a 2.45 m wall and above it there is an opening whose form and dimensions cannot be determined.

The paving stones of this dilapidated part are completely poured and we see that the rubble stone filling is exposed.

The C-KD5 continues on the rock wall of the building wall. The wall is 13.62m wide and 10.20m high. This section, partially collapsed from the upper section, has a clearance of 0.26x0.78m at the foundation level to the east. The surface of the wall where the covering stones are poured in places and cracks are seen is compatible with the other parts.

KD6 wall, this wall remains 15.78, which is integrated into the rock mass in width and height of 8.15 was used as a mass of rock walls in some places. A large part of the pavement stones of this dilapidated section are poured and we see that the rubble stone filling is exposed.

The wall of KD7 was built by using natural rocks on the rocky hill which is 8.79m wide and 6.97m high in the rocky area and the east wall gradually collapsed. We see that the rubble stone fill was exposed. The material used is rustic and smooth cut stone.

Then, a large rock mass emerges as the continuation of the rock mass wall and the lower level of the rock mass, KD8, the wall is on the rocky area at the base level is 9.42m in width and 2.70m in height.

Between the walls of KD8 and KD9 6.70m. The opening is located. The wall structure, which is 6.84 m high and 1.57 m wide, is the northern façade of the D structure. We see that the completely filled rubble stone fill of the paving stones is exposed.

3.4.3.3. Eastern Front Exterior Fortification Walls

Figure 3.25: Eastern Front General Appearance

2. Courtyard Exterior Fortification Walls - DD1, DD2, DD3, DD4, DD5, DD6 Fortification Walls

Figure 3.26: 2. Courtyard Exterior Fortification walls

DD1, which is positioned according to the shape of the rock mass, is 9.86m wide and 5.10m long. In the northern part of the wall, it was built with cut stone and continued with 0.75m protrusion from the part built with rough direction (south). In the northern part, the root can not be seen clearly due to planting.

It is the remains of the DD2 fortification wall on the rocky ground. The fortification wall, which has survived to the present day in ruins, has completely collapsed from the base level and in some places it is seen at the base level. The fortification wall is integrated with the rock mass in the southeast direction. We see that the rubble stone fill of the wall was completely exposed.

Between the DD2 and DD3 walls is an area of 11.60m cliffs. At the end of the rocky area, the DD3 fortification wall continues at a base level of 10.13m. The DD4 wall, which is located on the rocky area, is one of the walls forming the northeastern front of the building A. It is 6.90m long and 5.44m wide. We see that the rubble stone fill of the wall whose upper part was demolished was exposed. The wall was completely collapsed from the upper part and gradually built from the north.

The DD5 city wall takes the shape of the rocky area outward and protrudes 1.84m. The material is compatible with the overall structure. The DD6 wall is 3.17m wide and 7.88m high. This section, which has been completely destroyed from the upper section, is one of the northeast walls of Structure A. The wall was built with large stones. There are vegetation and microbiological formation on the wall surface.

3.4.3.4. Western Front Exterior Fortification Walls

Figure 3.27: Western Front General Appearance

2. Courtyard Exterior Fortification Walls - BD1, BD2, BD3, BD4 Walls:

Figure 3.28: 2. Courtyard Exterior Fortification walls

This section, which starts with the BD1 wall, is located on the rock mass in the northwest direction following the GD1 wall. Since the outer covering stones of the connecting walls of the fortification wall were poured, rubble stone interior filling was exposed. The wall BD1 is independently located in the northwest.

There is a 9.60m distance between the BD1 and BD2 wall. The BD2 wall is built on a rocky surface that protrudes from this part of the castle. This section, which has a height of 3.72m and 4.20m in width, has been exposed to rubble stone filling since the outer cladding stones have been poured.

At the point where the wall BD2 ends, the wall is connected to the wall BD4 in the form of an arc. This arc-shaped outgrowth portion forms the wall BD3. Since the outer cladding stones of the connection walls of this section, which has a radius of 5.28m, have been poured, the rubble stone filling has been exposed. As it is understood from the remains of the connecting stones and the cladding stones of the BD3 wall, mainly rustic stones were used in these parts. The interior of the wall is full of rubble.

The BD3 wall is located next to the BD4 wall. This section, which has a height of 8.25m with a width of 6.15m, is seen to have completely collapsed and filled with debris. Rustic stones were used mainly on the wall surface. On the surface of the wall, plants and microbiological formations are observed.

3.4.3.5 Structures

Structure A (A-GD13-A-GD14-A-DD7)

Figure 3.29: Structure A General Appearance

Structure A is located in the southeast corner of the 1st courtyard. It is a rectangular structure measuring 5.94m.x12.96m in east-west direction.

North Front**;** This facade is completely demolished from the upper part, several rows can be perceived from inside the structure and the body walls are standing. The rubble inner wall of the building, which was built with coarse stones, can be seen.

Figure 3.30: Structure A Northern Front

Northeast Front (DD3, A-DD4, A-DD5 Walls); It is shaped according to the topography of the rocky area. Paving blocks which completely destroyed contained in the upper portion of the body wall it is observed that the walls in places decanted.

Figure 3.31: Structure A Northeast Front

Southern Front (A-DD7, A-GD13 Walls); which has been shaped by rocky areas, A-DD7 wall at a height of 12.00 and 14.42. The A-GD13 wall is 9.46m high from the base level. 3.97 the height of the base level and the upper portion of arched openings 0.89x1.44m sizes are available. It is seen that the paving stones are poured and dislocated from the upper and lower part of the opening. Intense vegetation is present on the wall surface.

Figure 3.32: Structure A Southern Front

Southern Front (A-DD7); Rising above the rocky area, this façade is 12.00m high and 14.42m wide. The upper section is completely ruined condition is stable situation than the other wall.

Figure 3.33: Structure A Southeast Front

Southwest Front (A-GD14 Wall); The curved wall measures 7.18x5.06 m and is demolished from the upper section. The knitting system is the same as the overall structure.

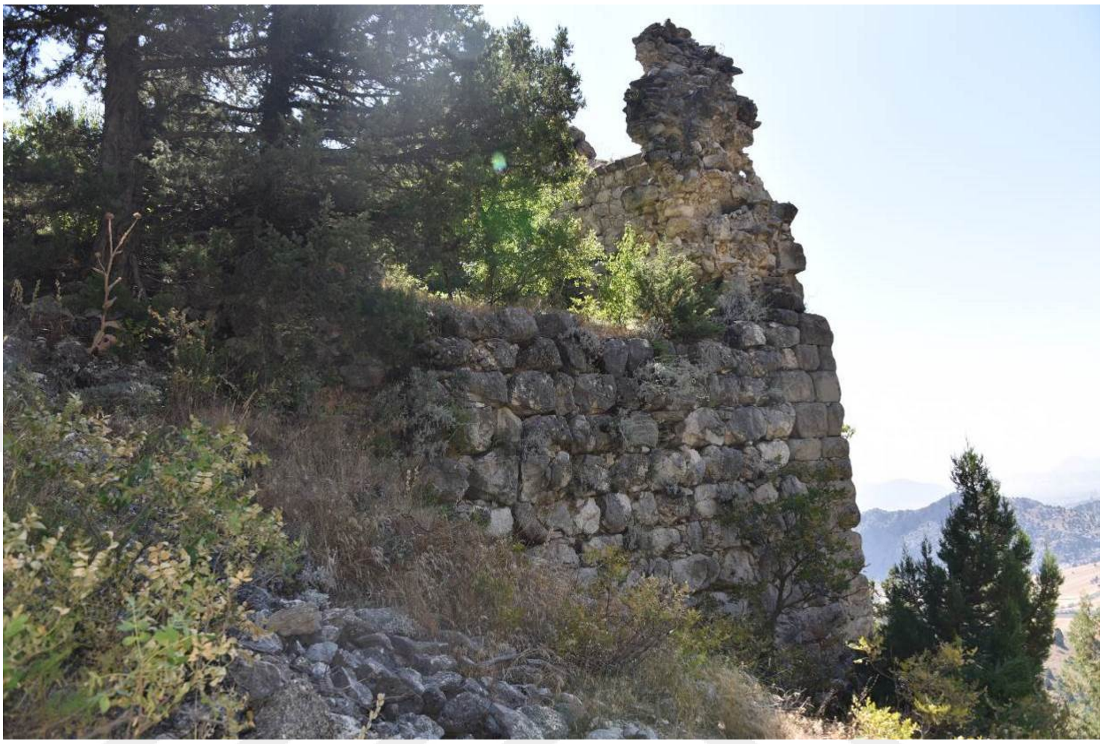


Figure 3.34: Structure A Southwest Front

Space Z01;

The top cover is completely destroyed and it is still partly standing today. The south side of the building is located in the south corner. The slightly tapered vault and its northeast and northwest corners were destroyed. There are remains of walls on the vault. The only opening in the southwest corner is 1.30mx1.98mx0.91m and is limited to moldings; There are a couple of cavities seen on the ground. Except for the perimeter of the opening in the south direction and the supporting wall, structure A was constructed entirely with large stones. The southern opening and the supporting wall were built with narrow and long cut stones on the inside and rustic stones on the outside. This opening has a flattened belt. The arch is exactly the same as the door stones on the southern walls. The function of the large niche measuring 0.85m.x0.67m, which is 1.79 meters high from the ground on the eastern wall, is unknown. Since the floor of the place is covered with trees and shrubs, information about the flooring cannot be given. On the wall surface, vegetation and microbiological formations (algae, heterotroph bacteria, fungi, green mosses, lichens, land mosses, high plants, animals, insects, damages caused by birds) are seen.

Figure 3.35: Structure A Space-1 Z01

Figure 3.36: Structure A Space-2 Z01

Structure B (C-KD2)

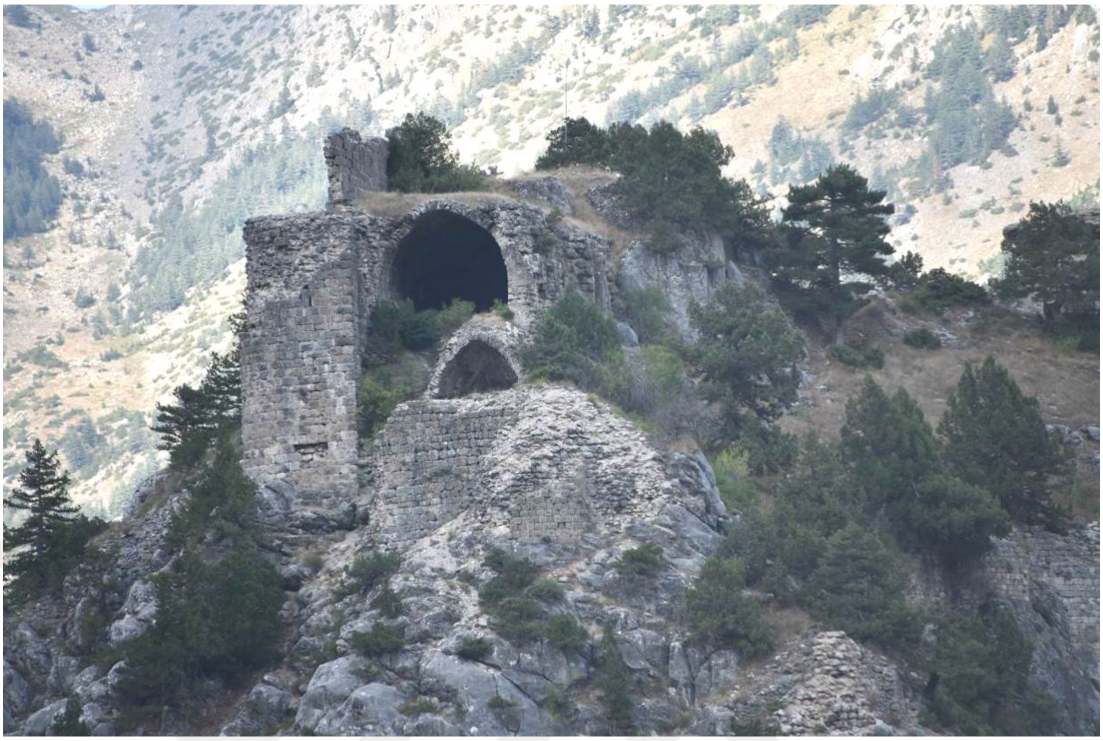


Figure 3.37: Building B General Appearance

Space Z02;

The 101 room, which measures 5.93x7.06m in the west direction of the castle structure, is 4.70m in height. The east and west walls of the room 101, which is covered with pointed arches, are completely demolished. There is a slightly flattened round arched aperture at 1.35x0.73m, opened at the southern end of the east wall, and an aperture at 0.50x0.70m in the west (Photo: 158, 159, 160). 101 on the north wall of 1.19m. height of 0.96m. This opening leads to room 201. (Photo: 156) In the southwest corner of the building is 0.20x0.30m. measures a niche. The flooring of the space has not survived, the interior is filled with falling stones, plants and soil. The cladding stones of the structure were completely poured in the covering system and in places on the walls. The rubble stone in the interior is exposed especially in the covering system of the application structure.

Figure 3.38: Structure B Space Z02

Structure C:

Figure 3.39: Structure C General Appearance

Southern Front;

The south façade wall is 33.00 m long and 14.30 m high. It was planned according to the topography of the rocky ground. This facade has survived to a very well preserved condition. The wall was mostly damaged in the west direction and the internal rubble filling of the wall was observed. In the east, it is integrated with the rock mass. There is a round arched door on the south wall. The door measures 1.47mx2.60mx1.39m and the jambs and arches are covered with smooth cut stones. There are also two rectangular windows in the east and west directions. The windows have dimensions of 0.20m.x0.40m. 4 struts with 0.75m protrusion from the thickness of the southern façade wall were added.

The southern wall of structure C has completely collapsed from the upper section and the remains of the wall, which is gradually overflowing from the wall, can be seen in the north direction of the upper section. It is seen that the paving stones of the southern façade wall have been poured from place to place, and vegetation and microbiological formations can be seen on the wall surface of the structure.

Figure 3.40: Structure C South Front

Western Front;

This façade, which is shaped according to the topography of the rocky area, has a height of 15.40m and a width of 15.00m. There is an opening of 0.19x0.93m in height of 6.73m above the base level of the wall where the BD5 wall and the circular sign of this façade facing room 201 are located. The walls of this facade have been demolished from the upper part, the cladding stones of the walls have been cast and the rubble stone material is seen inside. On the surface of the wall, the stones move to the lower level. Vegetation and microbiological formations are observed. It enters 5.00m inwards from the end of the wall in the western direction and joins with the western walls of the ıs C ”structure. The “C” space in the west has a width of 6.75m and a length of 5.95m. (The wall is completely destroyed in this direction)

Figure 3.41: Structure C Western Front

North Front;

This facade, which runs northward by drawing an arc from the wall of KD1, ends with the wall wall of KD5. The wall length in this direction is approximately 48.00m and its height varies between 5.00 and 15.00m. C-KD2, northeast of the structure 7.50m. width, 3.50m radius. There is a clearance of 0.30x0.65m at a height of 9.64m from the base level. In the eastern part of the C-KD3 wall, there is an aperture of 1.10x1.70m at a height of 2.10m above the foundation level and a second aperture at the top of this aperture 2.50m. The northern façade wall has completely collapsed from the upper part and the cladding stones of the wall have been poured from the upper part. Subsequently, the C-KD4 protrudes towards the 1.81m exterior and continues. The front wall of C-KD5, whose upper part is completely demolished, has a width of 13.84m and a height of 11.35m with an opening of 0.27x0.79m in the foundation level. The wall structure is 5.00 m high and merges with the rock mass. Damages caused by vegetation and microbiological formations can be seen on the entire wall surface where the covering stones are poured.

Figure 3.42: Structure C North Front

Space No. 201;

The interior of room 201, measuring 6.94mx20.87m with a rectangular plan, was built in accordance with the topography. At the eastern end of the room, monolithic protrusions were included in the thickness of the wall. Only a small amount of surface areas of exposed rocks are left in their natural form. The other parts were shaved. This room is covered with a pointed vault. Since the interior is quite long, the vault cover was supported by a round arch at a point close to the middle. The support belt resting on the consoles is 6.52m wide and built with smooth cut stone. The entire vault is plastered. At the expansion level of the vault, square slots are still selectable. They probably support the transverse beams in the center; The only opening in the north wall of room 101 is a wide round arched door. The floor of the door is approximately 1.00 m. It is high. Door on the south wall Another opening near the square measuring 0.40X0.60m at an altitude of 2.50m from the foundation level is observed in the western direction. East direction; 2.50 m in height 0.40 m in width and 0.50 m in length are seen in another opening. At the eastern end of the room 101 there is a round arched door leading to room 202. The door measuring 0.99mx2.05mx0.98m was constructed with smooth cut stone material. The building was built with large coarse type masonry. The vault at the western end of the space and the western wall were destroyed. There is an aperture of 0.90x0.64m facing the "B" section of this section seen at the foundation level. The eastern part of these rooms ends on solid rocks. Under the ground, there are remains of a building which is thought to belong to another building.

Figure 3.43: Structure C Space No. 201

Space No. 201, Watchtower:

It was built on a rocky ground that protrudes out in this part of the fortress in the north-west direction. Rubble stone inner filling is exposed as the outer covering stones of the connection walls of the room have been poured. As it is understood from the remaining walls of the connecting walls and the cladding stones of the space, mainly rustic stones were used in these parts. Since the interior of the tower and walls are under the rubble piles, it does not seem possible to get an idea. The semicircular planned space is 6.52m tall and 1.99m wide and 3.97m deep. There is a window opening of 0.45X0.87m in the middle of the northern wall at a height of 3.00m from the foundation level. The cover system of the space is partially demolished. On the western front wall, there is a door opening of the room that cannot be entered. The walls on the southern façade of the room have been demolished and the floor covering is partially demolished and the interior is covered with soil and plants.

Figure 3.44: Structure C Space No. 201 Watchtower

Space No. 202;

At the eastern end of the rectangular room 201, there is a round arched door that provides access to room 202. The door measuring 0.99mx2.05mx0.98m was constructed with smooth cut stone material. In addition, the only opening of room 202 is a small rectangular window measuring 0.36mx0.85mx1.44m on the south wall. The northwest corner of this small pointed vaulted room is full of natural rock fragments.

Figure 3.45: Structure C Space No. 202

Space No. 301 (2. FLOOR);

Only the northern wall of this space, which corresponds to the upper part of room 201, has survived. The north wall, which is 26.00m wide and 4.78m tall, is in ruins. The floor of the place is covered with plants and trees and we do not know about the flooring.

Figure 3.46: Structure C Space No. 301

Space No. 302, North Bastion;

In the circular form that corresponds to the east of the upper part of Room 202, the walls of this room were demolished and a vaulted structure remains on the floor. This section is completely demolished and the northern wall is more standing than the other walls. The stones forming the structure are scattered in the space. The floor of the place is covered with bushes, trees and stones falling from the walls.

Figure 3.47: Structure C Space No. 302

Structure D:

Figure 3.48: Structure D Overview

The ground level of the building is 4.53X8.40m in the western part of the building D, which has a basic level but it is full of woody plants, trees and stones and rubble piles. The building is in ruins.

Western Front;

The eastern wall of the interior is standing and the western wall of this section is completely destroyed. The vault cover system of the place is partially standing and the stones falling from the structure are filled with the interior. On the inner eastern wall there is a 0.44X1.17m aperture close to the rectangle (door opening) and another square close to the square (window aperture) measuring 0.83X0.98m at a height of 3.82m above the base level. The floor of the building was filled with rubble.

Figure 3.49: Structure D Western Front

East Front;

Situated on the rock mass and the walls of varying wall height of 7.54 at between a portion oluşturmaktadır.1.40x4.50m the rock found that wall formed by rocky areas, 1.20 is the thickness of an arched niche in 0.30m.x0.52m measure the south end of the east wall There. The western wall of room 204 is visible from this façade and the rectangular window measuring 0.43X1.15m at the southern end of the wall has been severely damaged. Smooth cut stone work is seen as a knitting system. An important part of the facade wall is demolished.

Figure 3.50: Structure D Eastern Front

South Front;

It is completely demolished and remains of 1.71x7.96m wall. It consists of a rocky, bushy and wooded area.

Figure 3.51: Structure D South Front

North Front;

Located on the front of the rock mass is 17.50 in length, in the eastern part of the wall remains the basic measure seviyede3.00x5.71m space 3.46X7.00 204 m in the western part of the northern wall ruins are seen in the dimensions.

Figure 3.52: Structure D North Front

Space No. 203;

The eastern wall of the room is substantially standing, and the wall in the south direction of the eastern façade has been severely destroyed and measures 15.67X6.20m. In the upper part of the facade, the vault cover has been destroyed. The internal rubble of the wall is seen. 204 on the east façade opening to space 1.17m height0.44m. width and 1.17m. There is an opening in depth. It is observed that the paving stones were poured in the area just south of this opening. On the eastern wall, two square beam holes measuring 0.30X0.30m still exist today. At the southern end of the eastern wall there is another rectangular aperture measuring 0.83X0.98m at a height of 3.82m from the foundation level. Stones and debris from the façade wall have covered the interior. The ground consists of trees and stones.

Figure 3.53: Structure D Space No. 203

Space No. 204:

Room 204 is not in proper form. The material is rustic and smooth cut stone. The west wall of this room is the wall of room 203. The interconnected spaces 203 and 204 are interconnected by a round arched opening. The east wall and cover system of room 204 has been demolished and consists of the remains of the city wall. The interior is full of rubble.

Figure 3.54: Structure D Space No. 204

3.5. Construction System

Today, the castle covers almost the entire rocky hill. The existing topography of the castle of Geben has an extraordinary structure. In the south and near the rocky hill there are probably large fields of wheat and millet. In the north, east and west, there are natural pinkish-gray limestone cliffs that form almost steep walls. In this state, the castle descends from the north to the plain and the only passage is the Strait (Meryemçil), while it controls the whole valley and plain in front of it.

In the whole castle, the system is formed by using smooth cut stone, rustic stone, big rough stone, small rough stone stone rubble and lime mortar as binding material. Although the data on the cover system of the castle structures are not completely available, it is seen that the vaults, which are round and pointed, are used in the structures that survive in whole or in part. No brick material was seen in the castle structures. Probably the wooden material has not survived. There is no marble or derivative material. The main element is stone material. In the interior, rubble filling, soil, rocky and weeds are found in a ground. No data was found on how the flooring was originally. Stucco traces can be seen on the inner sides of the vault covers of the spaces within the castle structure and described in detail above. Other than these, no coating or decoration elements are seen in the buildings.

3.6. Analyzing Problems

The carrier system of the registered building, material problems, color change and accumulation and analysis of biological formations were prepared as a result of two-stage studies carried out on site and in the office.

During the field works; the information obtained was examined by analytical drawings and scans.

In this process, the problematic areas of the structure were photographed in detail.

The problems identified as a result of the field work were transferred to the office on the survey drawings in the computer environment using the ping Mapping Method '(mapping).

In the mapping method, each problem and structural damage is indicated by scanning in a different color and these scans are defined with a legend on the letterhead in detail.

Thus, it was aimed to identify similar and different problems in various parts of the structure.

According to the legends prepared the problems of the historical structure; structural problems for the structural system, material degradation, color change and accumulation and biological formation are coded under the headings.

3.6.1. Problems with Structural System

In the historical fortress structure, during the investigation, mass collapses due to the derelict condition of the structure and the lack of repair were observed due to the collapses and the material losses in the inner and outer walls. There are visible structural cracks in the building walls and a serious structural problem has been identified due to material losses in the door openings.

3.6.2. Material Problems

Losses of internal debris and outer wall material, surface erosions and joint discharges were detected in the stone walls of the building, and some deterioration such as local porosity was detected.

3.6.3. Color Change and Accumulations

Due to the exposure of the structure to atmospheric conditions, color changes caused by moisture and accumulation of soot, dirt and dust are also observed.

3.6.4. Biological Formation

It is thought that the plant seeds carried by the wind, rain, animals and people on the building walls developed in the soil filling in the fortification wall at various times and continued to grow out of the surface. In addition, microbiological formations are observed on the facades exposed to atmospheric external conditions and the absence of the top cover of the structure.

3.6.5. Indifference and Vandalism

Since the building has been abandoned for a long time and the necessary maintenance and repair work has not been carried out, it has entered a process of collapse.

CHAPTER 4

STRUCTURAL PROBLEMS

Definitions of structural problems and their distribution on the structure are given in this section. It can be said that the problems are in fact parallel to each other and correspond to only one major representation. All of the walls of the building have lost their external debris, which has a high proportion of the outer wall starting from the upper elevations, and then has been lost to the internal rubble. In some of the walls, degradation was observed in the upper elevations and losses were observed in the outer walls near the base parts. In addition, some of the aperture transition elements resulted in loss of the original carrier form of the carrier. The top cover (flat vaults) of most of the indoor spaces have been demolished or in the process of being demolished. On the other hand, the ruined walls of the demolished space remained in a geometry open to overturning due to the loss of space integrity. Finally, it can be said that the adherence connecting the internal and external walls holding the internal debris together is lost in most regions by internal debris decay and the walls now move on their own.

A) Losses in the upper and sometimes lower elevations of the outer wall stones of the caboon in the castle walls

B) Mortar degradation, crumbling, sloping and continuous loss is observed in the internal rubble. The losses progress in the whole structure as slope melting from the upper parts to the lower parts whose outer walls disappear.

C) Due to the loss of the top cover of the spatial structures, the side walls have turned into a geometry open to overturning. At the same time, the walls of these spaces became vulnerable to overturning or naveling out of the places where the top cover was standing.

D) Therefore; Demolition and geometry degradation due to material degradation can be seen in building elements such as arches and vaults.

E) Similar to the places; high wall fragments (formation) of finished walls as a result of demolitions due to their attachment to the edge sections and other upright walls to include the risk of out-of-plane collapse; under some facade walls there are carvings and demolitions to form up the console above.

These deformations take place in some regions simultaneously; they are observed as a pattern that triggers each other and follows a pattern that has caused the latest serious local losses. In some areas, the river is present singly, without the possibility of step-by-step collapse. They are seen as occurrences that are likely to progress to more severe degradation.

Before describing the problem areas, it is necessary to list the damage factors the structure has been exposed to over the years. Significant factor from building damage; under the influence of climatic changes (wetting-drying cycles, freezing-thawing cycles) is that it has stayed for centuries. In this case, especially the climatic influences going up to the more hollow interior filling which will show weaker resistance to such effects have increased the material degradation of the structure. As a matter of fact, the material degradation (decrease in original strength) on the basis of the structural degradation seen on all four sides of the structure is the loss of resistance against external loading conditions and secondary loads formed as a result of its own dead weight and the occurrence of deformation occurrences.

Climatic effects are “wetting and drying cycles. Vegetation and salinization effects due to humidification occurred in the building joints and as a result, the losses in the material size were the most prominent causes of deformation. It is assumed that these material deformations form local small cracks in the outer walls which do not have a homogeneous strength. The cracking progression firstly destroyed the integral movement and inertia in the outer walls of the building, and these individual wall problems directly abolished the integral integration of the building walls. When the outer walls were destroyed, the internal debris, which was exposed to climatic effects, crumbled and entered a rapid destruction process. This weakened its resistance against lateral effects such as earthquake. This has turned the counter-resistance into a single wall level - an individual activity. However, while the relatively out-of-plane splint in the relatively thick walled parts still corresponds to the more abundant destruction of the rubble fill from the top to the bottom, variable collapses can be seen where the thickness of the walls is small. (Part of the wall can be demolished to the base level, while in some parts there are only melts in the upper parts.)

Although secondary destructive effects are not thought to be as effective as first-class effects, they are thought to play a role in local destruction. These effects are wind and light seismic effects that will trigger off-plane movements and vibrations of the walls of the structure. However, it is believed that these effects do not cause damage to the original compact form of the structure (when the structure is not subject to severe material degradation). It is thought that after the loss of strength as a result of building material deterioration, it is gradually damaged by these effects. However, it should be noted that the fact that the internal debris filling is the result of extinction in the walls and is now vulnerable to seismic and wind effects, corresponds to the still slight melting and filling disappearances that are still continuing. As a matter of fact, the slopes formed in the inner filling of the structure also occur under these influences.

It seems logical that the building is on the slope where the wind effects may have damaged the building. The castle is built on one of the high hills in the region. It is therefore relatively high. It can be said that the wind speed acting on the tower facades is much higher than the existing wind speed at the bottom of the hill. However, for the structure whose thickness is sufficient to withstand the height of the wall, which is approximately 4-5 m, the seismic effects are more likely to have produced more strong-pronounced degradation symptoms. The above mentioned structural inertia of the seismic movements is very likely to have had devastating effects on the local parts with the loss of integration resulting from cracks, internal filling and loss of strength in the joint material. As a matter of fact, it is clear that in mass structures, especially in defensive structures where wall thicknesses are relatively high, they have more seismic effects due to their high building masses (in these buildings, the full volume / space ratio is less than in other monumental buildings). Such side effects may cause vertical deformation or loss of unloaded, suspended, suspended components, especially when the material deteriorates.

In addition, the settlement of the structure on the rocky ground indicates that it is not subject to ground-related deformations or damage. As a matter of fact, this result can be supported and grounded from the damages existing in the structure. Detailed description of the degradation zones given below makes this description more clearly understood.

4.1. A Structure

Figure 4.1: A Structure Drone Appearance

Structure A It is the standing place at the southern end of the castle (at the eastern corner). The southern wall is the most surviving element of the structure, which has lost its vault and lost its indoor character. There are also wall fragments in the east and west parts to support this wall. However, due to the collapse of the inner wall and vault body of this southern wall, the internal debris was exposed and the outer wall joints were exposed to serious losses, so the wall was not able to withstand off-plane movement against seismic loads. In the following sections, it can be questioned by analytical modeling how this wall performs out of plane with wide aperture. Supporting the partial integrity of the structure with the completions in the vertical walls will limit this behavior. At the same time, the completion of the joints will increase the cross-sectional area of the wall behavior. Thus, wall stresses can show a more healthy distribution.

4.2. B Structure

Figure 4.2: B Structure West Respect Appearance

Structure B is a flat vaulted structure over a relatively more debris cover in the area. The thickness of the intrados mortar joints of the structure, which is made of vaulted braided stones, varies between 3-10 cm. Therefore, it can be said that the push line of the structure has changed with the loss of the materials which are exposed to external effects for years for the intrados joints located above the original push line. It can be said that the thrust line is transformed into the form where it is along the remaining contact surfaces, not along the side surfaces of all belt stones. As the contact surface becomes narrower, the risk of deterioration of the structure will be greater day by day. On the other hand, the fact that the structure has already been exposed to severe collapses and that the external rubble and coating lines have been lost is an indication that the rubble residue in the extradate melts day by day. Even the completion of the joints by the intervention of the structure will leave the contribution of the stabile superficially even if the structure is not completely lifted up. Therefore, it is also possible to provide a more secure static consolidation of the structure by temporarily installing an under-arched scaffold so that the spread contact to the under-arch can be stabilized without changing the load transfer terminology.

4.3. C Structure

Figure 4.3: Structure of C; a) Southern Front rundown buttresses and semi-rundown 3. Strut view b) Main flat vault space. c) Vault Exterior North Facade Wall Losses

Structure C It is the structure covering the largest indoor space within the castle. The building consists of 2 spaces covered by the same flat vault, and the spaces divide a wall perpendicular to the vault plan. The vaulting of the structure was laid with 5-10 cm mortar glazes and the caboon was built by longitudinal stones placed perpendicular to the vault intrados line. The same weave (unlike the castle-vertical wall) can be seen in Structure B vault. There is no structural damage observed in the interior of the vault structure except the entrance wall of structure B side. Although 2 of the 4 buttresses on the south side of the building were demolished, no deformation (cracks on the structure) was detected in the interior. However, the out-of-plane stability of the outer wall up to a height of 6-7 is more effective when supported by these outriggers. In addition, the collapse of the outer walls on both the southern and northern walls accelerates the degradation process of the internal debris. It is more severely exposed to external deformative factors.

4.4. D Structure

Figure 4.4: D Structure Facade appearances

Structure D It consists of the southern wall of a large room and the remaining part of the vault quarter. Therefore, there are consoles in both vertical and parallel corners of the structure. The inner and outer walls of the structure, starting from the edges, remain exposed to the external influences, especially in the form of vaults. The trace of the deformation of the structure starting from the upper elevations towards the lower elevations is clearly seen. Neither the outer walls nor the internal debris were detected at the lower elevations and at the basement level. However, today the structure is a geometry that includes a large percentage of its mass at its upper elevations. Therefore, earthquake loads will cause serious damages in the later stages of the structure. It is essential that the structure is stabilized, complemented and, if necessary, supported by a removable scaffold system.

4.5. Fortifications

In general, the losses of the inner walls starting from the upper elevations of the building walls were degraded by the emergence of internal debris and the effect of external factors. In these demolitions, the effective state is considered as material degradation (in internal debris and masonry mortars), but no serious degradation except for surface breakage of building stones is detected. On the other hand, other factors that trigger the collapse of the walls are the out-of-plane movements, where the wall thickness decreases and is the cause of the movement of the walls perpendicular to each other at the corner points. Therefore, the tendency of the walls to be bent out-of-plane as a result of material degradation in the inner and outer layers following the collapses results in local collapses. Consolidation of the structures in their original forms may prevent the tendency to move out of plane.

4.6. Studies on Horasan Mortar

4.6.1. Visual Analysis

In the analysis of Khorasan mortar, it is seen that while lime is used intensively, brick powder materials are used as sockets and strength enhancers.

In the analysis on the experimental samples, we can mention the silt material which we think is found in a small amount of river sand. But this material was ignored because it was in trace amounts.

Therefore, according to the results obtained from the test samples, the well-granulated river aggregate in horasan mortar was used with its properties (unwashed and sieved) while it was supported with well-classified brick powder into slaked lime.

4.6.2. Physical Analysis

In this study, it is an important study in terms of the life of the structure and the adaptation of the old and the new. The horasan mortar obtained for this study should start with the separation of all possible grains without deforming in the ceramic mortar. The point to be considered here is not to make the impact that will cause deformation of the mortar. In this way, the granulated mortar can be passed through sieves of various sizes to separate the material inside the mortar mortar. In this way, we can learn about material design.

This table will provide us with information about the largest grain diameter of the mixture materials to be used in the design of the new Khorasan mortar.

Sieve analysis and acid experiments overlap with each other. Khorasan mortar samples were completely compatible with each other and there were no significant differences between them.

4.6.3. Chemical Analysis

For this test, horasan mortar, which is completely particulated in ceramic mortar, is first weighed and kept in oven at 60’C for 24 hours. The horasan mortar extracted from the oven is then measured by weight. They are reacted with HCl (Hydrochloric Acid) in a ceramic cup according to the molar amount equivalent to the weight of Khorasan mortar. This reaction time should be waited until the gas is exhausted or for 24 hours. At the end of this situation, the losses in the re-weighed horasan mortar will be obtained after the reaction with the acid when it is proportional to the first mass.

Table 4.0.1: Acid losses Test Result

	1. Sample	5. Sample	6. Sample	7. Sample	8. Sample
Container Weight (gr)	285	280	290	230	185
Container Weight + Sample (gr)	350	360	340	310	230
Sample Weight (gr)	65	80	50	80	45
Container Weight After Oven + Sample (gr)	345	355	335	300	225
Etüvden Sonra Sample Ağırlığı (gr)	60	75	45	70	40
Asit Kaybı %	1,75	1,79	1,72	4,35	2,70

Figure 4.5: Soil samples

If we analyze the table above, the loss rate is not very high due to the high rate of aggregate in the material. Whether the difference is periodic or other reasons can be examined in the history of art. For these reasons, we merely state that there is a difference.

4.6.4. Biological Analysis

In this study, biological samples or traces of biological residues are searched in a simple visual inspection as a result of three different samples taken from horasan mortar, which is completely particulate in ceramic mortar, and grown 500 times. These traces may not always be available.

No biological material or additives were found in the samples that we considered as the original or closest material in the materials in question and without cement.

4.6.5. Reporting

The results obtained in laboratory studies are checked on the final calculations to be processed on the test form. After having the opinion that there are no computational errors after these controls, the reporting process is completed by making these results understandable. Here, the results of the experiments on displaced samples were tried to be put forward collectively.

Physical Properties:

- Medium Hardness
- Lime lumps in places
- Light-colored (white)

Chemical Properties:

- HCl Loss Rate (Acid Loss) 2,462%

Organic Analysis:

- Organic material was found.
- It has not been found to substances such as straw and hair.

Granulometric Analysis:

Table 4.0.2: Granulometric Analysis

SCREEN NO	SCREEN NO AVERAGE
mm.	%
4	50,50
2	19,68
1	9,26
0.5	7,75
0.25	6,32
0.125	3,56
0.063	2,13
0	0,8

Water Absorption Rate:

- Water absorption rate 11%

4.6.6. New Mortar Design

New mortar design is made in parallel with the results that have been reported. In this design, for the precise adjustments, trial production is made before the application and as a result of the experiments on these products, the mixture of horasan mortar is finalized.

New Horasan Mortar Proposal

Table 4.0.3: Recommended New Khorasan Mortar Mixture (Proportional by Weight)

GRAIN DIAMETER	MIXING RATIO	TYPE OF MATERIAL
2 – 4 mm	50 %	Aggregate
1- 2 mm	20 %	Aggregate, (Brick Powder 5%)
0,500 – 1 mm	20 %	Aggregate, (Brick Powder 5%)
0 – 0,500 mm	10%	Washed River Sand
	Enough	Creamy Lime

The values described above are weighted and should be finalized after the tests to be carried out following the test production.

New Injection Mortar Proposal

Table 4.0.4: New Injection Mortar (Proportional by Weight)

GRAIN DIAMETER	MIXING RATIO	TYPE OF MATERIAL
0 – 0,125 mm	10 %	Plate
	30 %	Creamy Lime
	60 %	Hydraulic Lime

The stones are designed to close the gaps between the rubble inner fill and the wall surfaces; low pressure (1 bar), aggregate-free (or silt grain size filled) hydraulic lime mortar injection.

4.6.7. Examination of Stone Specimens

Stone samples were also provided in situ. Samples 3-6 and 7 were evaluated as stone samples. These specimens are generally limestone based and have a crystalline texture, although not fully crystallized. The result table of the samples evaluated in terms of point load is presented below.

The stone specimens consist of limestone and a small amount of crystallized limestone. For this reason, the water absorption rate of the material was observed to be low. In addition, the point load strength of the stone material was higher than the amorphous limestone material, but was lower than the fully crystallized limestone material (marble, etc.).

If stone material is needed during reconstruction or restoration, the quarry should be investigated on the basis of the basic features listed below and these experiments should be tested on the quarry material and its compatibility should be investigated.

The water absorption rate is 2.6% by weight, which is the average value of both samples. In order to calculate the real strength, much more various stone samples will be needed. These procedures should be repeated in more detail during the restoration.

Figure 4.6: Point Load Test of Stone Samples

Samples subjected to spot load test in laboratory environment The following spot load test results are presented separately in the appendix.

For stone samples, various investigations and comparisons can also be made in the region. By examining the technical properties of the materials in detail, it is easier to determine where and how the stone materials planned to be used in restoration works will be obtained. Of course, the stone capacities of the existing quarries should be calculated to determine whether they meet the requirements. Because many quarries where small amounts of stone can be supplied can be found abandoned.

It is also seen experimentally that materials 2-3-4 were obtained from the same quarry or from the same quarry. The rock material in the places where samples 9-10 are obtained is obtained from a different quarry. These samples appear to be softer and less resistant materials.

Table 4.0.5: Point Load Strength of Stone Specimens

NOKTA YÜK DAYANIM ENDEKSİ HESABI													
Numune No	AÇIKLAMA	Numunenin Boyu	Numunenin Eni	Numunenin Yüksekliği	Numunenin Çapı	Numunenin Ağırlığı	Numunenin Doğal Yoğunluğu	Numunenin Kırılma Dayanımı	Eşdeğer Karot Çapı	De^2	Düzeltilmemiş Nokta Yükü Dayanım Endeksi	Boyut Düzeltme Faktörü	$Is_{(50)}$
							γ	P	De		$Is=(P*10^3)/De^2$	$F=(De/50)^{0,45}$	
		mm	mm	mm	mm	g	g/cm^3	kN	mm	mm^2	Mpa		kg/cm^2
2	Kayaç	53,1	39,9	26,6	46,5	90	1,60	50,200	46,5	2162,25	23,217	0,9679	
3	Kayaç	44,2	45,6	38,1	44,9	120	1,56	48,100	44,9	2016,01	23,859	0,9527	
4	Kayaç	48,6	42,7	32,4	45,65	105	1,56	49,150	45,65	2083,92	23,585	0,9599	
9	Kayaç	77,4	41,7	39,4	59,55	170	1,34	14,800	59,55	3546,2	4,173	1,0818	
10	Kayaç	61,1	45	27,1	53,05	90	1,21	27,600	53,05	2814,3	9,807	1,0270	
	Kayaç												
	Kayaç												
	Kayaç												
	Kayaç												
	Kayaç												
ORTALAMA		56,88	42,98	32,72	49,93	115	1,45	37,97	49,93	2524,54	16,928	0,9979	
* Bu rapor laboratuvarımızın izni olmadan kısmen veya tamamen değiştirilemez veya kopyalanamaz * Bu sonuçlar sadece deny yapılan numunelere aittir.												ONAY	

CHAPTER 5

ANALYSIS STUDIES WITH FINITE ELEMENT ANALYTICAL MODELS

There are 4 main structures within the castle area. Of these buildings, only the “C Structure” is almost completely standing and the other structures are partially survived.

It is thought that the most obvious and explanatory structural evaluation of the structures with the same construction technique throughout the whole building mass can be done with linear elastic finite element models in digital environment. It is thought that the mass movement of the castle towers, which have almost the same wall thickness and aperture ratios in the structure plan settlement, will remain at elastic margin. It can be said that the components that reach the elastic limit instead of plastic behavior are manifested by cracks and collapse problems. Therefore, instead of performing complex finite element calculations including detailed nonlinear plastic behavior mathematical approaches, modeling studies which are able to yield results in a short time and yield approximately the same approach level with nonlinear modeling techniques are preferred.

In analytical modeling studies; The problems related to the general structure of the buildings were carried out in the structural elements identified in the preliminary examination of the building. These building elements; it contains the most obvious structural questions clearly and is more likely to worsen structural problems over time. To determine the structural intervention criteria by trying to solve the problems of these components; the framework of intervention for the overall castle.

Kale structures analytical model was created by using SAP2000 software. Considering the fact that the internal debris thickness varies across the tower and the resistance of the wall inertia to lateral effects, the simplification of the shell element for the walls is considered appropriate, considering that the homogenized wall section for the rubble filler and caboon walling walls will produce more accurate numerical data. The contribution of the structural form that will be formed as a result of the evaluation of the existing form of the castle on the 2D plane and possible repair approach to the structural integrity is higher level.

With a generalized view, it is predicted to give more specific results specific to this structure.

5.1.A STRUCTURE ANALYSIS MODEL AND STRUCTURAL EVALUATION

The structures in Geben Castle were subjected to severe local destruction. The building “A miş, which was built on a sloping terrain as in the whole castle, is thought to be a vaulted structure and has a plan close to a rectangle. Currently the northern wall of the building has been completely destroyed and the roof cover has a trace on the eastern side. In the western part of the south wall, it can be said that there is no connection at one end of the south wall, where it collapses up to the vault stirrup line.

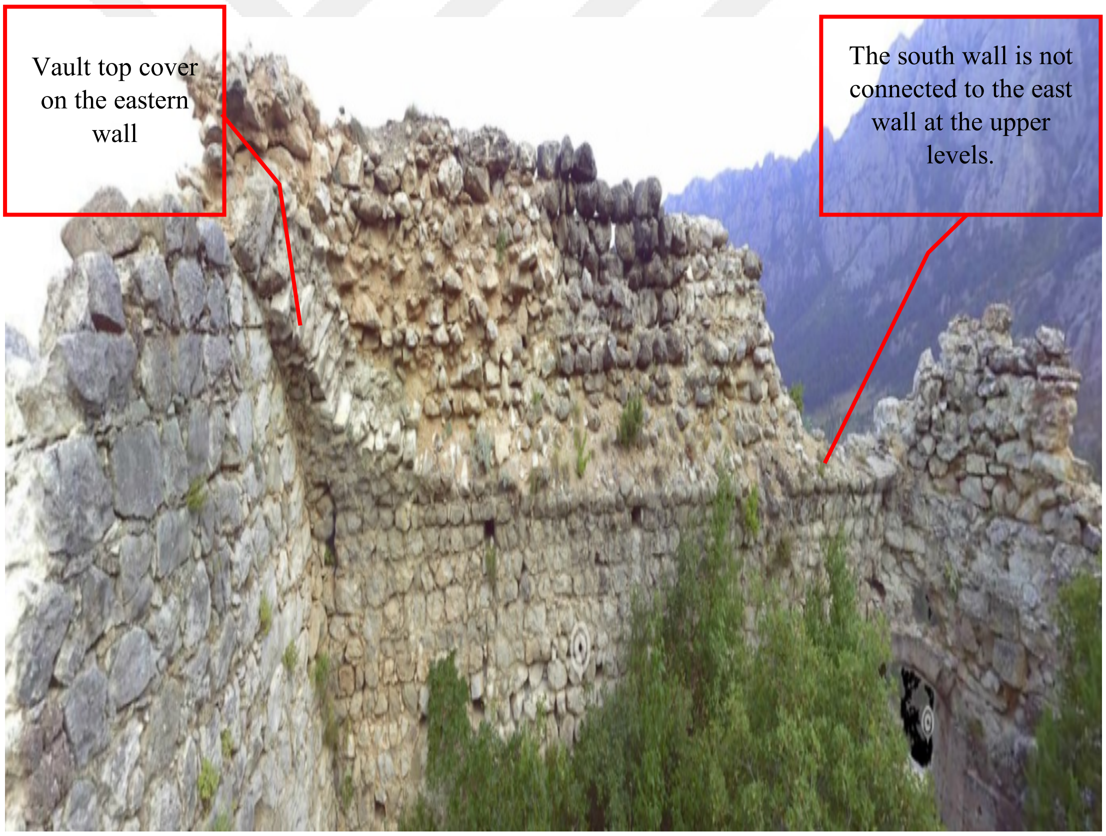


Figure 5.1: Structure A View of the South Wall from the Interior

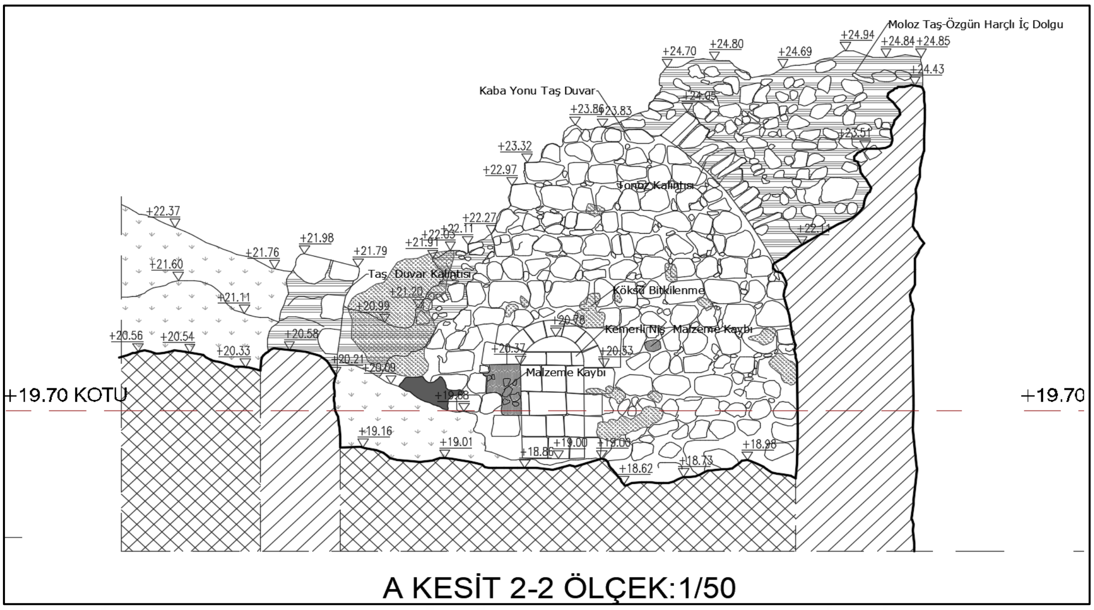


Figure 5.2: Type A Section of South Console Wall in Structure A in Surveying Drawings

Structure A Cross-Section of the Console Wall Type

When the section of the south wall seen in the survey drawings prepared for the structure is examined, approximately 3 different thicknesses can be seen. The 3.65 meters high section at the bottom of the wall is approximately 160 cm thick, and the 1.25 m section is 60 cm thick and the top is 25 cm thick.

As a result of literature comparison study results and parametric values research of similar building materials;

- Natural Specific Gravity; 2.56 ton/m^3
- Compressive Strength; 5 MPa
- Elastic Module Value = 1000*σ = 5 GPa
- Poisson Ratio; 0.25

Assumed. In order to keep these values on the safe side; In the literature, the smallest of the values found for the weakest stones and mortars of the same kind foreseen for these building materials were used as input.

Approach used in earthquake analysis The Regulation on Buildings to be Constructed in Earthquake Zones was handled according to the Mode Combination method given in 2007. Kahramanmaras - Andirin located in Turkey corresponds to the earthquake map earthquake in the 3rd district. In this case, in accordance with DBYBHY 2007, in mode coupling method and response spectrum effect analysis;

- Building Importance Coefficient, I=1.5
- Building Behavior Coefficient, R=2.0
- Effective Ground Acceleration Coefficient, A_0= 0.2

taken as. Since the castle structure is in a rocky area, the ground group is considered as Z2 and the acceleration spectrum is used.

In the analysis of the structure standing as a cantilever, only the 2 meter wide part was taken into consideration. For this reason, only the earthquake loads perpendicular to the wall axis were analyzed and checked.

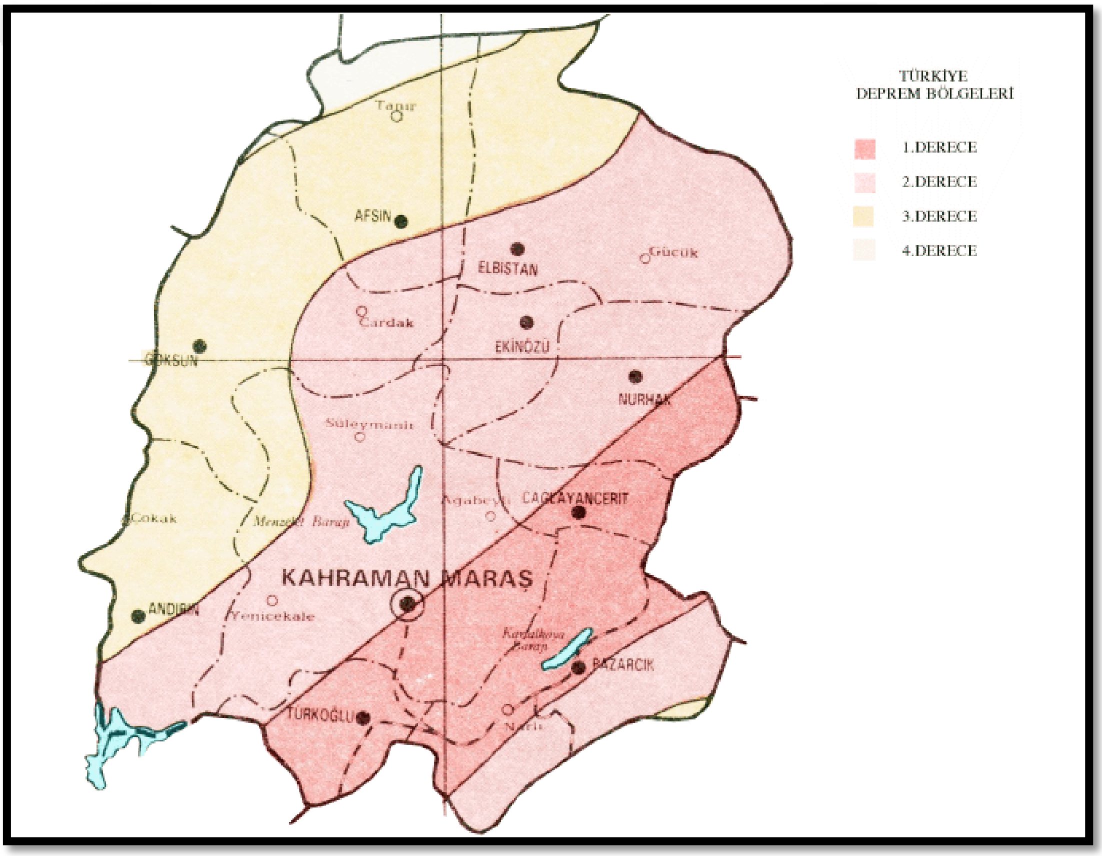


Figure 5.3: Turkey Earthquake Map - Kahramanmaras Seismicity

As load classes in structural analysis; G: Dead (Zati) load

E_x: Earthquake effect in X direction

E_y: Earthquake effect in Y direction

as combinations : $G+E_x+0.3E_y$

$G+E_y+0.3E_x$

Since the wall of the building is considered as a cantilever, the ground relation of the lowest row walls is defined as built-in and the built-in bearing features are defined at the lowest row button points. The thickness information of the shell elements was only handled by the software during the calculations and reflected to the results. On the other hand, the common wall values of different building materials with different physico-mechanical parametric values, which represent the heterogeneity of the wall, were extracted by hand calculation or literature search and defined in the program. Therefore, a complete macro-analytical model was created in the program, the effect of structural degradation zones was extracted from the results of the wall heterogeneity to obtain more simplified / generalized results and focus on these degradation zones.

The loading types on the models are limited by their own weight and lateral earthquake effects. As mentioned earlier, although the structure is located on the slope and high elevations, wind effects are not considered to have more serious destruction effects than earthquake effects. On the other hand, seismic effects that are directly proportional to the mass of the structure can reach serious destructive levels for the masonry structure. Therefore, modeling results will clearly show the share of earthquake on destructiveness by observing stresses caused by these effects on the structure.

In the case of vertical loads, no load is exposed to the structure other than its own weight (no coating or human load is present on the structure).

Natural vibration period calculations which are necessary for earthquake analyzes and yielding results by eigenvalue calculations - MODAL analyzes have been carried out in such a way that the approach of building mass participation exceeds 90%.

Table 5.0.1: Modal Participating Mass Ratios

TABLE: Modal Participating Mass Ratios					
OutputCase	**StepType**	**StepNum**	**Period**	**UY**	**SumUY**
Text	Text	Unitless	Sec	Unitless	Unitless
MODAL	Mode	1	0,0587	0,512378	0,512378
MODAL	Mode	2	0,05103	0	0,512378
MODAL	Mode	3	0,023989	0,142627	0,655005
MODAL	Mode	4	0,016723	3,498E-19	0,655005
MODAL	Mode	5	0,015154	6E-18	0,655005
MODAL	Mode	6	0,012418	9,457E-17	0,655005
MODAL	Mode	7	0,010504	8,989E-17	0,655005
MODAL	Mode	8	0,010353	0,084892	0,739897
MODAL	Mode	9	0,007899	1,741E-20	0,739897
MODAL	Mode	10	0,007383	0,001248	0,741145
MODAL	Mode	11	0,006432	6,577E-18	0,741145
MODAL	Mode	12	0,00576	0,108731	0,849876
MODAL	Mode	13	0,005239	7,493E-15	0,849876
MODAL	Mode	14	0,005218	3,754E-15	0,849876
MODAL	Mode	15	0,004294	1,215E-14	0,849876
MODAL	Mode	16	0,004006	3,129E-14	0,849876
MODAL	Mode	17	0,003897	2,331E-14	0,849876
MODAL	Mode	18	0,003724	0,000522	0,850398
MODAL	Mode	19	0,003621	5,046E-14	0,850398
MODAL	Mode	20	0,00338	3,068E-13	0,850398
MODAL	Mode	21	0,003347	3,72E-13	0,850398
MODAL	Mode	22	0,003327	3,732E-13	0,850398
MODAL	Mode	23	0,003193	0,016883	0,867281
MODAL	Mode	24	0,003171	2,383E-13	0,867281
MODAL	Mode	25	0,002974	9,969E-18	0,867281
MODAL	Mode	26	0,002959	8,443E-14	0,867281
MODAL	Mode	27	0,002913	2,9E-13	0,867281
MODAL	Mode	28	0,002805	3,696E-13	0,867281
MODAL	Mode	29	0,002796	8,868E-14	0,867281
MODAL	Mode	30	0,002721	6,522E-14	0,867281
MODAL	Mode	31	0,002692	4,141E-14	0,867281
MODAL	Mode	32	0,00258	2,149E-14	0,867281
MODAL	Mode	33	0,002534	0,00176	0,869041
MODAL	Mode	34	0,002462	6,655E-16	0,869041
MODAL	Mode	35	0,002359	3,616E-14	0,869041
MODAL	Mode	36	0,002358	9,992E-14	0,869041
MODAL	Mode	37	0,002337	0,01216	0,881201
MODAL	Mode	38	0,00229	0,024953	0,906154
MODAL	Mode	39	0,002287	7,354E-15	0,906154
MODAL	Mode	40	0,00227	2,231E-13	0,906154

According to the results of the modal analysis, the first natural vibration period is 0.0587 sec.

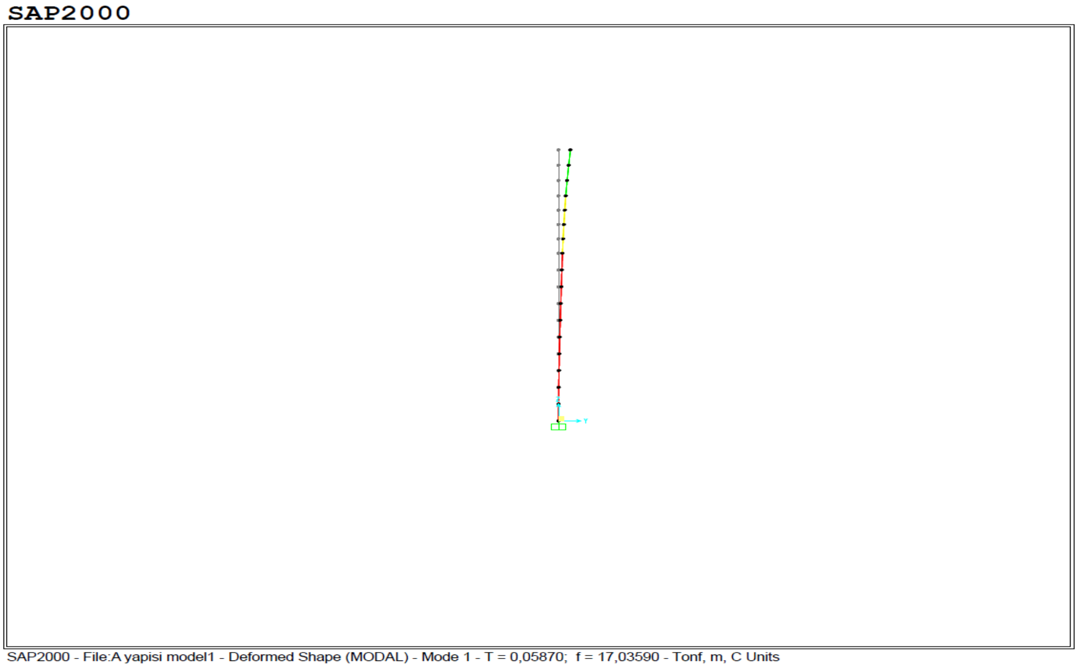


Figure 5.4: A Structure Deformed Model

Evaluation of earthquake effects on the southern wall of Structure A is carried out on S22 vertical stress distribution maps. (-) negative values indicate pressure stresses (+) positive values indicate tensile stresses.

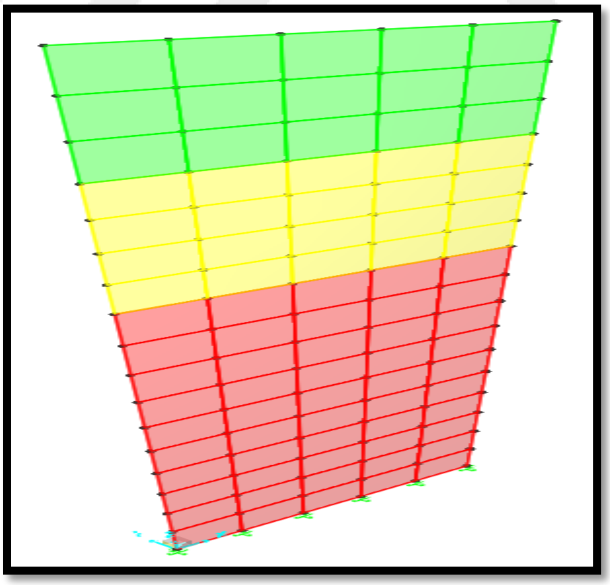


Figure 5.5: 2 Meter Width Wall Analysis Model Appearance; red - 3.65 meters high, 160 cm thick wall; yellow - 1.25 meters high 60 cm thick wall; green - 1.0 meter high 25 cm thick wall

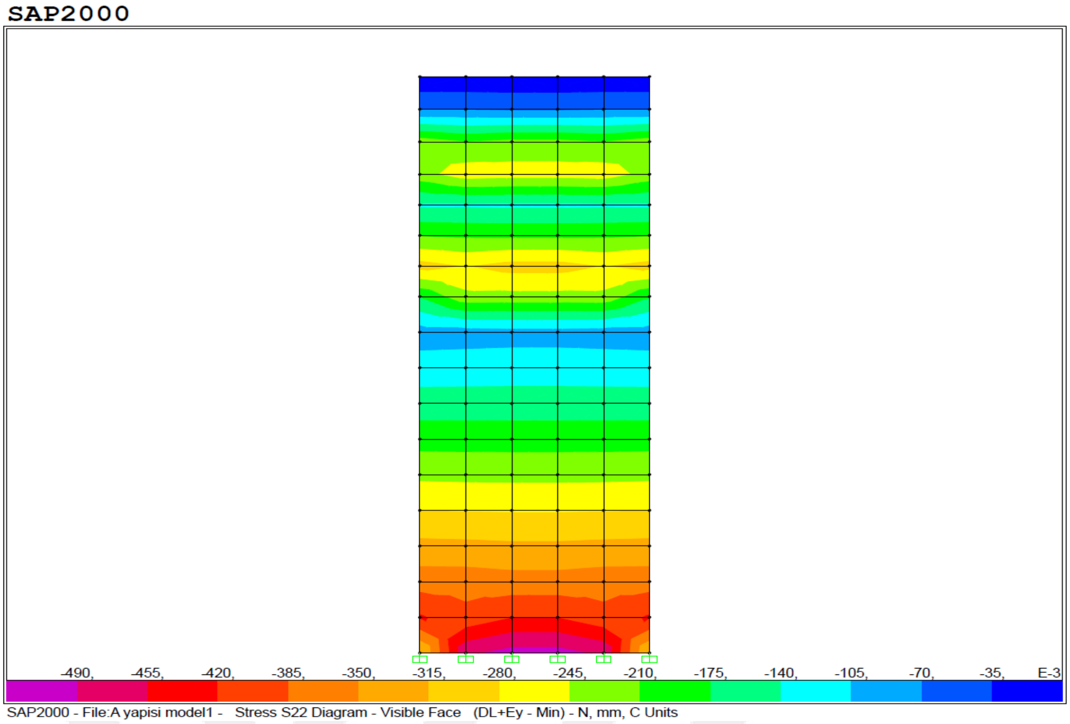


Figure 5.6: Vertical stress distribution (pressure stresses) on the wall under Wall G + O Combination (wall cross-section shown)

According to the results of the analysis, the pressure stresses in the wall remain in the order of 0.5 MPa (wall level). No additional stress was observed in the sections where the wall cross-section changed.

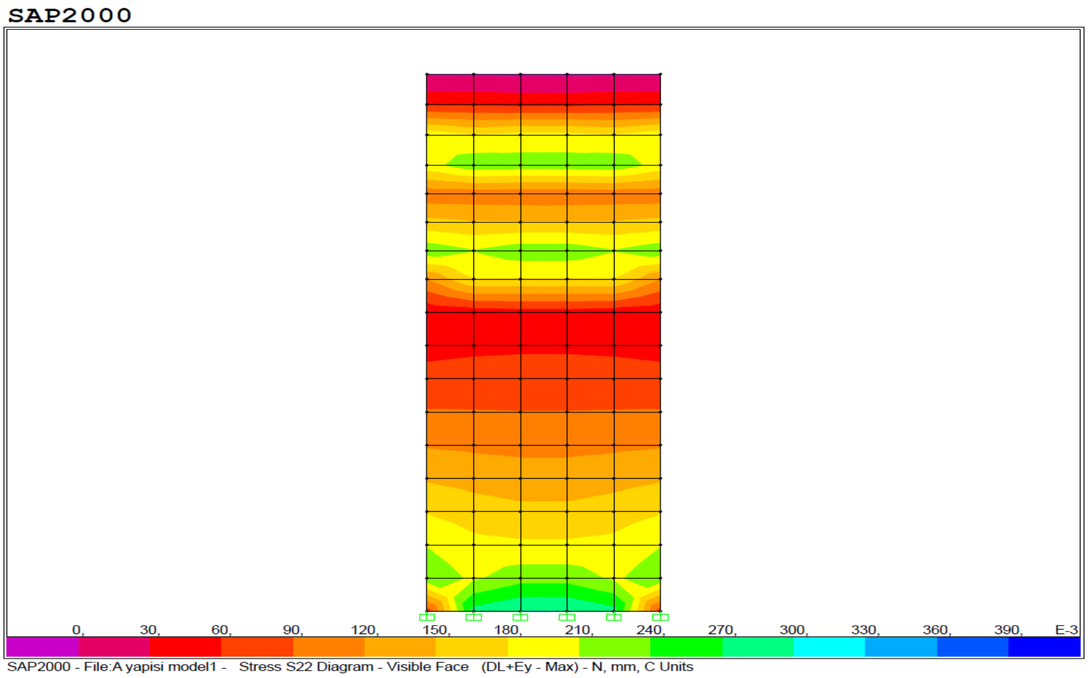


Figure 5.7: Vertical stress distribution (tensile stresses) in the wall under Wall G + O Combination (wall cross-section changes shown)

According to the results of the analysis, the tensile stresses that will occur in the wall are in the order of 0.3 MPa (at the wall base level and the sections where the wall cross-section changes).

As is known, the tensile strength of masonry walls is quite low. However, according to the generally accepted approach, the tensile capacity of masonry walls can be taken as 10% of the pressure capacity. In this case, an order of 0.3 MPa on the masonry cantilever wall can be considered an acceptable limit.

Turkey Earthquake 2018 Building Regulations solution with our values again made will be checked.

Turkey Earthquake Hazard Map data entered through the Interactive Web Applications;

Earthquake Ground Motion Level: DD-2 (earthquake ground motion level with 10% probability of being exceeded in 50 years (475 years of repetition period))

Local Soil Class: ZC (Very tight layers of sand, gravel and hard clay or weathered, very cracked weak rocks)

Latitude: 37.81526°

Longitude: 36.408637°

As a result of these data, the results to be used for analysis;

S S = 0.717 S1 = 0.186 S D S = 0.870 S D 1 = 0.279

PGA = 0.307 PGV = 18.284

SS : Short period map spectral acceleration coefficient [dimensionless]

S1 : Map spectral acceleration coefficient for the 1.0 second period [no dimension]

SDS : Short period design spectral acceleration coefficient [dimensionless]

SD1 : Design spectral acceleration coefficient [dimensionless] for 1.0 second period

PGA : The greatest ground acceleration [g]

PGV : En büyük yer hızı [cm/sn]

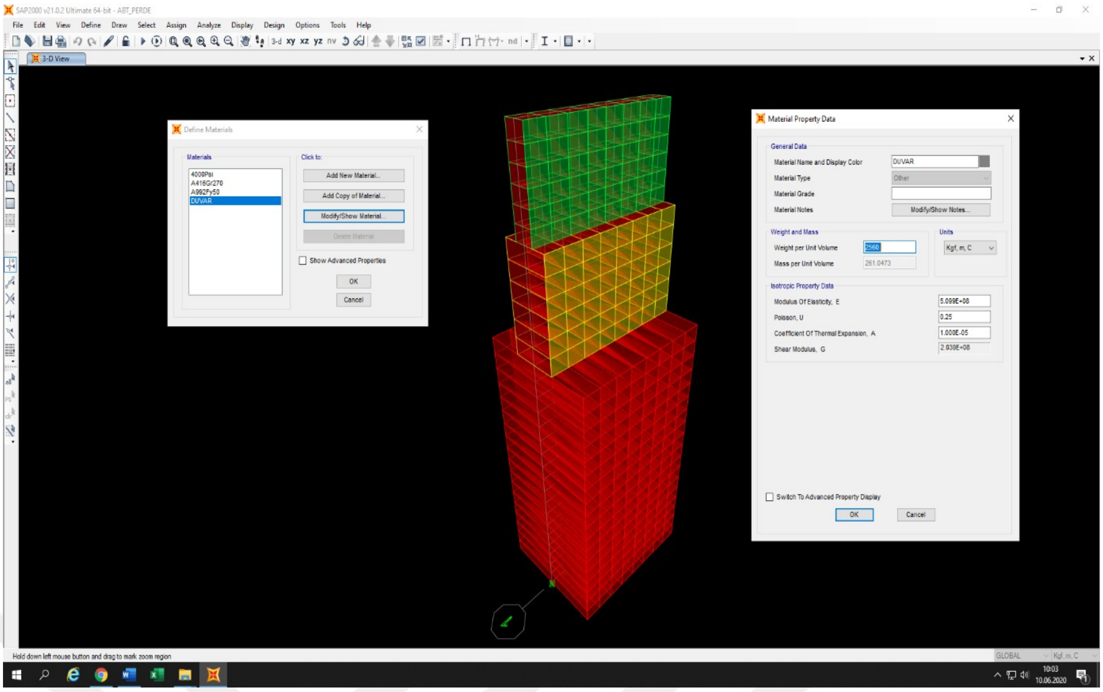


Figure 5.8: Material Property Data

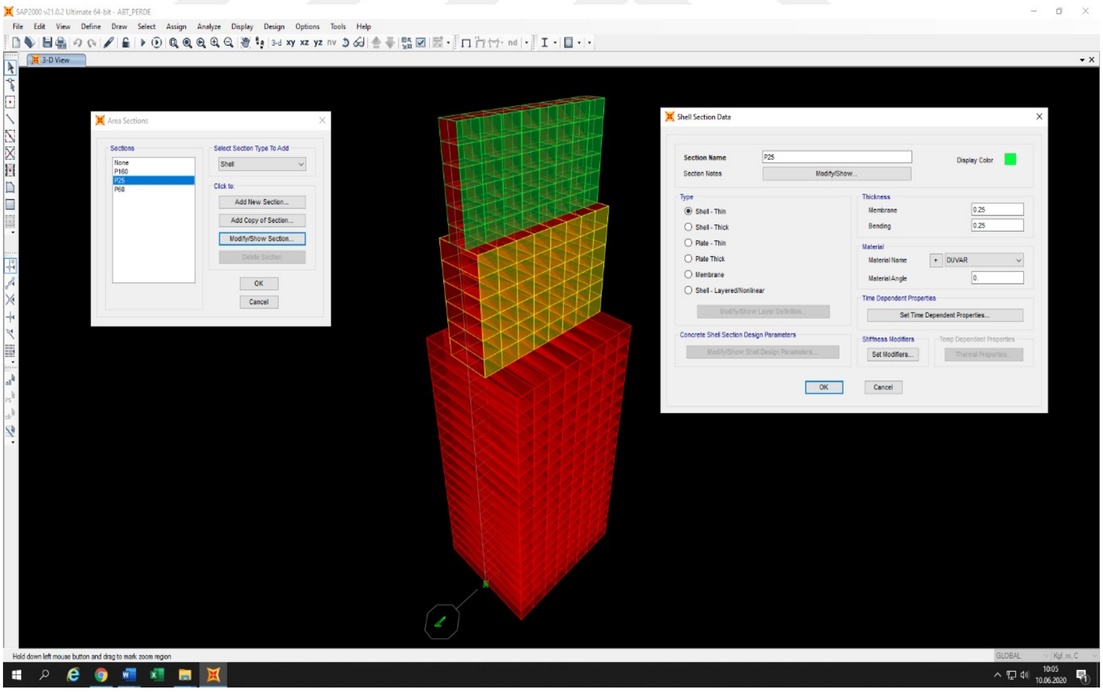


Figure 5.9: Shell Section Data (P25)

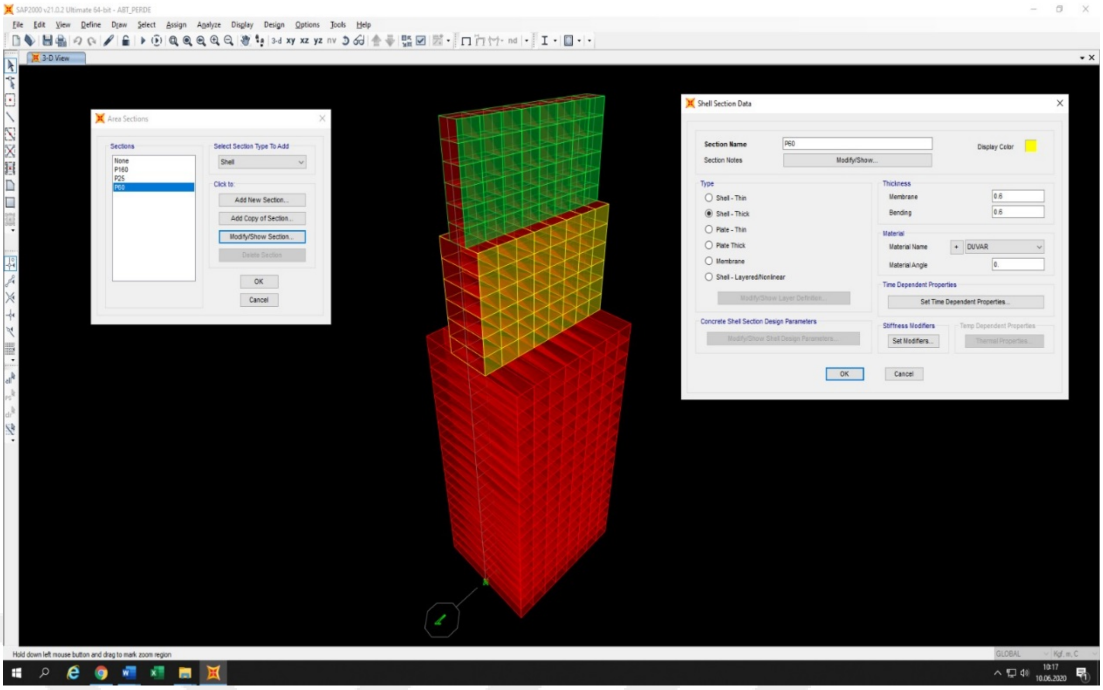


Figure 5.10: Shell Section Data (P60)

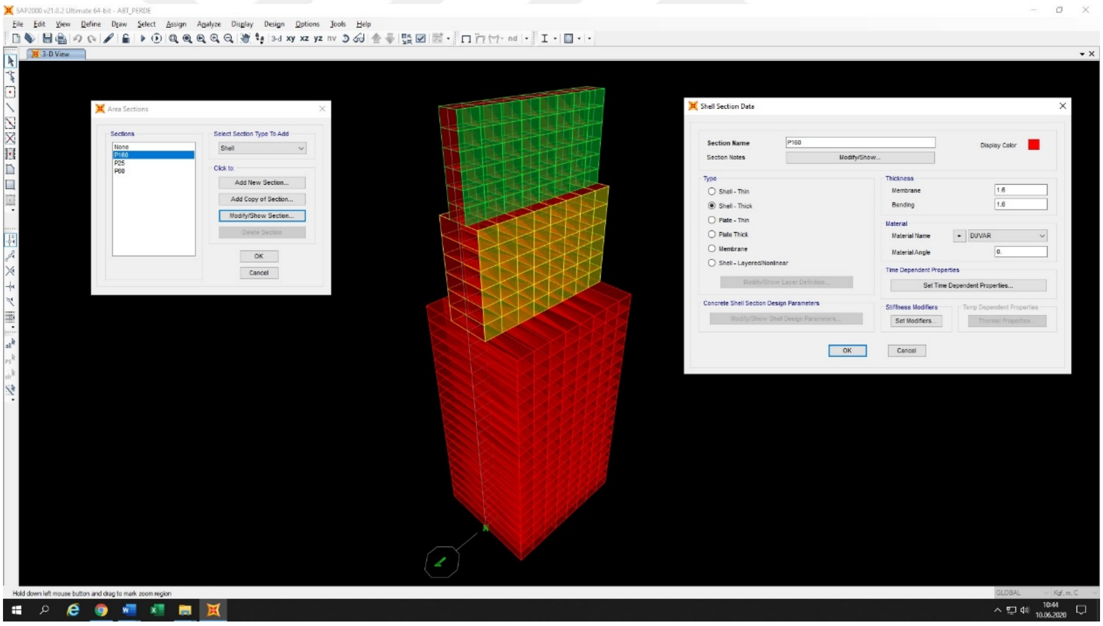


Figure 5.11: Shell Section Data (160)

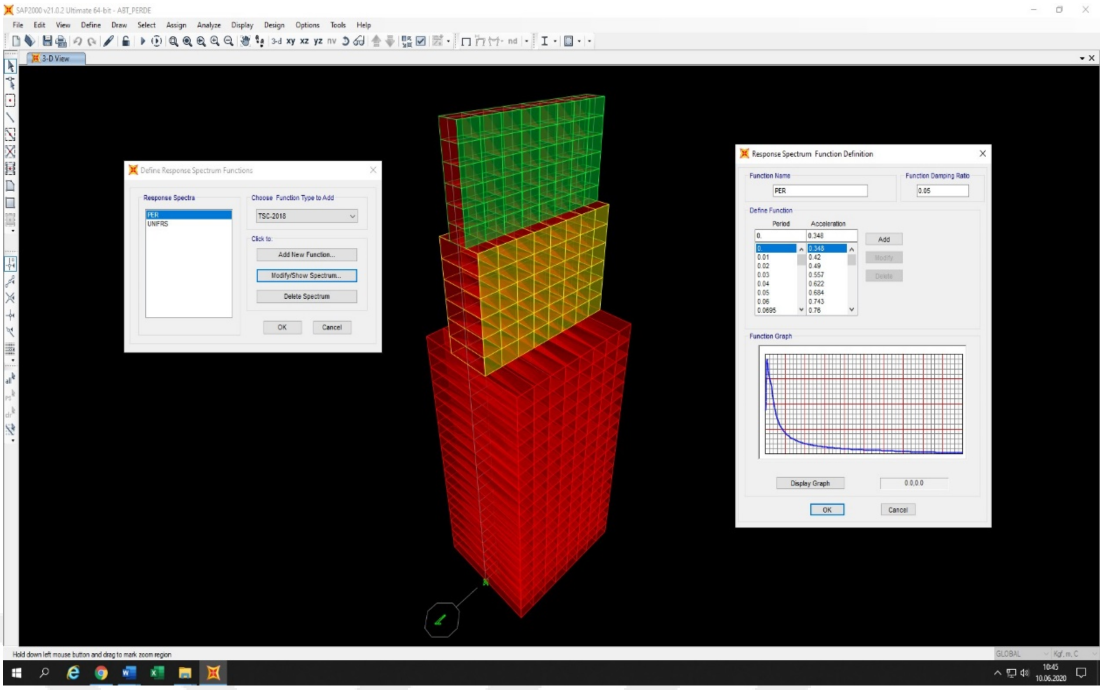


Figure 5.12: Response Spectrum Function Definition

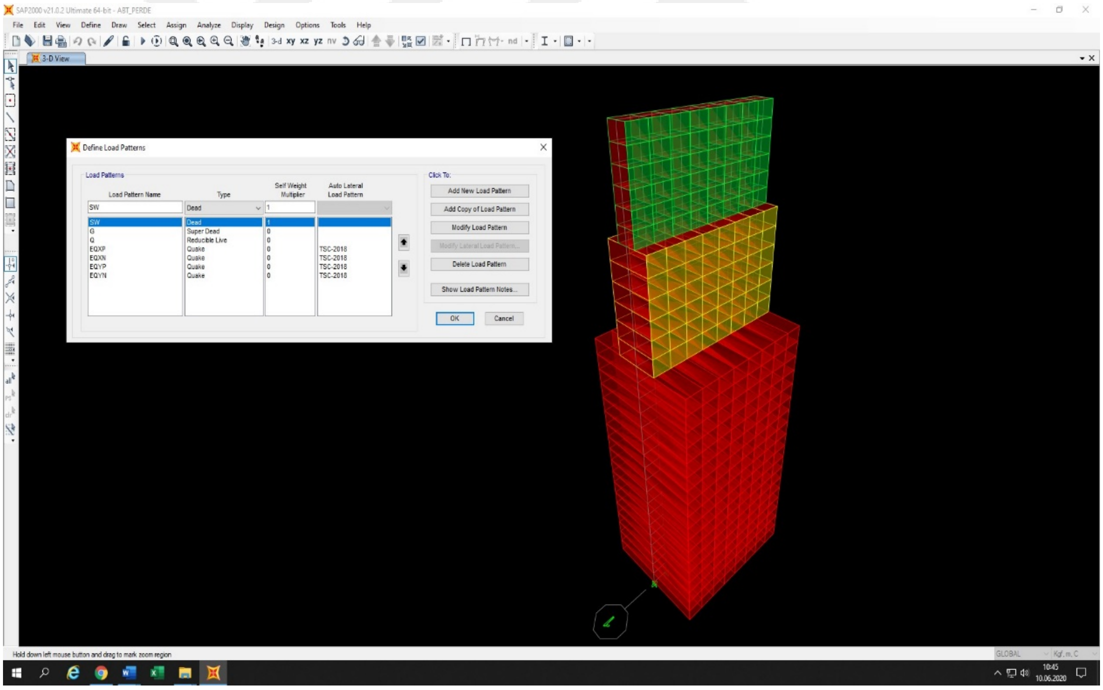


Figure 5.13: Define Load Patterns

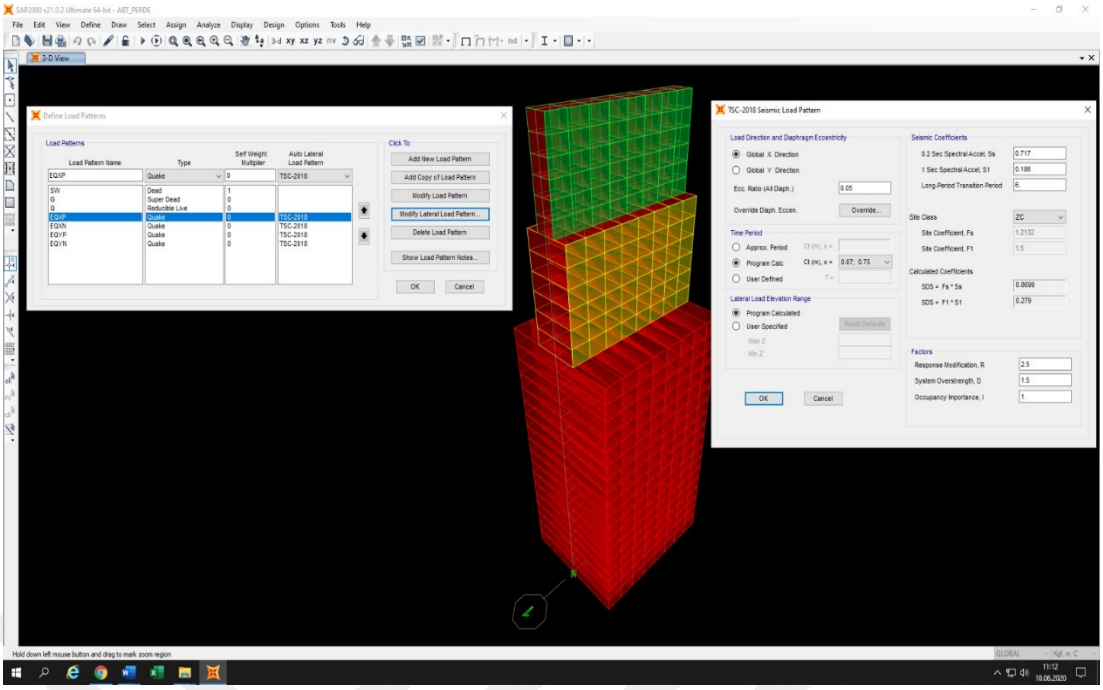


Figure 5.14: TSC-2018 Seismic Load Patten (EQXP)

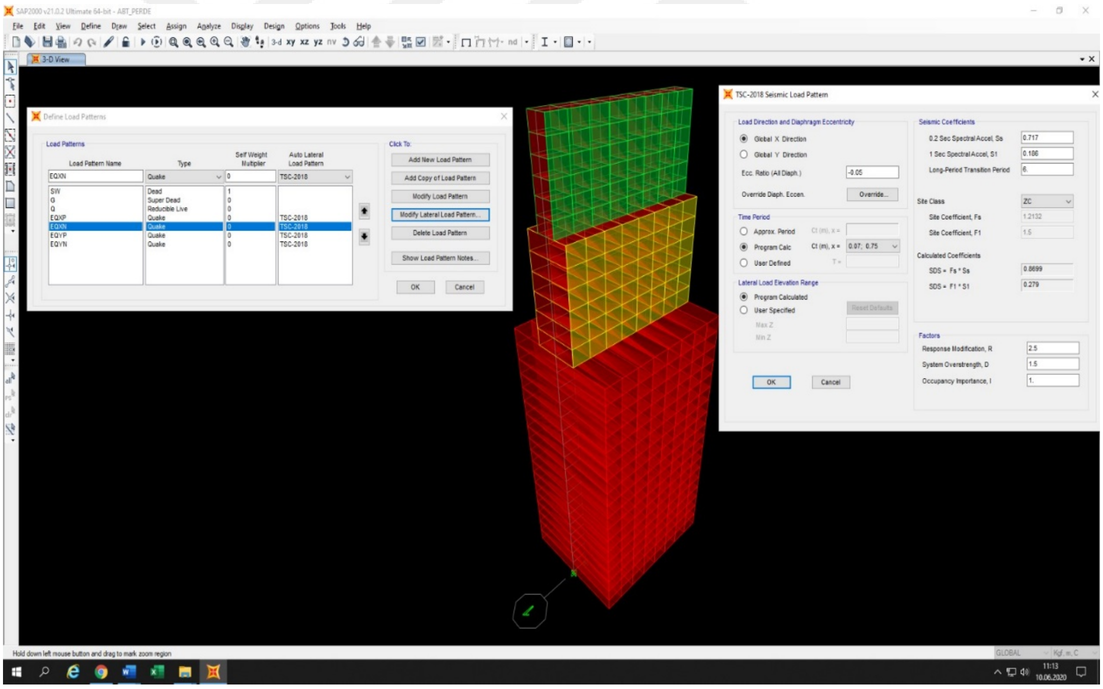


Figure 5.15: TSC-2018 Seismic Load Patten (EQXN)

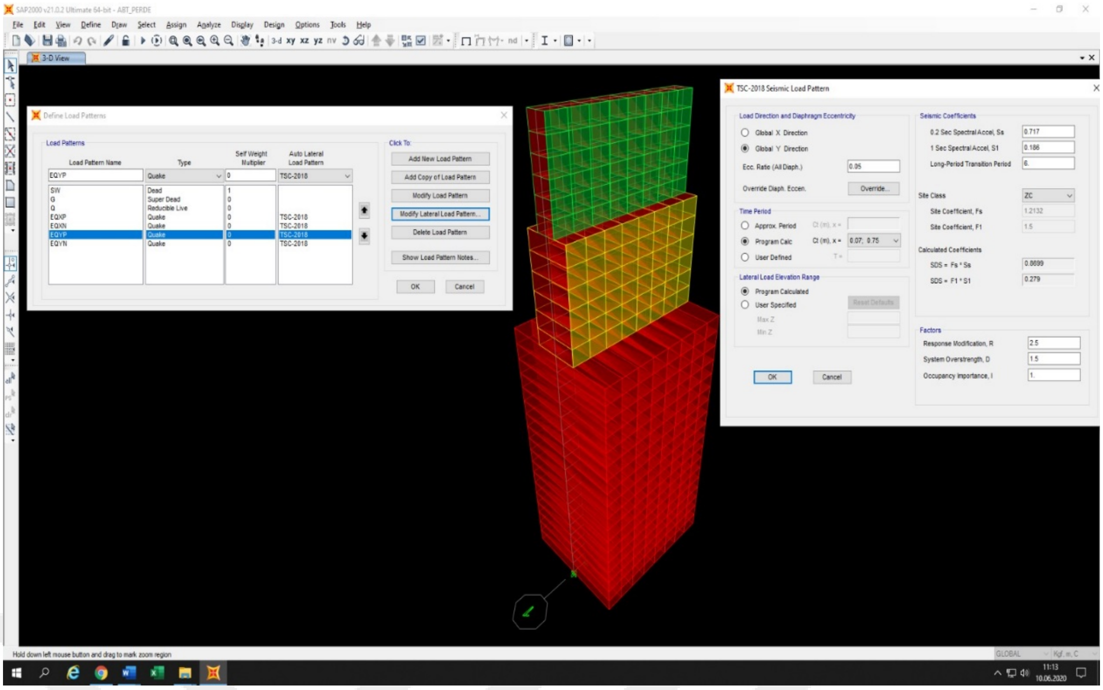


Figure 5.16: TSC-2018 Seismic Load Patten (EQYP)

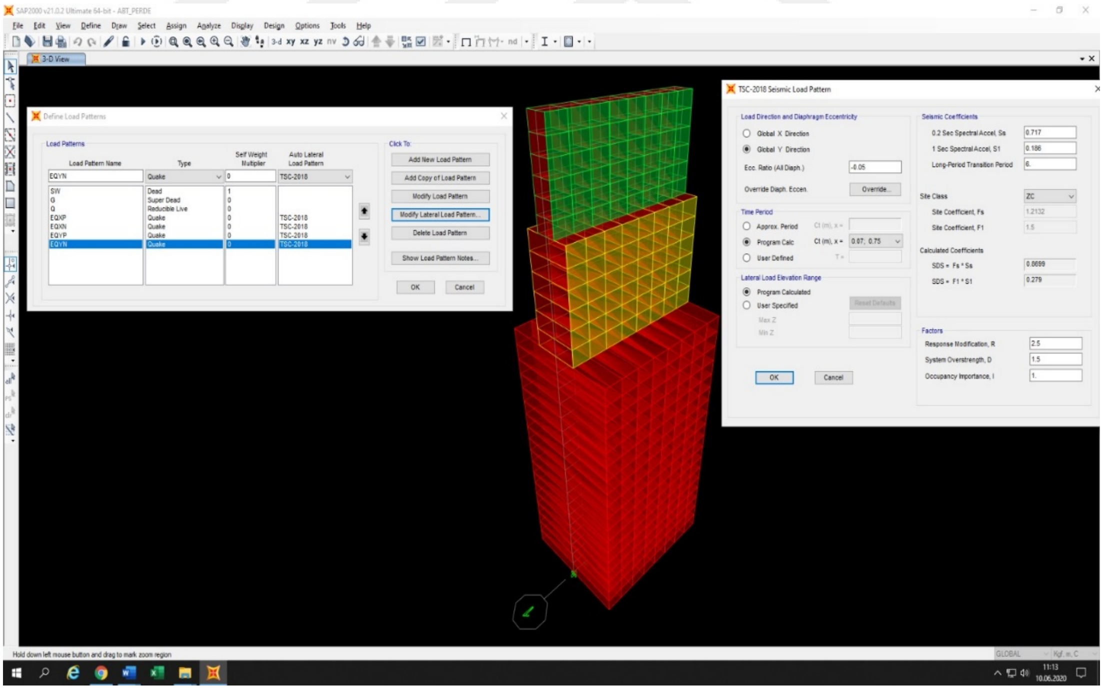


Figure 5.17: TSC-2018 Seismic Load Patten (EQYN)

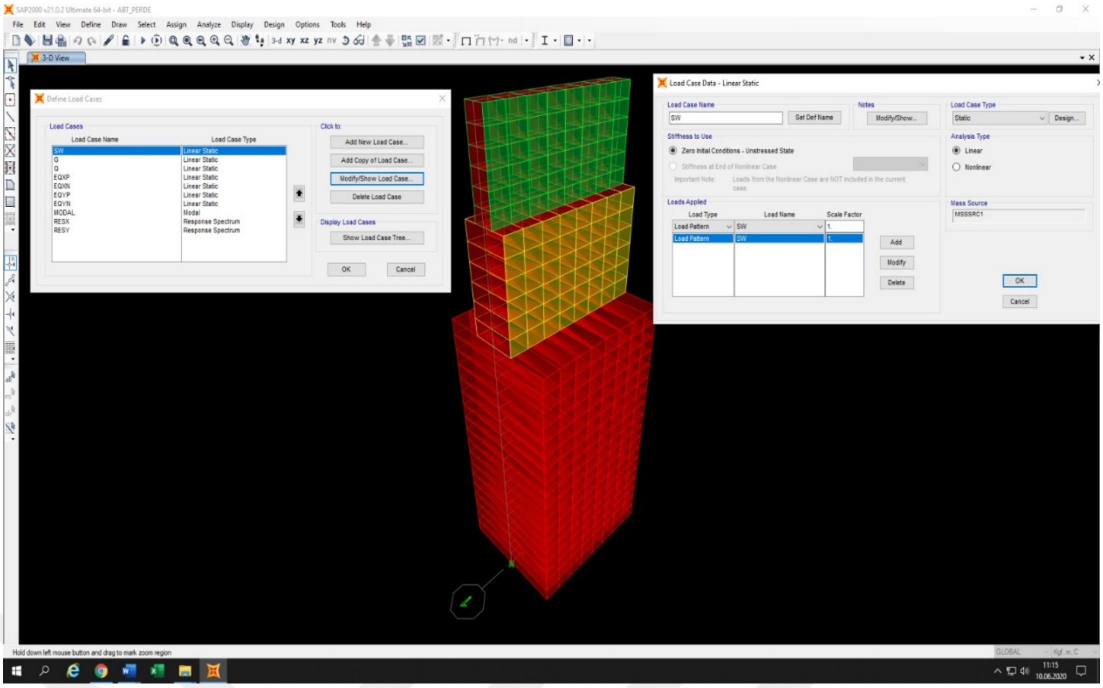


Figure 5.18: Load Case Data (SW)

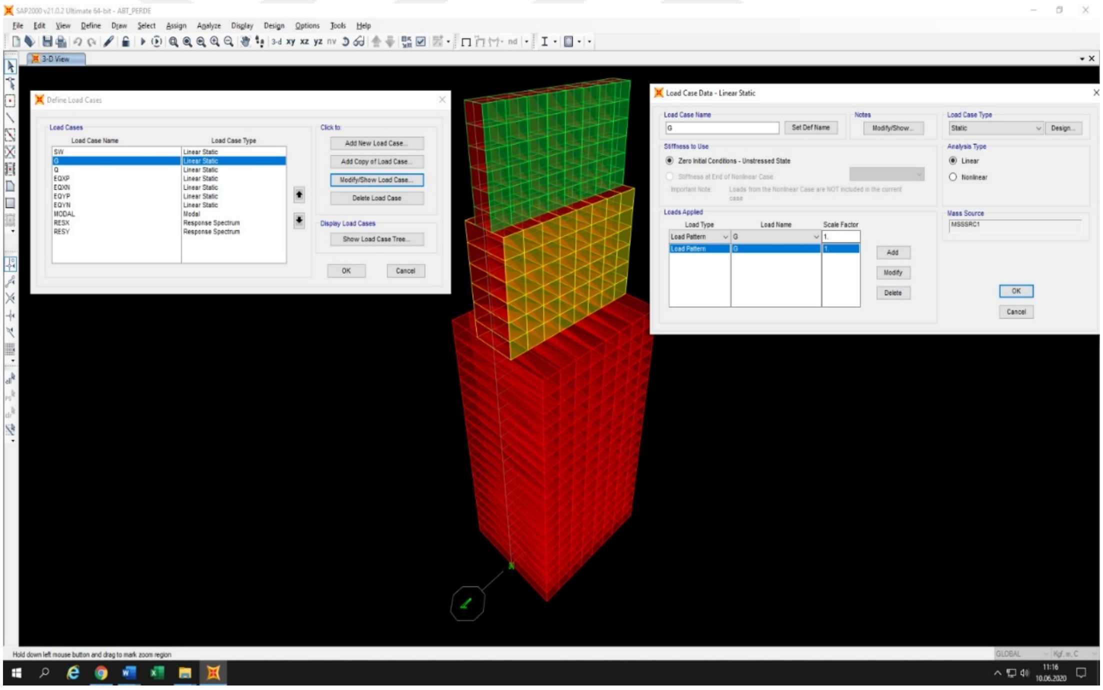


Figure 5.19: Load Case Data (G)

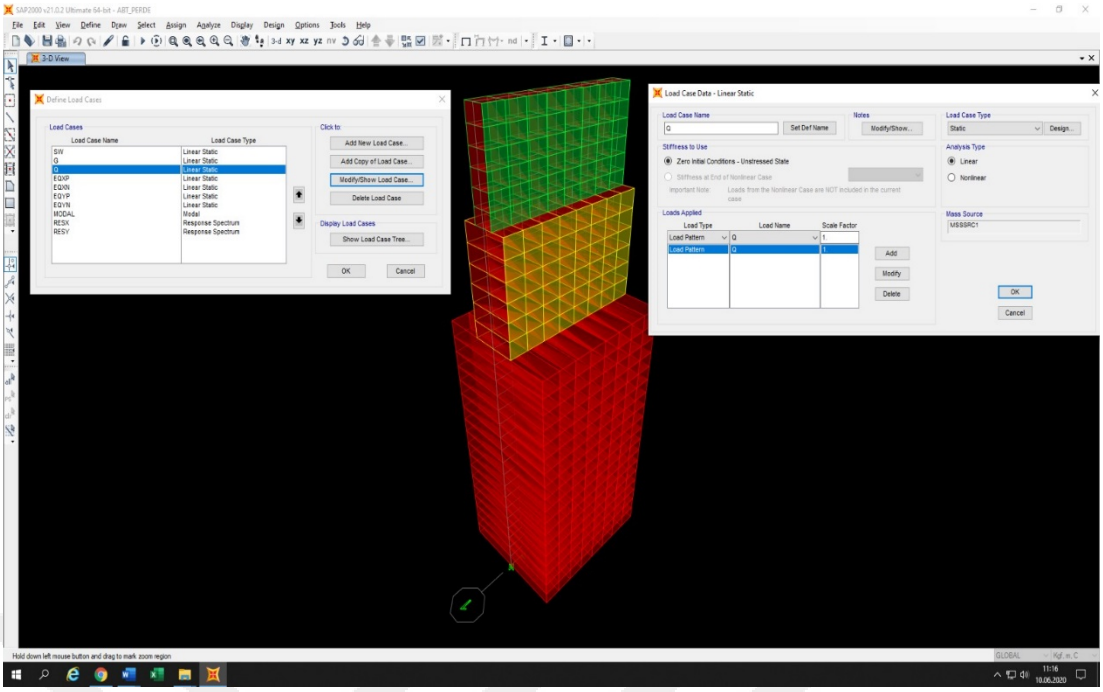


Figure 5.20: Load Case Data (Q)

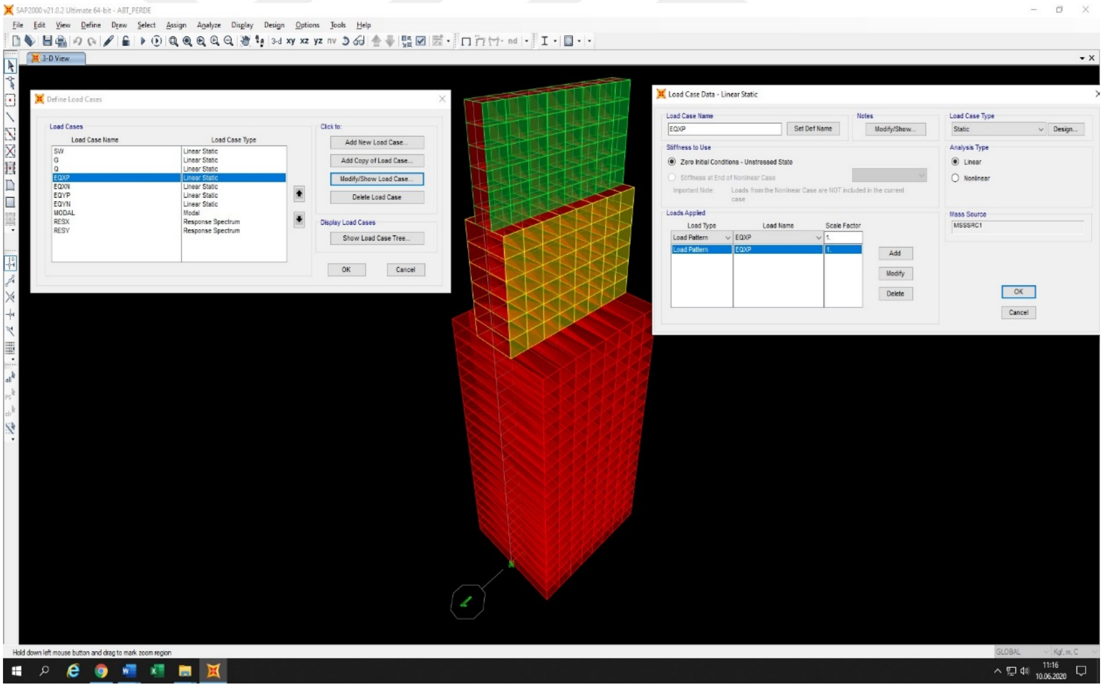


Figure 5.21: Load Case Data (EQXP)

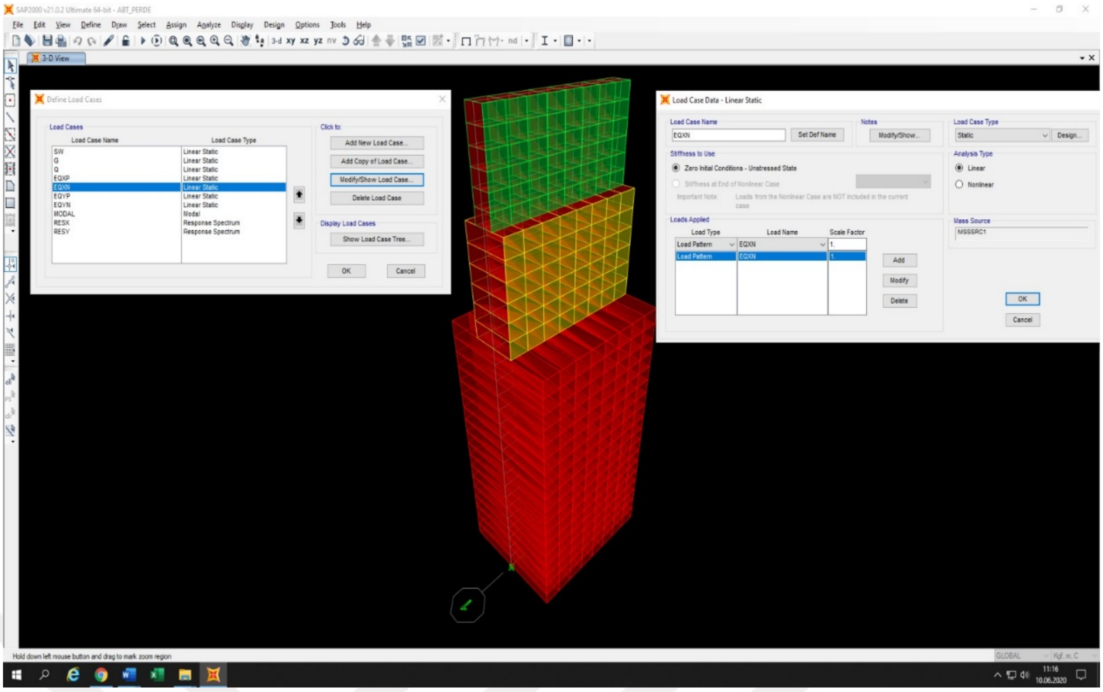


Figure 5.22: Load Case Data (EQXN)

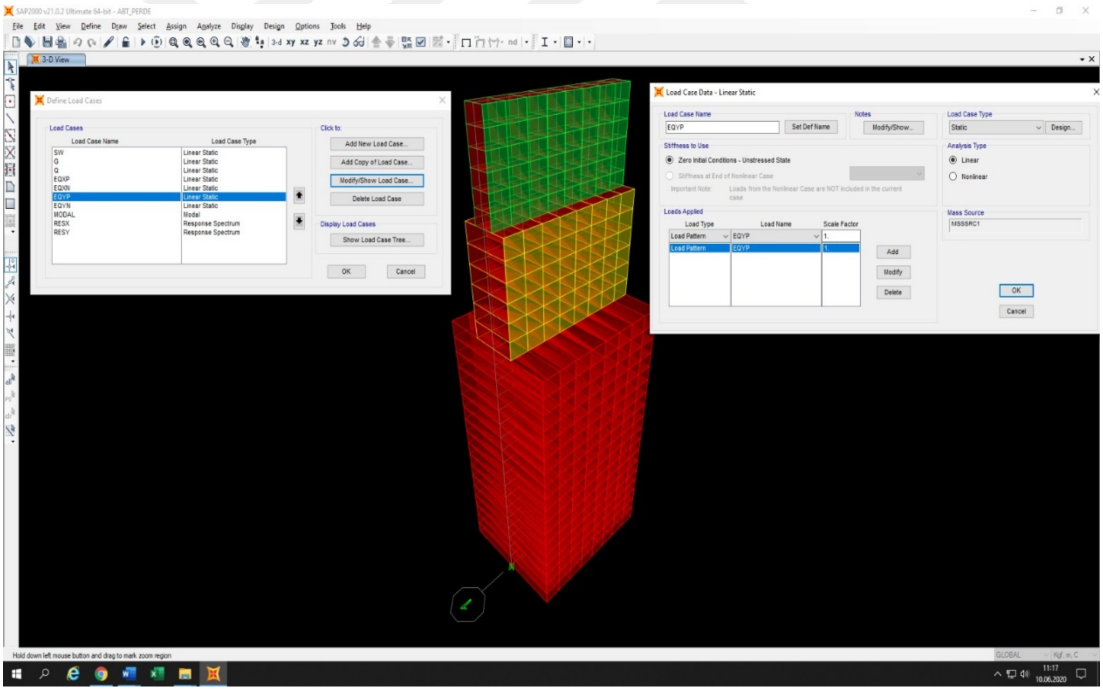


Figure 5.23: Load Case Data (EQYP)

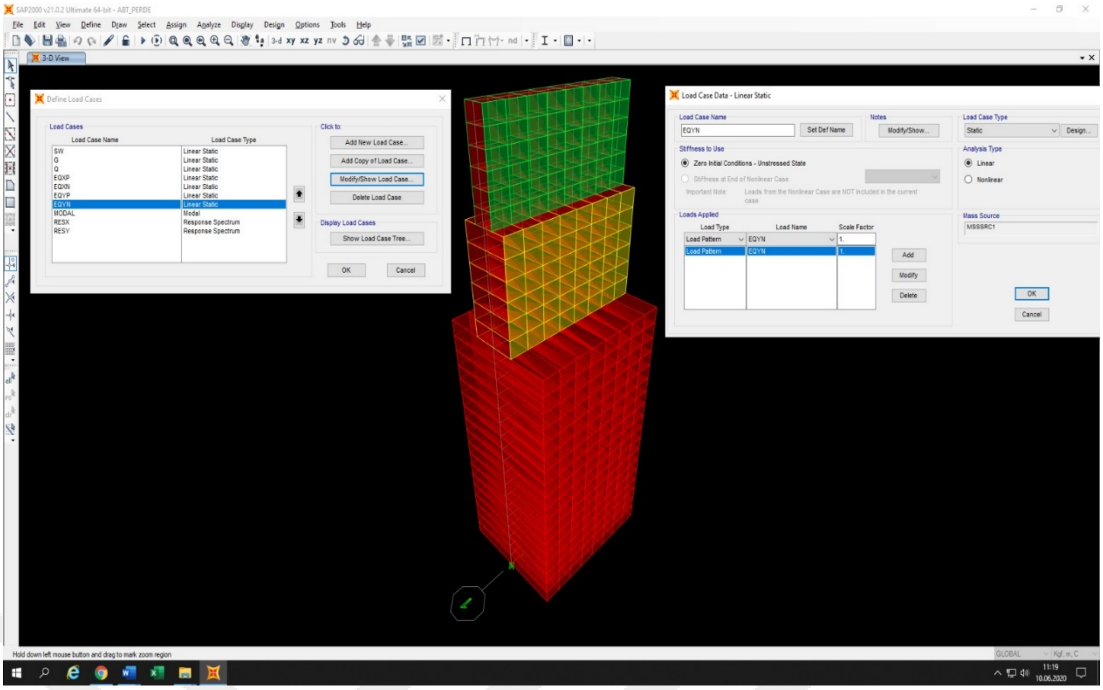


Figure 5.24: Load Case Data (EQYN)

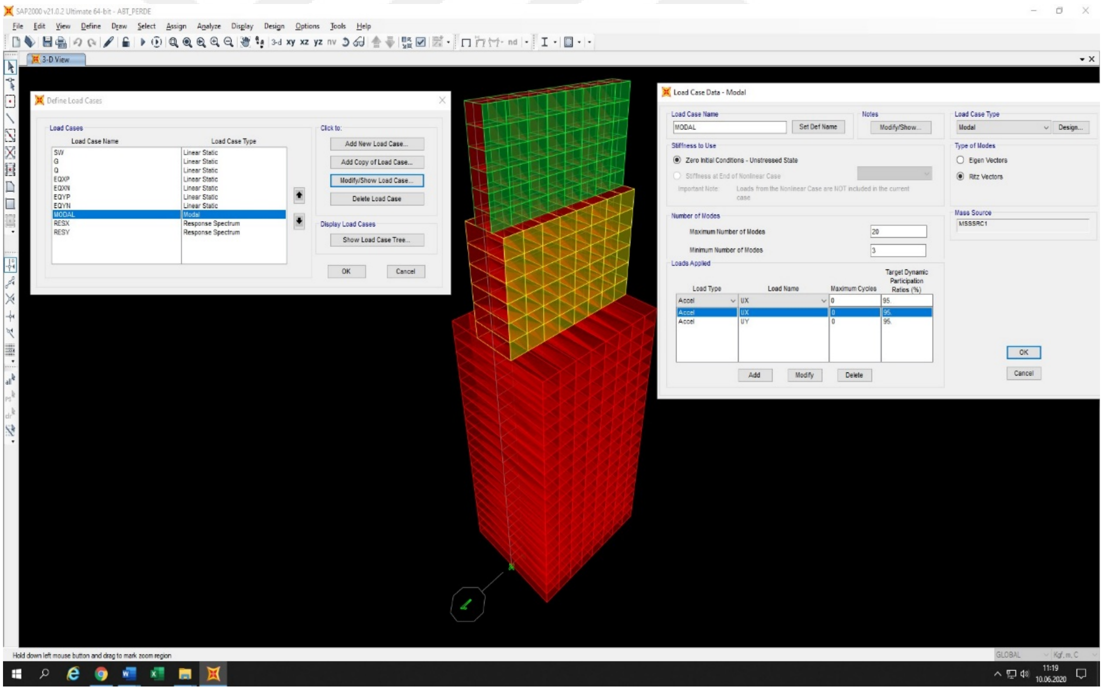


Figure 5.25: Load Case Data (MODAL)

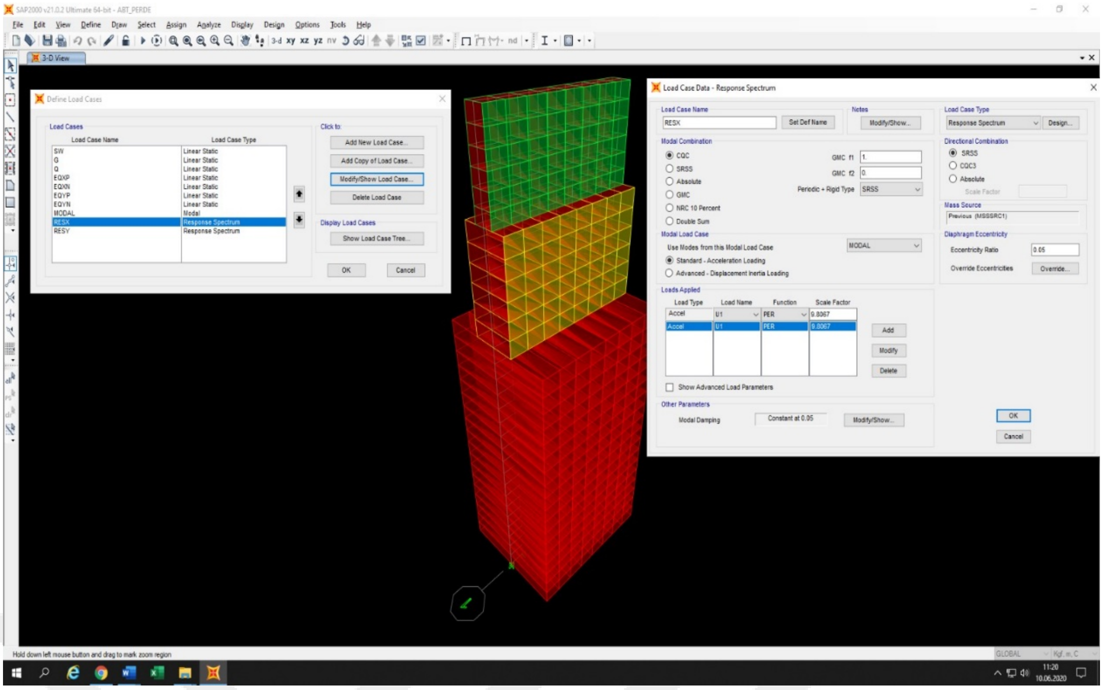


Figure 5.26: Load Case Data (RESX)

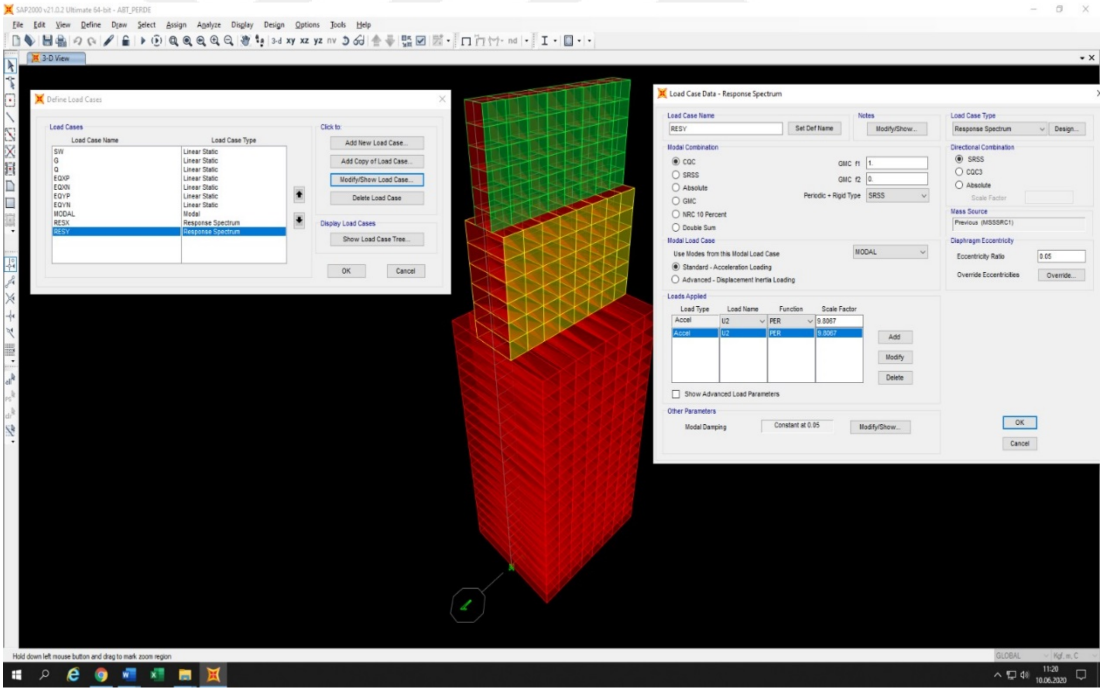


Figure 5.27: Load Case Data (RESY)

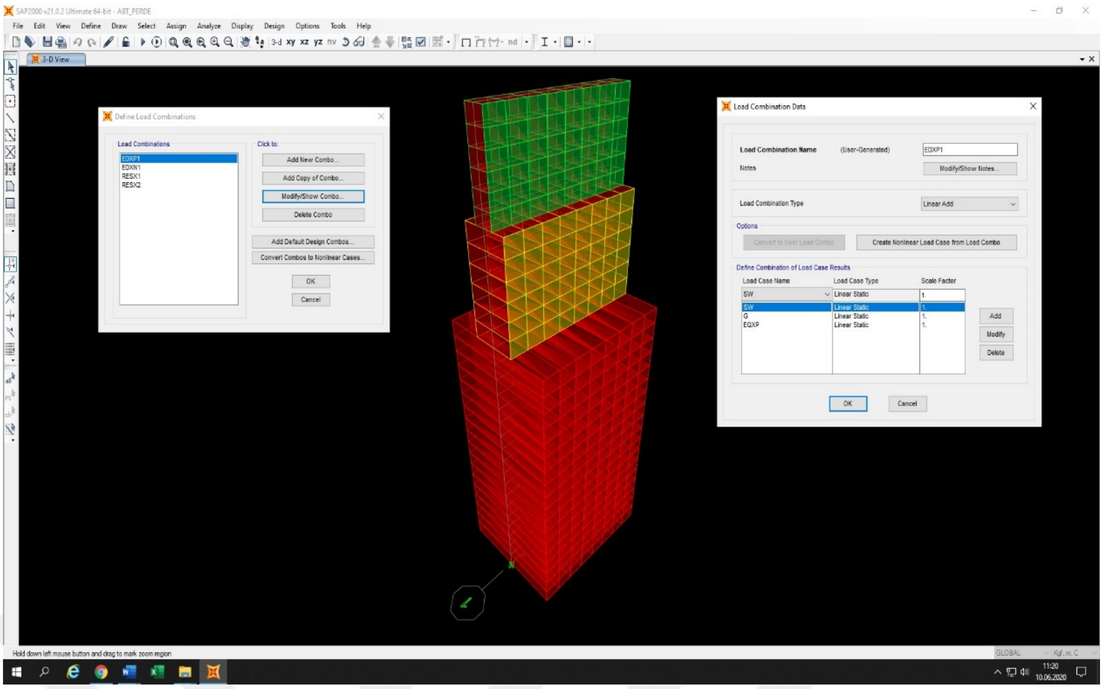


Figure 5.28: Load Combination Data (EDXP1)

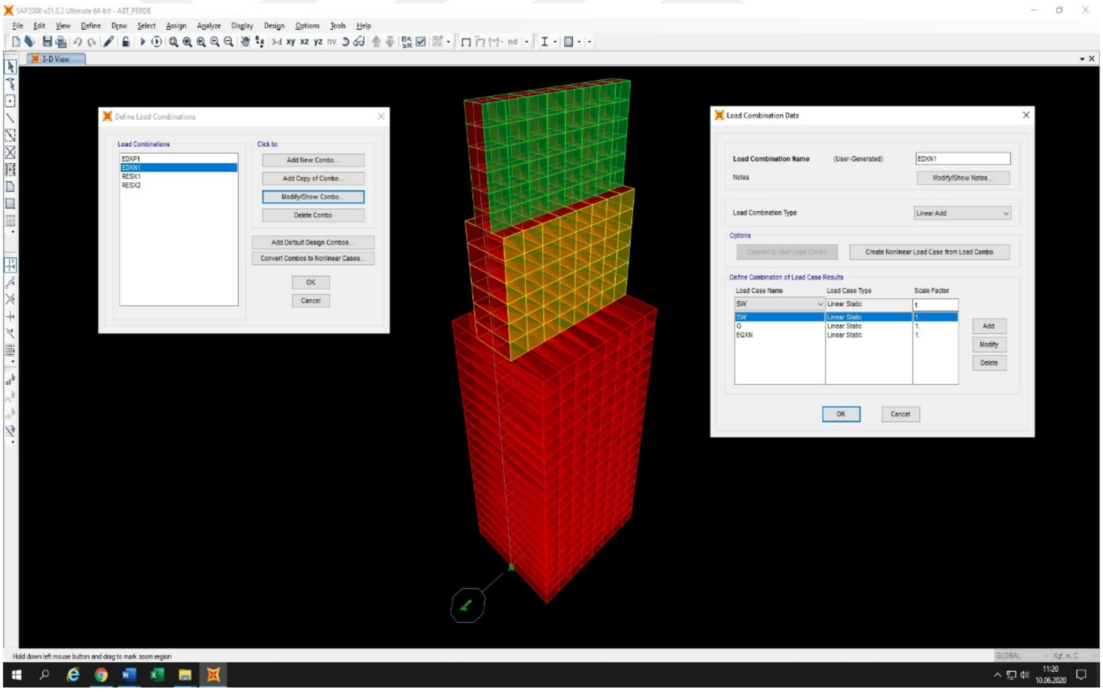


Figure 5.29: Load Combination Data (EDXN1)

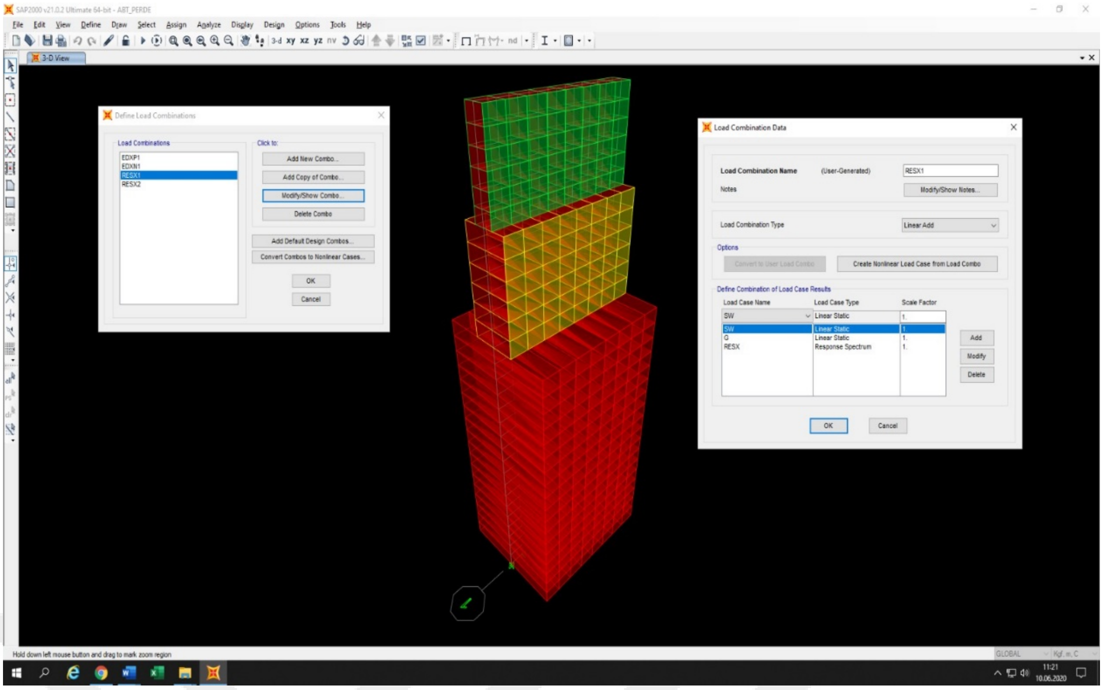


Figure 5.30: Load Combination Data (RESX1)

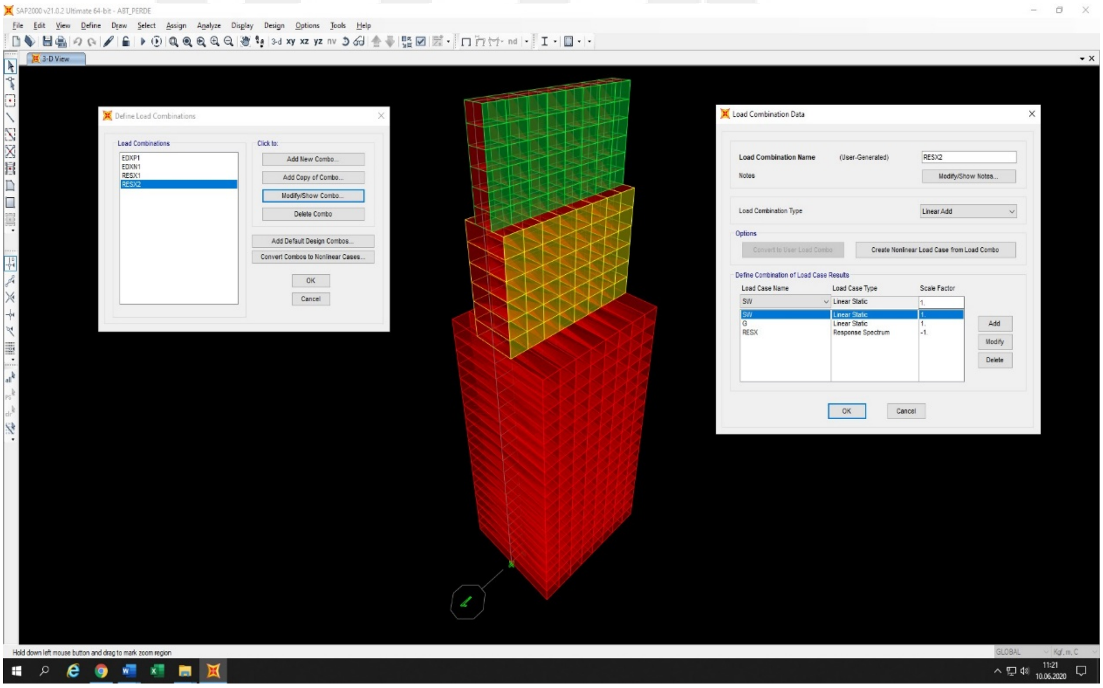


Figure 5.31: Load Combination Data (RESX1)

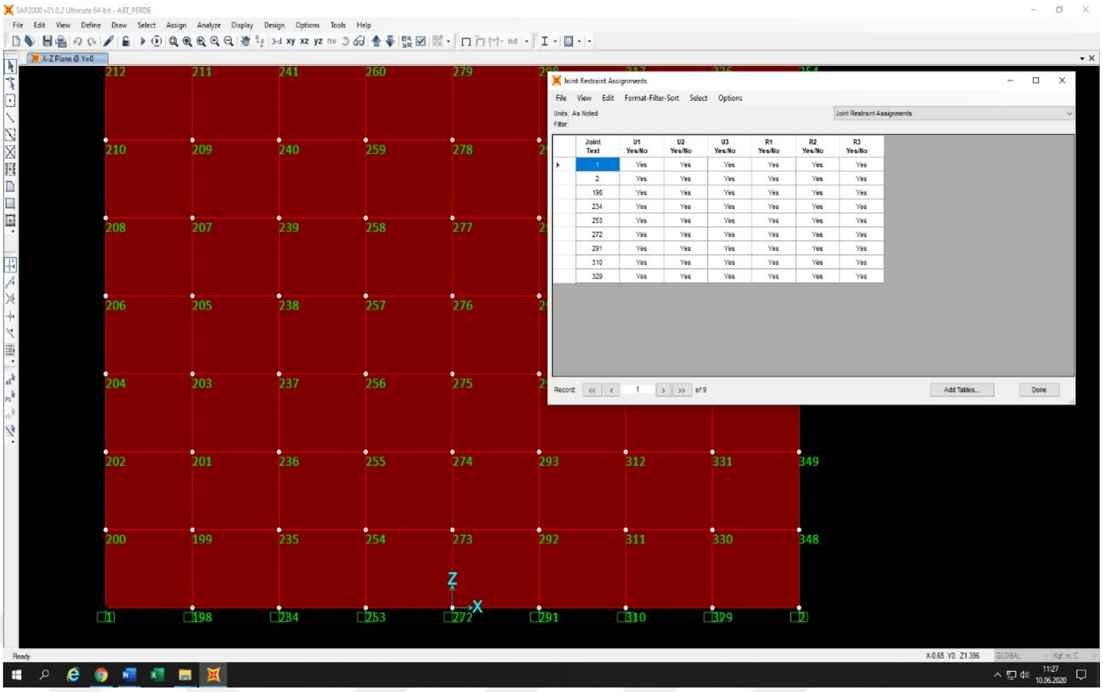


Figure 5.32: Joint Restraint Assignments

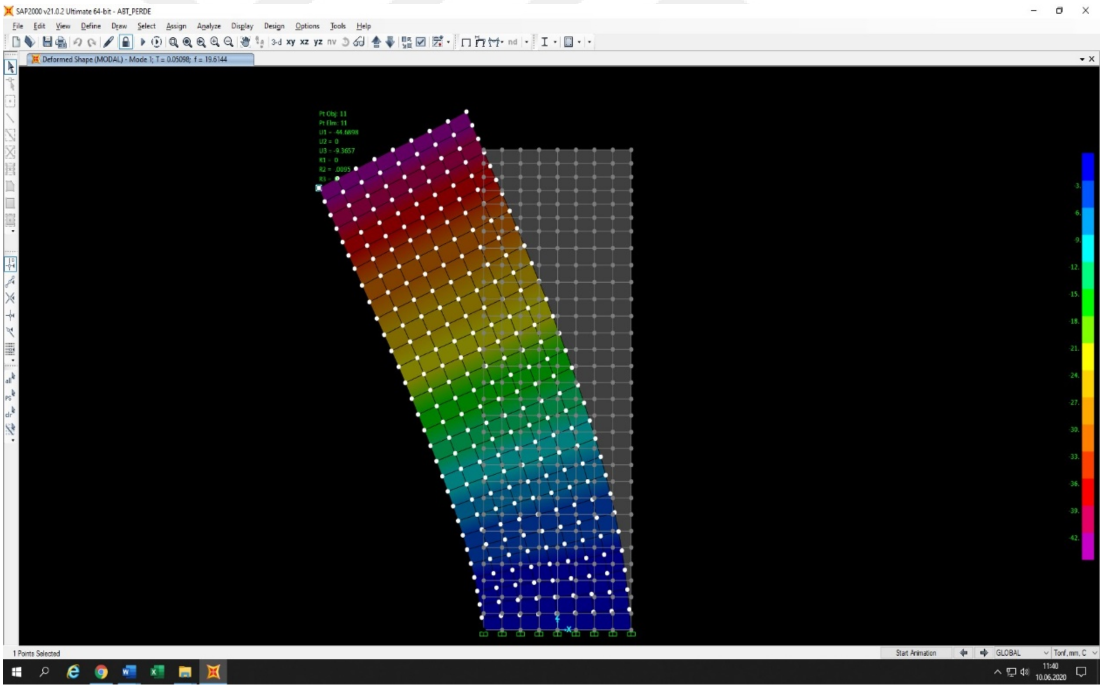


Figure 5.33: Deformed Shape (MODAL)

Table 5.0.2: Modal Participating Mass Ratios

TABLE: Modal Participating Mass Ratios					
OutputCase	**StepType**	**StepNum**	**Period**	**UX**	**SumUX**
Text	Text	Unitless	Sec	Unitless	Unitless
MODAL	Mode	1	0.05098	0.572	0.572
MODAL	Mode	2	0.01508	0.228	0.8
MODAL	Mode	3	0.01243	0	0.8
MODAL	Mode	4	0.00782	0.09	0.89
MODAL	Mode	5	0.00516	0.03	0.92
MODAL	Mode	6	0.0042	0.009314	0.93
MODAL	Mode	7	0.00382	0.021	0.95
MODAL	Mode	8	0.00325	0.00044	0.951
MODAL	Mode	9	0.00288	0.012	0.962
MODAL	Mode	10	0.00271	0.001446	0.964
MODAL	Mode	11	0.00248	0.006335	0.97
MODAL	Mode	12	0.00219	0.001997	0.972
MODAL	Mode	13	0.00209	0.004875	0.977
MODAL	Mode	14	0.0019	0.003217	0.98
MODAL	Mode	15	0.0017	0.004487	0.985
MODAL	Mode	16	0.00148	0.004527	0.989
MODAL	Mode	17	0.00125	0.004283	0.994
MODAL	Mode	18	0.00102	0.003732	0.997
MODAL	Mode	19	0.00082	0.00239	1
MODAL	Mode	20	0.00065	0.000212	1

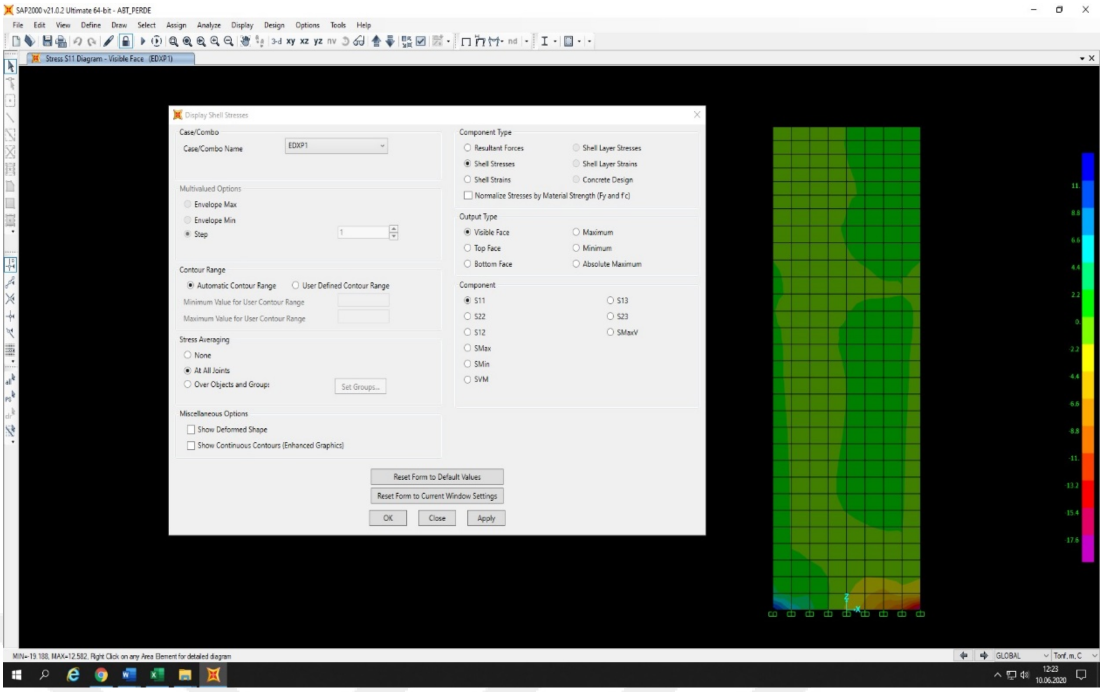


Figure 5.34: Stress S11 Diagram- Visible Face (EDXP1)

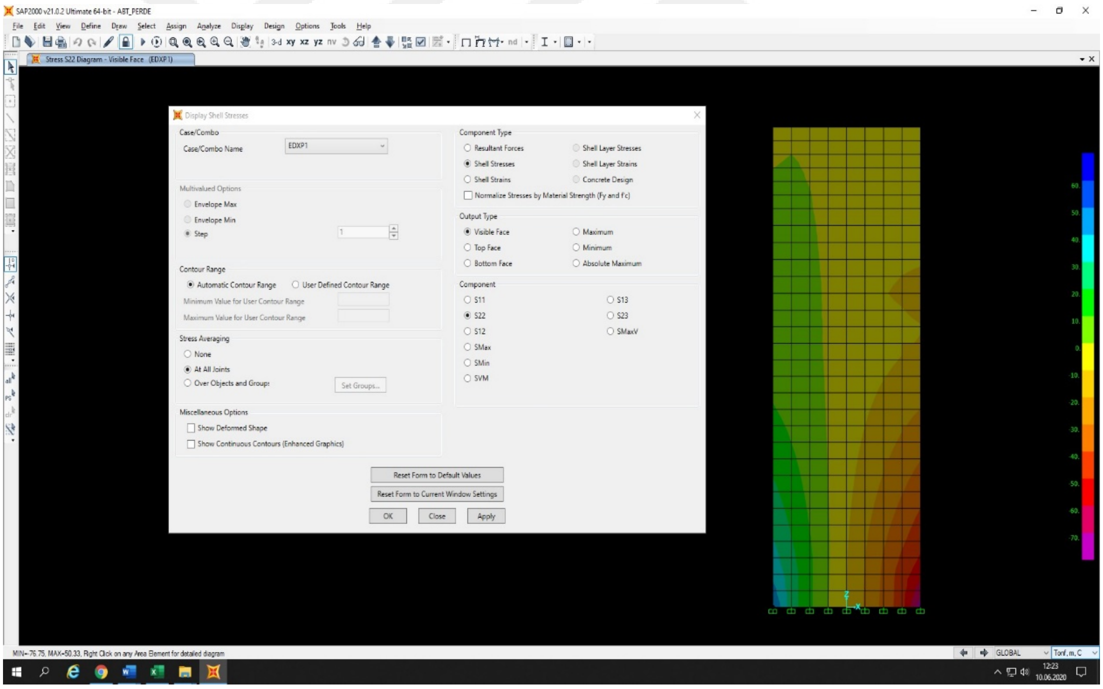


Figure 5.35: Stress S22 Diagram- Visible Face (EDXP1)

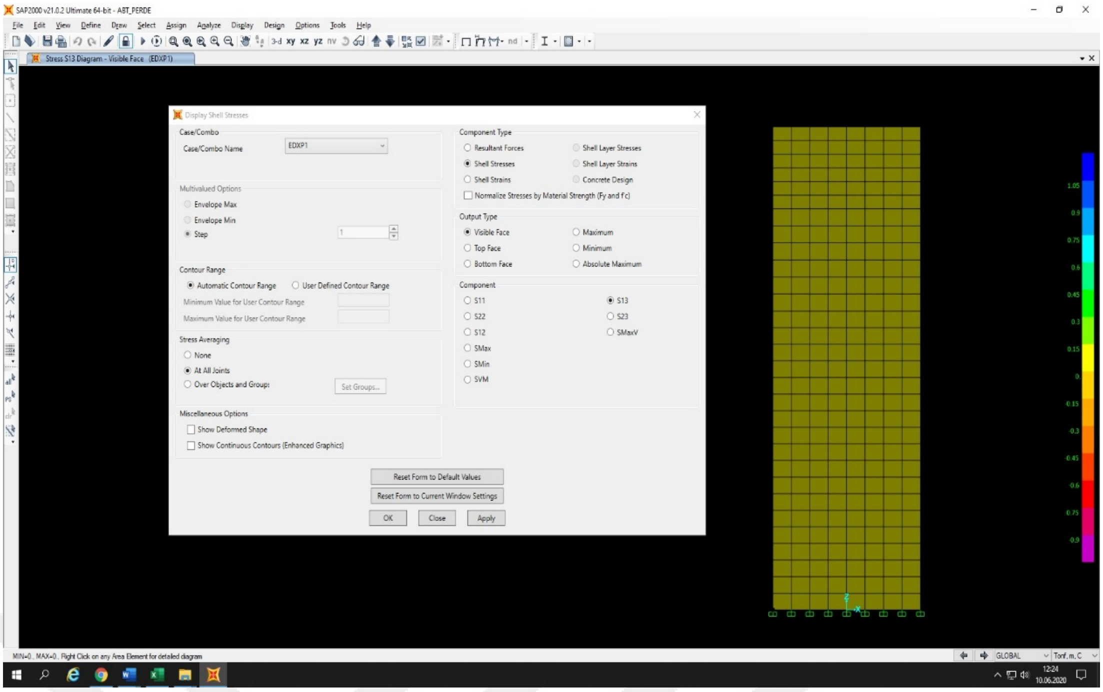


Figure 5.36: Stress S13 Diagram- Visible Face (EDXP1)

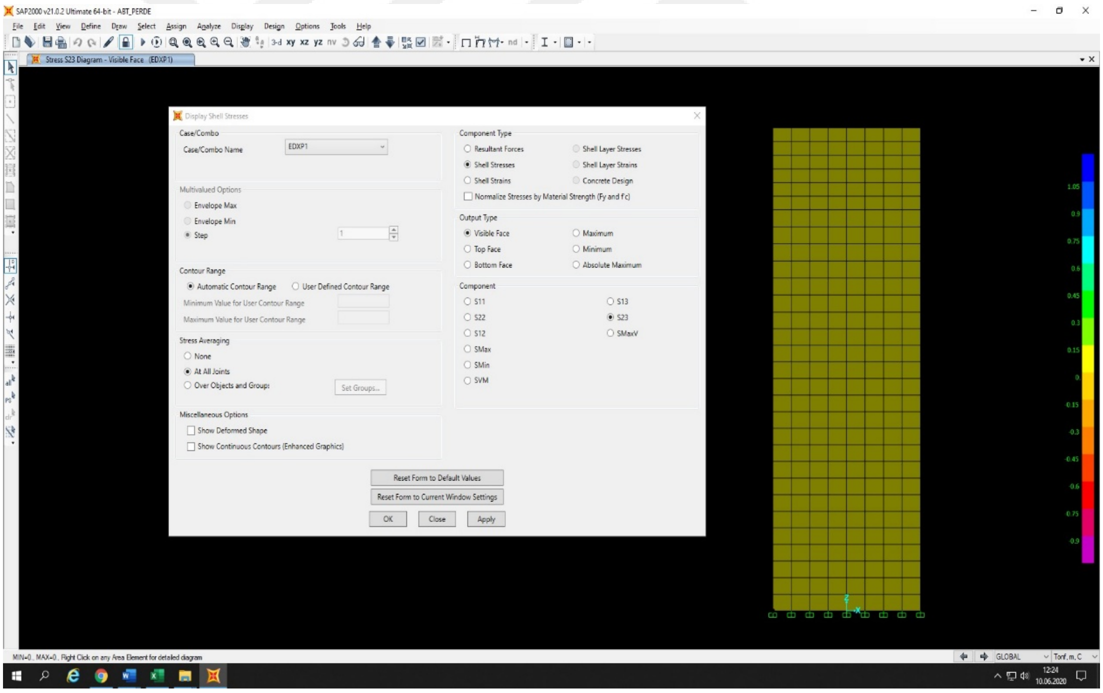


Figure 5.37: Stress S23 Diagram- Visible Face (EDXP1)

However, as it is seen in the current situation of the structure, there is spillage, emptying and deterioration in the mortars between the rubble stones. Since the analysis model does not include material problems due to the current condition of the wall, at least the necessary repairs should be made to the wall part.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS FOR STRUCTURAL STRENGTHENING

As a result of the problems given under the title and in the light of the data from the structural analysis intervention levels can be defined as follows;

1. Loss zones are those that will cause further destruction if the partial or total completion is not performed for the above-described parts. Particularly long wall parts that have been subjected to variable collapses and have lost their parts by off-plane movements should be consolidated with this complement. It is thought that this type of collapse will continue by destroying the remaining parts under all kinds of lateral effects. In order to ensure the joint movement of the structural bushings or walls perpendicular to each other, in the thinned aperture sections as a result of collapses of the corner points and horizontal loads of horizontal loads, the original wall sections can be reached (with completion); the original wall horizontal load transfer habit must be restored to the structure. However, the supplements need not be increased above the existing upper elevation levels unless the internal debris is supported by the wall. In these parts, it is recommended to complete using original masonry technique (original construction techniques). However, in order to be able to perceive the periodic intervention for the future generations, we have moved away from the original knitting technique; For example, it is recommended to make it more prominent by using smoother cut stones. Reconstruction of masonry debris netting should be done with original materials determined as a result of material studies to be performed during application in the structure. The cut stone arch element is of great importance for transferring the said horizontal loads in the building openings and for transferring the vertical loads along the full wall sections. As a matter of fact, as a result of the belt collapse and arching along a wider opening in the entrance gate area, the opening in this area expanded over time. It is important to avoid this again and to complete the original form for healthy load transfer.

2. No crack formation was observed throughout the structures. However, structural cracks or formed capillary cracks detected during application; It is recommended that the stones around the crack be replaced with longer or larger cut stones so that the crack course is cut (cutting the cable) so that the crack course is destroyed. In this way, the wall parts separated from each other as a result of cracks will be combined with both interventions.

In order to restore structural integrity and to provide inertia against out-of-plane movements of the walls, it is essential to interfere and stitch the braids on the outer walls with the inner rubble shell surface in order to complete the complement or to reduce the crack formations. Thus, there will be friction-based relationship and strength between the internal debris and the outer wall lattice.

3. It is important that structures B and D are supported by a wooden scaffold-like system from the bottom, even after completion of the necessary completion. The main reason for this is that today's ruined forms of buildings continue to be damaged by external load factors and that the prevention of this cannot be achieved by partial completion. In order to minimize the interference to the structure and develop a recyclable solution, this type of support system is recommended as the most undamaged and most efficient system.

4. The main degradation prevailing throughout the structure is the reduction of the internal strength of the internal rubble mortar (due to climatic influences, aging, climatic freezing, dissolution and wetting drying cycles) and weakening of the relationship between the outer walls and the internal debris filling. As a result of the attenuation, the walls, which were destroyed by the out-of-plane movement, exposed the internal debris to climatic negative effects. In this context, in order to strengthen the binding property of the internal debris, it is necessary to carry out complete consolidation of the parts in order to maintain their position.

5. Day by day weakened and due to the internal structure of the internal filling in the gap, the change brought by salting has caused the bond between the walls to break. It is necessary to change the hollow structure in order to restore this inner filling and to prevent water and salt transfer to the building materials. In this context, C structure, A structure and D structure, while this type of reinforcement is recommended. It may also be advisable to apply a partial section for the areas where the inner walls of the city walls are exposed to external influences and the outer walls are lost. It is recommended that injection of the application areas with liquid mortar (without

aggregate) original mortar; injection process; the internal and external surfaces of the wall shall be made of holes of 20-30 cm deep 1-2 cm diameter corresponding to the original mortar joints. It is recommended that the injection to be applied is done with a pressure of 1 bar (maximum) from vertical and horizontal points with 1.5 m intervals. Through the plastic pipes placed in the holes, the original repair aggregate without aggregate (the viscosity is provided by increasing the water content) shall be injected in a way that the pressure level shall not exceed 1 bar. When injecting through one hole, it is recommended that the others be closed and that the total volume of injection applied is no more than 10% of the wall volume (volume corresponding to the injection depth - shell volume). It is not considered that the injection to be applied above these levels will flow and contribute to the already saturated wall interior porosity. The main purpose of reinforcing the inner rubble wall with a thickness of 2 m already by injection is to support the solidified shell formations at a depth of 20-30 cm, thus increasing the binding effect and protecting it against surface abrasion.

Application of the injection depth to the bevels above 45 degrees in the upper parts of the inner mortar (remaining in the pillar of the upper alignment of the outer walls)

6. Joint rehabilitation is required throughout the structure, in particular the joint loss zones described in the problems section of this report. This process should be done after the injection process using joints. During the application, the original mortar content determined by the material studies should be used during the application.
Wall filling mortars that have lost their strength as a result of vegetation and material degradation should be cleaned. At the same time, cement-containing mortars, which are the source of salt, should be removed. The elevations in which the walls of the towers narrow and turn into thinner sections and climatic elements affecting the walls in the upper elevations of the walls should be destroyed. Rubble stone elements (internal and external wall stones) whose structural carrier is weakened; It must be removed with the digestion method and replaced with stones compatible with the original material.
7. After the completion of all operations, it is recommended that the mortar rows on the building walls be repaired with the completion of the internal grouting and natural drainage is provided by using the original materials if possible at the top of the building and using natural materials (this is indicated for the straight lines formed on the completed outer walls). Joint rehabilitation will be possible by pointing with repair

mortar on the 5 cm depth of the joints close to the surface. Thus, the climatic effects such as rain and snow will not penetrate the inner parts of the wall. It is considered that the mortar joints are as thin as possible in the knitting to be used at the top elevation and the climatic influences will be prevented from reaching the internal filling of the structure. Keeping the structure away from any cementitious repair material in the future and keeping it safe from salt effects will be one of the measures that will prolong its life.

8. It is recommended that the pre-fill of the internal tap wall be terraced if it is not necessary to completely remove it. It is recommended that this wall be thickened in sections where it is ~ 80 cm thick and then the wall should be stabilized by injection. Because of the current state of the wall, the outer walls of the mesh walls have been lost; the inner filling was exposed. In order to maintain the retaining feature in this state, it must remain in a holistic form. This can only be achieved by consolidating the original binding mortar of the wall; and repair of the abutment system which contributes to the binder. Considering the height and thickness of the wall as a result of the restoration interventions as a result of the prefill cascade, stability control is shown in this report and in the appendices section.

9. It should be noted with these reinforcement recommendations that the structure is not subjected to further deformation; consolidation is aimed to maintain its current state. These suggestions will ensure that the structure does not suffer from total losses. However, since the internal debris of the structure is exposed and will be subjected to serious climatic activities and cycles from now on, consolidation of the debris against local losses or falling of stone fragments can only be achieved through continuous maintenance and repairs. It may also be weak after local intervention against the seismic and wind effects of the structure. The continuity of such repairs is essential. Particularly, this project was carried out in order to attract and advance the visitor routes away from places that are visually destroyed in the internal debris or where there is a threat of falling parts. This principle must also be observed during operation. Because, in these proposals, restitutive completions were avoided in order to ensure the preservation of the original state of the building as much as possible, and the future generations wanted to be transferred as much as possible.

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