

Vulnerability screening by visual inspection of churches of North-East Anatolia

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ABSTRACT: The aim of this study is to detect historical churches in north-eastern region of Anatolia and to perform a visual inspection regarding their structural conditions. A group of churches, which are located in the north-eastern region of Anatolia, are investigated in a field trip. Due to the important historical works of art and architecture, the north-eastern part of Anatolia offer a priceless treasure with the traces of Byzantine, Roman, and Pontus Empires. Reflecting the architectural features of the century, an important number of churches were built in different centuries. Some of these churches still serve for different purposes, while some other are severely destroyed. Today, none of these churches are used for worshipping. On the other hand, these churches are among the most important means to reveal the cultural heritage. It is very important to protect these buildings to provide the link between the past and the upcoming generations. Any process related to the protection of a structure starts with a detailed diagnosis. But when an important number of structures are in question, it might take considerable time and energy to perform a detailed diagnosis for all. Besides, it might not be possible to save all of them at once. Under these circumstances, a visual inspection would be good start to determine the condition of these churches to take the necessary precautions and to perform the most appropriate process in the further steps.

Keywords: Historical Churches, Cultural Heritage, North East Anatolia, Visual Inspection, Structural Evaluation.

1 INTRODUCTION

Historical structures, as the most important means of cultural heritage, are the links from past to future. They reveal the social, archaeological, aesthetic, economical, political, architectural and technical features of their times. Today, it might seem to be unfortunate that no nation remained in its original territory. From the very early years of humanity, different civilizations left some parts of their cultures by means of historic buildings that still stand. Anatolia, have hosted many civilizations since the very early years of humanity. Protection, conservation and restoration of historical structures start with a full diagnosis of a structure. Visual inspection methods, which have widely been used in the recent years, are among the most effective means to obtain detailed information that would be effective on the selection of the appropriate protection method. These methods enable to summarize the existing situation of the building and to form the basis for what would be needed in the proceeding steps, before carrying out more expensive

and time consuming processes like technical surveys, experimental works, and etc.

In this research work, the churches in north east part of Anatolia are investigated and visual inspection is realized regarding their structural conditions. A group of churches, from north-eastern region of Anatolia are investigated in detail. The north east part of Anatolia has an important number of historical works of architecture thanks to the traces of the Byzantine, Roman, and Pontus Empires. Reflecting the architectural features of the century, an important number of churches were built in different centuries. Some of these churches still serve for different purposes, while some other are severely destroyed. Today, none of these churches are used for worshipping. On the other hand, these churches are among the most important means to reveal the cultural heritage. It is very important to protect these buildings to provide the link between the past and the upcoming generations. The results of the study show the risk level of the historical churches in the north-eastern region of Turkey. This would help to take the necessary precautions to

help the structure by means of the most appropriate method for conservation/restoration/strengthening.

2 HISTORY AND SEISMICITY OF ANATOLIA

Anatolia involves significant transition roads or passages, such as Silk Road. The lands have hosted many civilizations, some of which date back to the very early ages. The most evident traces of these civilizations could be seen as the historical buildings that stand still. These buildings are diverse in terms of construction type, function, structural materials and architectural aspects due to the requirements and possibilities of their ages. This does not mean that each building has been kept as its original situation; some of these buildings served for more than one society in quite a long period of time with minor or major modifications. This creates a harmony in the overall character of the built environment.

An important number of historical buildings that date back to different periods keep lighting the past of the land. This is the reason that people from all around the world visit Anatolia to see the traces of their civilizations to understand the lives of their ancestors. On the other hand, it is unfortunate that most of the historical buildings in Anatolia are in poor situations today. Anatolia is a potential source for earthquake engineers to carry research on earthquake behaviour of the existing structures. It has a strong seismic activity. Several severe earthquakes throughout history have caused significant damages in some regions. Movements of the Eurasian Plate, African Plate, Arabian Plate and Anatolian Plate are what that causes earthquakes. The Arabian, African and Eurasian Plates move to north and south towards each other. As a result of this, the Anatolian Plate is squeezed out westwards. This westward movement results from differences in rates of motion between the Arabian and African Plates. It has been reported that several intense earthquakes have hit Anatolia in the past centuries. For earthquakes that occurred after 1900, far more detailed information is available. There are many reasons that existing historical buildings sustain damage or collapse: soil settlements, fires, and decays in the material due to weathering conditions, human vandalism, and natural hazards. Among them all it is the earthquake that has the worst impacts on historical buildings. Even the modern codes and regulations related to earthquake resistant building design could not prevent contemporary buildings to sustain damage in the recent earthquakes. It is unavoidable that historical buildings the design of which were not based upon seismic design regulations, but past experience and geometrical proportion rules sustain damage or to-tally collapse. These buildings are supposed to be means to protect cultural heritages through history and should be well protected against hazards.

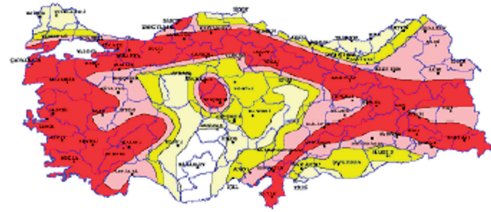


Figure 1. Seismicity of Turkey (General Directorate of Disaster Affairs, Earthquake Research Department).

3 SEISMIC AND HISTORICAL STRUCTURE OF NORTH EAST REGION IN TURKEY

The North east Region covers approximately 18 percent of the land in Turkey, with a surface area of 141,000 km². It is also called as Black Sea Region, which gets its name and characteristics from the adjacent sea, extending from the border of Georgia in the east to the eastern edge of the Adapazari Plain in the west. All the provinces of Artvin, Rize, Trabzon, Gumushane, Bayburt, Giresun, Ordu, Sinop, Samsun, Amasya, Kastamonu, Zonguldak, Bartin, Bolu, and almost all of Tokat, are in the Black Sea Region. Artova County of Tokat Province is in the Central Anatolia Region. One half of Corum Province is in the Central Anatolia Region and the other half is in the region. This study investigated east part of the region where the historical churches are located mostly.

Trabzon is an important port in the Eastern Black Sea Region. Along with its natural beauties it also has a reputation as an industrial city. Besides, the city is an important historical centre. There is an important archaeological excavation centre remaining from the early Bronze Age.

Trabzon was founded by the Ionian rooted Milesians people in 7th century BC. The city was dominated by the Persians in the 6th century BC. In 334 BC, with the triumph over the entire Anatolia, the region was conquered by Alexander the Great. In 280 BC, Trabzon was taken in the borders of Pontus Empire. It was the Roman Empire that ruled the region from 66 BC to 395 AC. Afterwards, the region was under the domain of the East Roman-Byzantine Empire until 1204. In 1204, the Komnenos Kingdom was founded at the end of the Crusades. Trabzon had a brilliant period under the reign of the independent Komnenos Kingdom until 1265. Due to some disagreements between the Ottoman Empire and the Komnenos Kingdom, Trabzon was conquered by the Ottomans in 1461. It was 1916 when the Russians had short term dominance over the region, but this lasted only less than a year. After the fall of the Tsarist Russia, Trabzon has become a province of the Turkish Republic.

Gumushane is a typical Black Sea town covered with hazelnut groves which extend for kilometres away



Figure 2. Black Sea Region in Turkey.



Figure 3. General views from the Black Sea region.

within the greenery. It is also a very attractive place thanks to its natural beauties besides historical values.

The history of Gumushane dates back to 3000 BC due to rich silver mines. Despite the very old history, the amount of architectural works in and around the city is quite limited. The reason for the lack of architectural examples of early ages could be seen as the fact that the province remained as a buffer zone because of its geographical conditions. On the other hand, it might not be so pretentious to claim that Gumushane has the highest number of churches among the other cities in Anatolia when compared to its surface area. The city first hosted the Hittites. Enjoying considerable power in the Middle Anatolia, Urartu people were in the region from 860 BC to 550 BC until the dominancy of Alexander the Great over Anatolia. The Persians were the end of Alexander the Great, but they could not extend their borders till Gumushane. From 301 BC to 20 AC, Gumushane was the territory of the Pontus Empire. From 20 to 395 it was the time of the Roman Empire. The city seems to have hosted either the Arabians or the Byzantines in turn, from 7th to 11th centuries. In 1016 the province started to be ruled by the Turks. The Mongol Empire took the domain from

the Seljuks in the 13th century. The Ottoman Empire lasted in the region from 1514 to 1916 until the Russian occupancy that ended in 1918.

Artvin is located at the Caucasian border of Turkey. It was the hardest one to reach for the research. Kafkasor, Bilbilan, Yaylalar, Meseli, Meydancik, Camlik and Yarlik are famous high plateaus of Artvin which have a great number of historical churches. Artvin and its surroundings host bunch of churches, which were constructed by the Georgians and are of interest with their architectural attributes. Among these, the Ishan with extremely beautiful stone carved workmanship, the Barhal, which is a basilica with its interesting facade, the Dort, which consists of four different structures and the Rabat, which has secret passages, are the most important of the historical heritage. These churches were generally constructed in the ninth or tenth centuries.

The history of Artvin does not point to very old ages. From the 4th century BC, the province seems to have hosted civilizations with Caucasian language, Indian-Persian language, and Turkish language. The province was under the domain of the Pontus Empire in the 1st century BC. During the dominancy of Romans over Anatolia, Artvin and its environs were the territories of the local kingdoms. The province hosted the Byzantines in the 5th century, the Arabians in the 7th century, the Seljuks in the 11th century and the Mongol Empire in the 13th century. It was under the reign of the Ottoman Empire from the late 1400s to the early 1900s. Artvin was under the do-main of Russians for 43 years in a period from 1878 to 1921.

4 METHODOLOGY

In this study, with a particular emphasis on churches, the historical characteristics of the north-eastern region of Turkey are explained. The importance of the cultural heritage, which is under great risk due to the earthquake prone characteristics of the country, is reflected. Rapid Visual Inspection (RVI) Method is chosen as the quickest way to understand the reliability and risk level of the group of churches chosen as the case study for the research.

In the present study, the historical churches located in north east of Turkey are investigated. 9 different churches are taken into consideration and RVI methodology is applied on these buildings to understand their structural conditions. This study evaluates an earthquake risk regarding with structural conditions of the existing historical churches.

Rapid Earthquake Assessment is realized by means of Rapid Visual Inspection (RVI) methodology from ATC 21. After the method is explained in detail, it is applied to the selected churches.

5 RAPID VISUAL INSPECTION (RVI)

There are so many rapid visual inspection (RVI) methods available from various sources as given in ATC 21 and 156 some other references (ATC-21,156, 2001). In this study, ATC 21 is considered as RVI methodology for earthquake evaluation of historical churches in north east part of Turkey.

The objective of the methodology is to inspect and evaluate historical churches in the subjected area quickly and with minimum man power. Rapid evaluation is designed to utilise the talents and experience of building inspectors and other people with similar experience. This does not preclude the possibility of using experienced structural engineers. Once all buildings in a given area have been inspected and those are apparently safe or obviously unsafe have been posted, the remaining structures are left for detailed evaluation by a structural engineer. The rapid evaluation method is designed to be used by individuals with some experience in general building design. This includes building inspectors in particular as well as volunteer civil engineers and other who have been involved in building design and construction.

The damage inspectors need to be familiar with building construction. Rapid evaluation procedure begins with a reconnaissance of a subjected buildings area. When the building(s) is selected for evaluation, the first step of RVI is inspecting the envelope of the structure. The inspectors need to walk around the entire structure. Ordinarily, only the exterior of the building is inspected at this phase, unless there is a suspected or reported problem. This is done primarily to maximize the number of the inspections in the immediate post-event period.

Each church is evaluated using six basic RVI criteria given below. These are used to rate the building condition with respect to nature of building especially in case the building has historical value (ATC-21, 2001). Rapid Visual Inspection Methodology Procedure could be given as below;

1. Examine the outside of the structure entirely.
2. Examine the ground in general area of the structure for fissures, bulged ground, or signs of slope movement.
3. Ordinarily enter a building only when the structure cannot be viewed sufficiently from the outside.
4. Evaluate the structure according to condition of the structure and complete the RVI. Doubtful buildings should be kept for detailed evaluation.
5. Post the structure according to the result of the evaluation. Post every entrance to a building classified limited entry or unsafe.
6. Explain the significance of limited entry or unsafe postings to building occupants and advise them to leave immediately.

6 APPLICATION OF RVI METHODOLOGY ON SELECTED HISTORICAL CHURCHES

According to methodology, rapid evaluation inspection methodology procedure part, the churches are evaluated for earth-quake resistance and structural properties (ATC-21, 2001). This form sheet is applied on the churches with visual inspection. The rapid visual inspection methodology is applied on the selected churches, which are: Trabzon Hagia Sophia, Trabzon Girls Monastery, Gumushane Mother Maria, Gumushane Sariun, Gumushane Harmancik, Gumushane Ugurlutas, Artvin Yusufeli, and Artvin Ishan. These churches are historically very important and some of them are under the risk of collapse.

Trabzon Hagia Sophia Church:

The Hagia Sophia Church was built in the 13th century during the period of the Komnenos Empire. 1427 is the date when the church was provided with a bell tower. It is a well-known fact that in 1864, while the building was serving as a mosque, it was maintained thanks to the donation by Riza Efendi. During the 1st World War, the building served respectively as store, hospital, and mosque. It was re-stored again between 1858–1962 by a collaborated work of Edinburgh University and the General Directorate of Endowment (General Directorate of Pious Foundations). Since then the church has been serving as a museum.

The building is a good representative of the late Byzantine churches. It has a cross shaped layout covered with a central dome at the top. The 12-cornered dome and its drum are supported by means of four marble columns, arches and pendentives. The abscissas are circular at the side naves and pentagonal in the central nave. The narthex, which hosts a chapel, serves as the entrance. Different types of vaults were used as the means to cover the top of the structure around the main dome. This ends up with different heights along the structure, all covered with roof tiles.

The precise workmanship on the stones reflects not only the Christian but also the Islamic art of the Seljuk period. The stalactite niches on the western facade, together with the medallions with geometrically sleeved ornaments on the western and northern cloister facades show typical characteristics of Seljuk stonework.

6.1 Trabzon Girls Monastery

The Monastery was built in the 14th century (1349–1390) under the reign of Alexsios III. Several additions were made to the building in the 18th and 19th centuries. When it was first constructed, it was composed of the Rock Church with sacred water inside, and a chapel at its entrance and some small chambers. There are epigraphs and the portraits of Alexsios III, his wife Theodora and his mother Irene in the Rock Church.



Figure 4. Outer view of the Trabzon Hagia Sophia.



Figure 6. Gumushane Mother Maria Church.



Figure 5. Trabzon Girls Monastery



Figure 7. Gumushane Sariun Church.

In the 19th century (1893–1906), a church on behalf of Konstantions, the bishop of the monastery, his sepulcher, student rooms and guest rooms were built. Located on the hillside of Boztepe, the Monastery is surrounded by fortification walls. The frescoes inside the Rock Church and on the outer walls of the entrance part are severely damaged. The sons of Alexsios, Anrokinos and Manuel are buried here. The monastery has been abandoned since 1923.

6.2 Gumushane Mother Maria Church

The church, which is located in the Kurtun Province-Yaylali Village is a work of 19th century. It is rectangular in plan and has one nave and one abscissa. Constructed of cut-stones, the structure is covered by a steep triangular roof at the top. Surrounded by marble architraves, the entrance of the church is on the southern side unlike the other churches. There are no frescoes or any other ornaments in the church.

On the eastern part of the church a cistern, which is connected to the building with an arched passage takes

place. Meanwhile, on the southern part, there seems a partially damaged fountain located about 5 m away from the church.

6.3 Gumushane Sariun Church

The Sariun Church, which was constructed in the 19th century, is located in Yaglidere Village, Krom Valley, Sariun District. The building is rectangular in plan with three naves and three abscissas. Constructed on a scenery hill, the top cover of the church was demolished years ago. The only means of ornament of the church is seen to be the motif of a cross on the entrance door. There are no frescoes or any other ornaments within the building.

6.4 Gumushane Harmancik Church

The building is located in the Torul Province, Harmancik Village, Mesehor District. It is an Armenian church, which is believed to have been built in the second half of 19th century. The building is



Figure 8. Gumushane Harmancik Church.



Figure 9. Gumushane Ugurlutas Church.

constructed of regular cut stones on the western wall, and rough stones on the rest. It has a rectangular layout in plan. The arched entrance has a tympanum at the top, and is on the west. Nine windows are arranged around the building. The roof, which is supposed to be a barrel vault, is severely damaged. Just as the church itself, the chapel, which is 100 m away at the south, is also demolished.

6.5 Gumushane Ugurtas/Ugurlutas Church

The building is in the Torul Province, Ugurtas Village. The construction date is not known. The building is rectangular in plan and has three naves and three abscissas. There are 14 windows around the building. The top cover consists of a barrel vault and a hexagonal dome, which is partially demolished. There take place 6 columns and arches in between, to support the roof. The columns are connected to each other by means of tension ties underneath the arches. The entrance door is original.



Figure 10. Artvin Yusufeli Church.



Figure 11. Artvin Ishan Church.

6.6 Artvin Yusufeli Church

The church, which is also known as Barhal Church is located in Altiparmak Village within the borders of Yusufeli Province. The literature depicts that the building is a work of late 9th and early 10th century and was dedicated to Saint John the Baptist during the period of King David Magistros. After 16th century, it was repaired on behalf of Haci Serif Efendi and was converted into a mosque. The church is constructed of regularly cut stones in a basilical plan layout with about 28×19 m dimensions. The building has three naves. The facades, all of which are constructed of grey coloured cut stones, are given a harmonious rhythm by means of identical arches on the southern and northern facades and slightly widening arches from the sides to the middle on the western and eastern facades.

6.7 Artvin Ishan Church (Ishan Monastery Church)

The church is located in the Ishan (Dagyolu) Village at 11 km east of Yusufeli Province. The monastery was

Table 1. Evaluation of selected churches with RVI methodology.

Churches	Damage levels	Under protection	Restoration	Environment	Entrance control	Structural members	Risk of collapse
Ayasofya	Low	Yes	Yes	Full	Yes	Existing	Low
Trabzon Girls Monastery	High	No	No	Non	No	Damaged	High
Gumushane Mother Maria	Mid	No	No	Full	No	Existing	Mid
Gumushane Sariun	High	No	No	Non	No	Damaged	High
Gumushane Harmancik	Mid	No	No	Non	No	Existing	Mid
Gumushane Ugurlu Tas	Mid	No	No	Full	No	Existing	Mid
Artvin Yusufeli	Low	Yes	Yes	Full	Yes	Existing	Low
Artvin Ishan	High	No	No	Full	No	Damaged	High

constructed in the 9th century, and served as the episcopacy until the middle of the 16th century. In 16th century the building was converted into a mosque by the Ottomans and served as a mosque until 1983.

The monastery is composed of a church and a chapel, both of which are constructed of regularly cut stone. The church is an important reflection of the art of the age both with architectural features and with frescoes at the inner surface of the dome. Outside, the dome is seen to be a cone which sits on a deep drum. The column capitals have carved ornaments. The entrance of the church is surrounded by means of geometrical relieves.

7 CONCLUSION

In this study, the importance of the historical structure of Turkey and particularly, East Black Sea region is emphasized. It is clearly seen that the historical structure of Turkey is very strong and valuable. Particularly this region is very important location in terms of historical and natural values. On the other hand, Turkey is one of the earthquake prone countries. The existing historical structures in Turkey are under high damage risk. It is necessary to take some measures immediately against the earthquake and disaster risk.

Rapid Visual Inspection methodology from ATC-21 is given in detail in this study. This methodology is a pre-evaluation methodology for structures under earthquake and collapse risk. Via this methodology, the earthquake seismic assessment can be realized in approximate boundaries. This is very important stage of complete earthquake evaluation process.

In the present study, the rapid visual inspection methodology is applied on eight churches located around Black Sea region, Turkey. The results of the methodology are given in Table 1. As a result of rapid visual evaluation, most of the existing churches are under risk of collapse and it is necessary to take some precautions immediately.

There are some structural damages on the walls and some diagonal cracks on the wall structural system. These churches' structural members are getting older and getting damaged in its service life. The next step of the earthquake evaluation of these two historical churches is performance based evaluation of the structural systems of the churches.

In Table 1, damage levels, protection information, restoration information, environment of the structure, entrance control, conditions of the structural members and finally, risk of collapse are given in chart. With these information, the general condition of the selected historical churches are taken into consideration in sense of structural behaviour and seismic assessment. The parameters given in the chart are very essential regarding with the structural seismic assessment. As a result, historical churches in turkey under structural damage risk and should be consider as a cultural heritage to protect for future generations. Some of them are in need of structural strengthening and must be control with structural analytical damage assessment methodologies.

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