“OVIDIUS” UNIVERSITY OF CONSTANŢA CITY
INSTITUTE OF DOCTORAL STUDIES
DOCTORAL RESEARCH FIELD: CIVIL ENGINEERING

THESES OVERVIEW

CONTRIBUTIONS ON REDUCING RISK FACTORS FACED BY HISTORICAL MONUMENTS BUILDINGS LOCATED WITHIN THE ACTIVE OF THE BLACK SEA CLIFF. SOLUTIONS FOR USING THE LIMITED SAFETY

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CONTENT

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I truly hope that by using my knowledge acquired during all these years and put down in this thesis, I had a contribution to making popular the history of the old part of our City, its streets and buildings of the 19th and beginning of the 20th century; I also hope my doctoral research work will contribute to preserve and pass on to the future generations an important technical and historical part of our city history.

I consider that, for the time being, my contributions will be a first important step in the economy of big projects that are to be implemented by Constanta City Hall in the near future.

Key words:

built, patrimony, monument, protected area
cliffs, land sliding, disruptive elements,
risk, monitoring, limited safety

Chapter 1 – Introduction

1.1. Reason for choosing the theme

The City of Constanta has an important number of buildings classified as historic monuments and many others with elements of distinguished composition, as the result of talent and creation of engineers, architects and, last but not least, of traders over the centuries. Ovid Place, Tomis Harbor with the entire cliff of the old town are the most precious part of the history and civilization of these people, of the new modern history concept combined with the classic old fashion of the last 2 centuries.

Placed on the ruins of the old town, each building we see today is a hystorical step, clearly defined in the urban composition.

Like nowhere else in the world, it seems that old buildings, imagined and built by well known engineers and architects, are submitted to a powerful exploitation process made up of destructible elements logically sinthetized as it follows: natural hazards (earthquakes, coast erosion, powerful winds, salty environment), or agressive factors generated by the human activity (pipe leakeages, maitenance works done too late or of poor quality, slope works for certain buildings, creation of slopes due to foundation land type).

As time goes by, these dangerous elements become more and more agressive, hard to stop and very expensive to be eliminated. To be aware of the the situation means to have measured all hazard elements which alter the buildings vulnerability degree; it also means to make risk maps for slopes in order to adopt the necessary measures to reduce or even eliminate the risks.

Taking into account all these, the work wants to help to quantify the risk elements, to reduce their impact on the patrimony buildings, to propose intervention measures to preserve and rehabilitate historic monuments.

Therefore, there are two aspects on which the work focuces on: elimination of the risk elements and adoption of minimal measures on the resistance structures of the buildings, of their infrastructure, of the land under the foudantion in orde to obtain a limited safety.

1.2. Theme importance and topicality

Studies and researches made for the researching plan showed that international governments are very interested in reducing the risk for historic monuments and they began a series of projects intensely supported by international bodies such as UNESCO. This is a growing concern among the members of communities, among specialists, all over the world, as all of them are interested in preserving and passing to the next generations, the valuable components of buildings and urban assemblies, just as they are, rich and diverse in their authenticity.

This work wants to start and develop fundamental principles for preservation and protection of historic monuments and urban assemblies set as historic sites or protection areas in order to preserve and maintain the historic nucleus of buildings, to limit the desasters effect and also to participate to the discovering process of such procedures and methodology for all these actions.

The theme of this work is a very common topic nowadays as it contains a preserving and protective attitude for historic monuments, it will present measures for limiting the risk by combining the needs of contemporary community with the preservation of these a historic pieces of evidence. The results of the research will be an important basis for adapting the present regulations to the requires of historic monuments, given the fact that nowadays there are no regulations or guiding lines focused on exploiation, maintenance and preservation of such buildings.

The importance of the research plan is highly supported by the lack of a specific regulation for historic monuments, by the absence of the research analysis and interpretation criteria, by the absence of a catalog focused on traditional techniques and helpful for preservation and protection works.

1.3. A theme present also among the national and international concerns

Europe has a very diverse law frame on preservation and protection of historic patrimony.

For instance, in Germany, the law is not the same for all regions. In Bavaria there are laws from 1908 whereas government in Schleswig-Holstein Land applies the regulations after the 2nd World War. In Holland after inappropriate works on a cathedral, in 1875 a special Department was created in order to supervise the monuments.

Europe made the first list of historic monuments in 1903. In Italy, the preservation actions played a crucial role. Special laws have been applied since 1939 as it is mentioned by the works of Gustavo Giovannoni.

France was the first country in the world that, at the beginning of the 19th century, created a commission specialized in natural patrimony. Here, the law regarding the environment protection is over 200 years old and that is the reason for which we can see an attitude to preserve not only important buildings but also urban sites. More and more, in the recent years, we have seen being promoted a policy for protection of the valuable patrimony areas located outside the urban limits. France is the first country where there is a law frame on landscape protection (Forest Code of 1669 including elements of environment protection and old areas). An important moment in the French history was the adoption of the law proposed by Andre Malraux – writer and political man, in 1962, who proposed an inventory of the artistic patrimony values. Thus, the first protected areas were in Paris. Today, the French policy is highly connected to complex programs for integrated economical administration in order to promote tourisms, traditional jobs, all for rehabilitate and maintain the patrimony. Given al these, France has a new approach based on clear measures for urban and territory planning, tourist attraction for these objectives [70]

The United States have a different legal frame concerning the patrimony preservation. Here, the first time we have a mention related to this is 1856. This kind of actions focus also on the house of George Washington which was bought by public contribution. The first law made to protect the historic monuments was in 1906 with the name Federal Antiquites Act, asking the Home Affairs to protect the prehistoric and historic ruins, the monuments and the objects located in the federal area. Also, in 1949, during a congress, The National Trust for Historic Preservation is founded and in 1960 starts the national program called National Historic Landmark.

In Romania, the first interest in protecting the historic monuments apprears in 1870[71]. In 1892 the Commission for Historic Monuments creates the first law on historic monuments taking its inspiration from the French model. Now, an important figure in promoting restauration principles is represented by the French architect Andre Lecomte du Nouy, who, during 1875-1914, asked by the King Charles 1st of Romania, came and worked restauring several monuments in Romania. He is the one who initiated the stylish restauration procedures, a little too exaggerate, given the fact that they were no longer used in Europe.

In the works of architect Dumitru Ionescu, we can see that architect Andre Lecomte du Nouy used the restauration doctrine of Viollet le Duc, but in a regrettable way, as, by doing so, he destroyed architectural monuments such as *The Assumption of Virgin Mother* of Curtea de Arges and *Three Churchemen* Church of Iasi. His technique consisted in demolishing part of the construction and rebuilding it, not always observing the initial style.

The Commission for Historic Monuments was created at the beginning of 20th century and ceased its activity in 1948, being seen as a bourgeois institution. In 1951 the Scientific Commission for Museums, Historic and Artistic Monuments is established while in 1959, the Department for Historic Monuments begins its activity.

In 1974 is adopted the Law no 63 on setting up the Central State Commission for National Patrimony playing an important role in the next time period. For almost 2 decades, important restauration works took place (cities, churches, monastery assemblies, ancient sites). At the beginning of 1970 modernizing strategies for Romanian towns were adopted, reaching their climax in the 1980s when the entire Romanian cultural life is marked by an absurd attitude towards material and spiritual elements of historic monuments.

In 1990 is made up the Commission for Monuments, Assemblies and Historic Sites which afterwards carries out its activity under some national institutions, bringing a new attitude in the cultural and spiritual life, more exactly Law no 422 of July 18th 2001 on protection of the historic monuments. At the same time, several state institutions are created with the aim to provide scientific, logistic and financial coordination in the patrimony protection activity, such as National Institute for Historic Monuments, National Office for Historic Monuments and National Commission for Historic Monuments. [72]

The City of Constanta has a Area Urban Planning – rehabilitation and revitalization of Constanta peninsula area, approved by the Local Council Decision no 416 / 21.11.2003, now being subjected to updating process, which allows local authorities to value the urban potential, to make efficient the economic objectives, especially the touristic ones, and to integrate the area within the road traffic of Constanta City. This work has a regional and national importance at the same time. Investments analysis pays attention to the prognosis of the main merchandises flows on the Black Sea between 2020 – 2040.

In the Peninsula Area Urban Planning [79], as compulsory provisions, there are the following items that underline the necessity and the importance of urban and engineering studies in the protected area:

Article 5 – (a) Any action carried out to some historic and architectural monuments or on the protected historic site, requires specialized approval according to law, supplementary justifications being necessary in order to obtain authorization, by displays, photo productions, models for each action on buildings declared historic and architectural monuments as well as for emplacement of new buildings or beginning of outside furnishing works or for demolition of parasitical constructions; all these shall be showed in connection with the present historic and architectural monuments, within 100 m around and in the co-visibility area. [79]

Article 6. - (a) All territory reference units, mentioned in this regulation, shall take into account the conditions presents in the basic study on Geotechnical Circumstances. For the buildings located in areas with difficult or risky foundation circumstances, due to sliding, geotechnical studies shall be demanded through the Urban Planning Certificate able to establish the sliding risks, the soil stabilization and the works carrying out conditions (POT, CUT and base technical conditions). [79]

That is the reason for which the research carried out for this theses is so important in assuring the resistance and stability measures for historic monuments situated in the active area of the Black Sea Cliff.

1.4. The title and the objectives of this theses

The research carried out during the doctoral studies aimed at identifying some measures for reducing the risk elements of the historic monuments present in the active area of the Black Sea Cliff, as well as proposing some solutions in order to ensure limited safety for the existent buildings. The research activity envisaged the following objectives:

1. Analysis of constructive solutions and behavior parameters of these buildings;
2. Studies and researches regarding the destructive elements and analysis of limited risk factors.
3. Development based on the research results, of techniques and methods able to reduce the risk and the monuments disintegration, by putting them in the limited safety.
4. Researches on the impact of the Cliff on the buildings present in the area. Elaboration of special provisions on structure safety and limitation of the risk agents;
5. Logical chart for monitoring the sliding phenomena.

Research actions were based on:

- The analysis of technical state and vulnerabilities for the Black Sea Cliff.
- The analysis of the important patrimony buildings in Peninsula, by identifying architecture, valuable artistic components, construction methods and techniques, disintegration degree and the necessary measures to be adopted.
- An important point of this work is the study of the built area features of the cliff area: technical state, used materials, construction solutions, special techniques of patrimony importance.
- Using cadastral plans I studied the historic evolution of instability in the peninsula cliff area and the works carried out over the years, pointing out the coast line alterations and the impact of natural and anthropic factors on the buildings from the studied area.
- I took part to the approving steps of the urban planning papers drawn up for the protected area of Constant City (updating P.U.Z. Peninsula, updating P.U.G. Constanta, etc.). [80]
- For the works carried out over the years, I studied the present construction solutions, their authenticity, together with the measurements for either the assimilation of some modern materials and technologies in the present urban assembly or the adoption of some traditional materials and technology, aimed to obtain a valuable homogenization.
- While preparing the theses I studied original methods for reducing the risk elements and the measures for resistance and stability of the historic monuments in the cliff area.
- An important intake in the rehabilitation process of some monuments was the use of adaptable materials for thermal correction techniques of the functional space, with no façade plating or change brought to the original architectural look. My studies and researches showed that in this historic area there are buildings that can bear Thermoshield membrane. The use of this Thermoshield membrane allows complying with the present functional requirements and represents a solution for assuring the functionality of the built spaces. Subchapter "*6.1.4. Protection of monuments after consolidation*" shows the efficiency when using this material on different horizontal or vertical surfaces, with or without the interruption of migration through water capillarity in the masonry.

1.5. Possible contributions

- Focusing and synthesizing the natural and anthropic elements with possible dangerous potential for the historic monuments in the cliff area;
- Solutions that ensure limited safety for historic monuments, according to law on protection and preservation of such buildings;
- Production of structure safety assessment methods for patrimony buildings;
- Chart for monitoring activity, aiming at reducing the risk elements and placing in a limited safety these buildings.
- the study results can be a valuable support in developing some technical solutions for the historic monument s safety field;

Chapter 2. Historic and urban development of the buildings in the peninsula area

2.1. General aspects. Features of the cultural real estate patrimony of Constanta City

2.1.1. Cultural patrimony. Protected monuments

The cultural patrimony is an important feature of the culture, with a very wide meaning, a "cultural heritage" (DEX, 1995: 661), practically any value inherited from the ancestors can be part of the national cultural patrimony.

Romanian estate cultural patrimony is extremely various. Constanta has in its old part of the city, historical monument that survived the time passing. Some of them are in good shape and therefore still being used, while others are badly damaged, and needing to be placed in limited safety state.

A historic monument, besides its functionality, has the role to educate the wide public being an ambassador both of the past and of the present time. Its administrative managers are responsible for the state of the monument, having the obligation to anything necessary in order to ensure its best protection.

Historic monuments have weak structure, unable to resist to the influenc of natural or anthropic agents, and therefore, the time passing leads to their deterioration and most of them need complex rehabilitation processes in order to be safe and stable.

The assessment, preservation, rehabilitation and restauration of historic monuments must be done by specialists according to law.

One of the major problems of the estate patrimony is the lack of financial funds for sonsolidation, restoration and rehabilitation.

The restoration process consists of the following steps: construction analysis, diagnosis, undertaken work.

After interventions, historic monuments enjoy limited safety standards which are not equal to those of a new building, as the initial intention is the preservation; only in special cases the standards are adapted to the current regulations and this means the structural reinforcement of the entire building.

Causes of the historic monuments degradation:

- present since the building process;
- weather;
- high land humidity;
- inappropriate works;
- earthquakes;
- fires;
- environment severe aggression;
- changes of the land shape.

The commission for Historic Monuments starts **emergency restoration programs** by observing the following criteria:

- building special historic and architectural value;
- value of the investment necessary to consolidation, restoration and highlight;
- high degree of usage;

- structure bad state due to land sliding, loess land settling, mortar cyclic degradation, mould, weakness of brick blocks, etc .
The present work focuses on historic buildings whose stability is reduced by land sliding. Thus, the first measure that must be adopted, and the most expensive one, is stopping the land sliding. The following measure is represented by the monument stabilization and restoration.

2.1.2 Constanta Peninsula Area

The peninsula area, located in the South East part of the City, represents the object of this study as it is the space where people have been living here for more than 2500 years. It is a place with representative historic pieces for the local culture – group B, but also monuments of national and international value – group A.

The entire peninsula is under the incidence of:
Law 378/10.07.2001 on protection of archeological patrimony,
Law 422/18.07.2001 on protection of historic monuments
Order 2314/08.07.2004 of Minister of Culture and Cults on approving the list of historic monuments.

The peninsula has a surface of almost 80 ha, with Ferdinand Avenue in the North West, an alley in the West as extension of I. G. Duca Street, whereas the other cardinal points are represented by the natural element Black Sea.

When talking about the role of the Peninsula, the following major functions are attributed to it:

- The biggest concentration of values of universal, national and local importance, preserved "in situ" and inside museum specially arranged spaces;
- Big concentration of facilities: administrative, political, social, financial, banking, educational, cultural and religious;
- Preservation of traditional areas with various trading functions and some important urban memory points;
- Various relationships with important functional neighboring areas of the city: Constanta harbor (entrance gates no1, 2 and 3), Tomis yachting marina and the central zone of the City, with plenty and various shopping facilities (*Stefan cel Mare* Street, *Tomis* Avenue).

From the urban point of view, since 1974 – 1975, based on specialized studies approved by the Ministry of Culture, the Peninsula area received the status of historic centre of the City, featuring archeological and architectural reservation.

Based on the law on protection of cultural patrimony, the approved list of historic monuments of 2004, by the Order of Ministry of Culture and Cults no 2314 of July 8th 2004, the following zones are defined as **areas with big concentration of objectives**: [101]

1. Archeological site "**Orasul antic Tomis"** (Tomis ancient town) comprising the entire peninsula (cod LMI-2004: CT-1-s-A-02553) as objective of national and international importance.
2. Urban site "**Peninsula Area of Constanta"** with architectural values of national and local importance (cod LMI-2004: CT-II-s-B-02832).

2.1.3 General action principle: Venice Charter which provides the international framework for the conservation and restoration of historic monements. [100]

2.2 Historic and urban developmnt of buildings of Peninsula Area of Constanta City

2.2.1. Ancient location

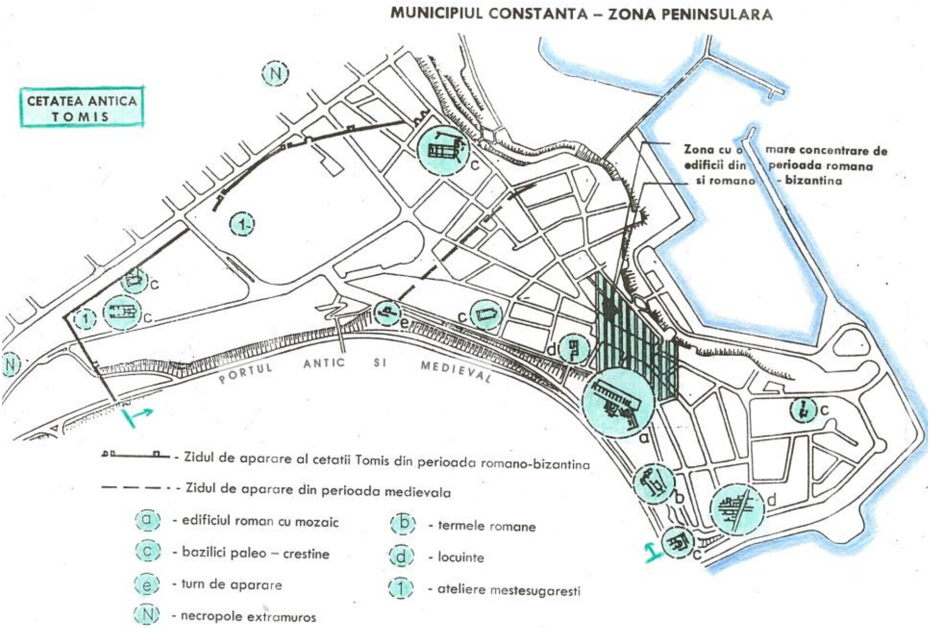


Figure 2.1 - Tomis Ancient City (Archives of Constanta City Hall)

There are little information about the foundation of Tomis City and its first century of existence *(Figure 2.1).* This point of commercial exchanges shall become the nucleus of the future Tomis City (Tomeus, Tomos, Tomis, Tomi), mentioned for the first time in a written document in the middle of the 3rd century A.D. (259 a.Chr.) and marking 2275 years of existence.

The beginning of the Roman period (2nd - 4th A.D.) meant the climax of the economical, administrative and military development both of Tomis City and of the entire province. *(Figure 2.2), (Figure 2.3).*

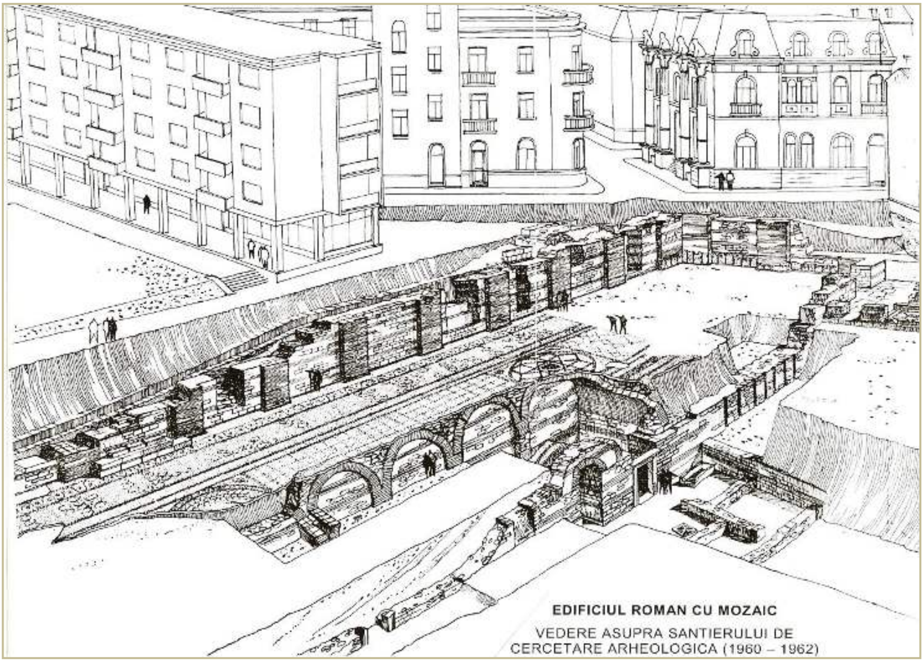
The City is destroyed by the Barbarians in the 6th and 7th century. It slowly recovers and only under the Byzantines, in the 10th 11th century, we have information about Constantiana.

At the beginning of the medieval age, the Genoese, rebuilding Tomis ancient harbor, used the name Constanta.

During the Byzantine period (8th – 12th centuries) the Northern part of the defense wall is rebuilt se reface, slightly backwards. Its initial line is nowadays on the Northern side of Aristide Karatzali Street, whereas the defensive moat is in the North.

Between 12th – 14th centuries, the Genoese rehabilitated part of the ancient harbor and built big warehouses for merchandises, marking a new start of the economic and urban development.

The beginning of the state centralizing process finds the entire region of Dobrogea under their influence (14th century).



General view of the cliff area, from the South side of Ovid Street

Archeogical site on the South– Eastern part of the existing a museum building
(on the right, in the back ground, the elderly asylum, demolished in 1975)

Figure 2.3 – Peninsula Area – Roman Mosaic
(Archives of Constanta City Hall)

2.2. 2. Medieval emplacement

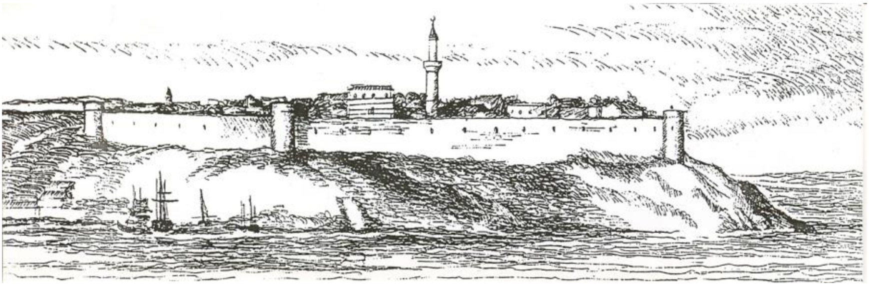


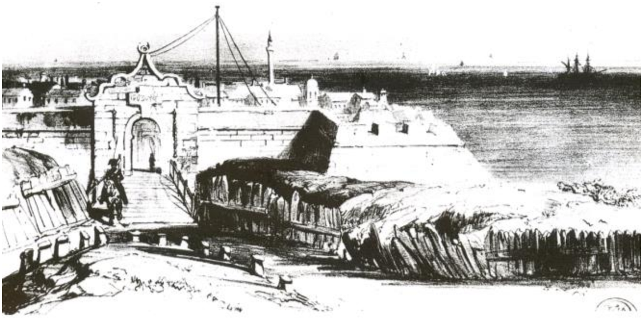
Figure 2.4 – ***Medieval City of Constanta (Southern part), Drawing of Hector de Béarn, published in Paris in 1828*** *(Archives of Constanta City)*

At the beginning of the 18th century, Constanta enjoys a period of economical and urban development ended unfortunately by the war between Russians and Turks of 1768 - 1774.

Giulio Mancinelli, travelling in this region in 1583 - 1586 writes about encountering *"a small village which would have been the famous city of Constanta"*;

From the urban poit of view, the town development and organization will be made following the road diagram of the City from the Roman and Roman-Byzantine period.

The image of the last days of the medieval city is painted in 1826 by Hector de Béarn, representing a city surrounded by powerful walls and with many buildings in its middle area. (*Figure 2.4), (Figure 2.5)*



Zidul de aparare al cetatii medievale Constanta,
latura de nord-vest si poarta principala
- dupa un desen de Hector de Béarn, publicat la Paris in anul 1828 -

Figure 2.5(Archives of Constanta City Hall)

2.2. 3. The development of the modern city

After the complete destruction of the medieval city (1829), the town will be rebuilt only after a 20 year time period.

During the Crimean War (1853 - 1856), due to the temporary camp of the French troupes, the informational level about the town of Constanta shall reach the European level, and therefore the first foreign investments will make their presence felt by starting the town development, among which:

- building of Constanta - Danube (Rasova) Road - (1858) ;
- building of the railway Constanta – Cernavoda – (1860);
- the first organization of the harbor (1860 – 1870). *(Figure 2.6)*

Figure 2.6 Ancient Constanta, Modern perioad. View on the harbor (Archives of Constanta City Hall)

During the first developing stage (1860 – 1880), the modern town develops within the limits of the ancient medieval city and on the same old road system. *(Figure 2.7)*

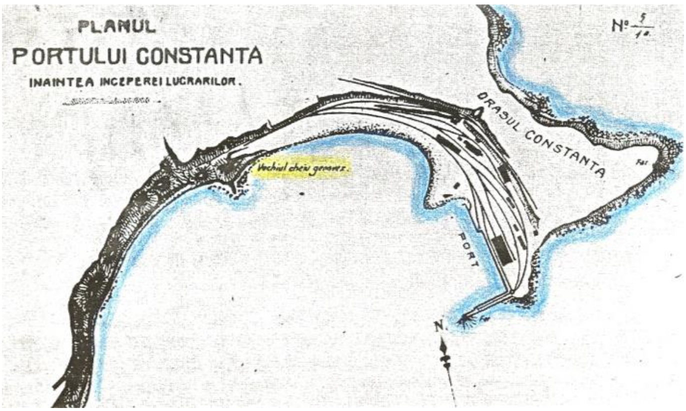


Figure 2.7 –Constanta plan before the beginning of the harbor construction (Archives of Constanta City Hall)

The second developing stage, (1880 – 1900), the residential area of the modern town will be extended towards North up to the current Ferdinand Avenue, between the railway supplying complex and coast occupying part of the land of the Roman city of its maximum developing period.

In comparison to the old town, the road diagram of this new space will be more organized, where the main streets line between North and South. *(Figure 2.8)*
The urban development of Constanta town after 1900, shall take place towards North, using the rectangular road system, orientated North – South and East – West, based on approved projects. [74]

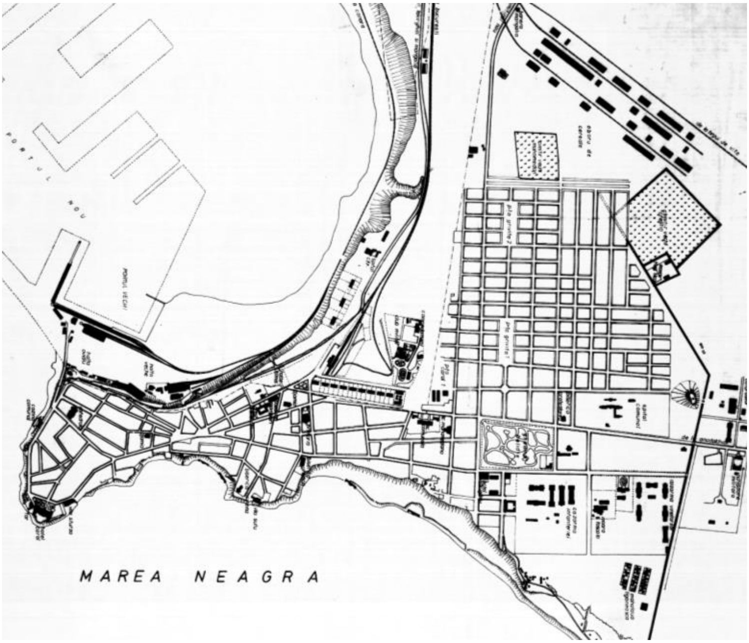


Figure 2.8 Constanta Road system (Archives of Constanta City Hall)

For residential areas, the basic urban element is represented by one family residence, with 200 - 300 sqm a 1-2 storied height regime, most of them at the ground floor.

In the central areas and especially on the main roads, the minimum regime is P+1, and the building have a double function: ground floor for public relationships (commercial purposes, services etc), whereas the floor is designed for living.

Here the land parcels are smaller and the buildings are organized in compacted front sides.

These urban features will dominate the peninsula and the central part of Constanta up to middle of the 20th century.

Chapter 3. Identifying the historic monuments and their protection areas situated in the cliff zones, by studying their own features: used materials, constructive strategies, special techniques contributing to the value of the patrimony. Aspects of the technical state of the existing built spaces belonging to the patrimony.

Urban development and organizing solutions of the main spaces and urban functions of the modern city are based on:

► General developing and organizing plan of the city drawn up by architect engineer drawn up by architect engineer D. Banescu between 1905 – 1908;

► Organizing system of Constanta drawn up by architerct Bedeus in 1938.

Maps are more important for this first stage of urban evolution:

► Constanta plan of 1898 completed with further elements 1:4600;

► General plan of Constantra drawn up in 1921, with proposals for development and urban proposals made in 1905 – 1908: 1:6500.

The urban and structural development of the patrimony has important well known authors: Al. Orascu, I. Mincu, P. Antonescu, Gr. Cerchez, Gh. Stephanescu, G.M. Cantacuzino, together with other foreign names.

Usage of construction material recovered from the ancient ruins, especially the polished and semi polished stone, for building pursposes was almost a general phenomenon for Constanta City.

Among the patrimony buildings present in the peninsula area we mention the ones that needed special technical interventions for protection against lans sliding and cliff erosion *(Figure 3.1)*:

* Eastern side of the cliff area in the peninsula

- **« Metamorphosis » Greek Church** – 36 *Mircea cel Batran* Street
- **« Mihail Şuţu » Vila** - K.Zambaccian Street (former Mării Street)
- **National Bank** – 1 1989 Revolutiei Street

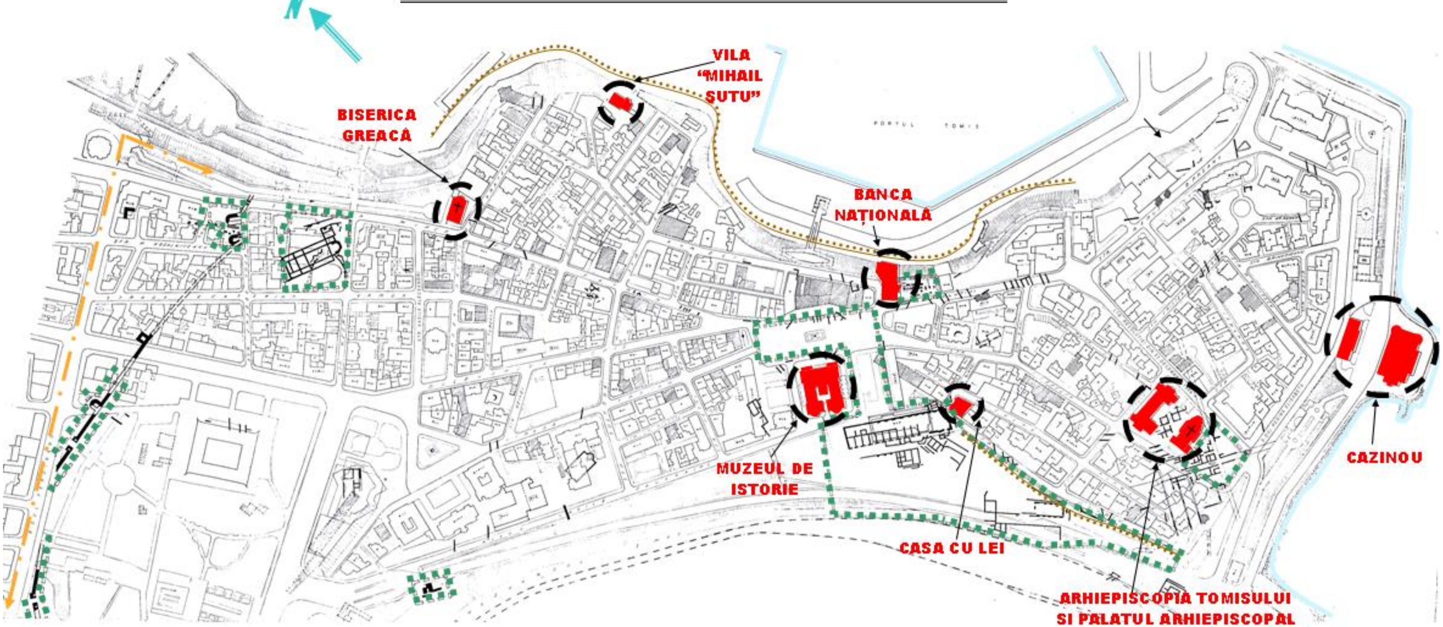
* Southern side of the cliff area in the peninsula

- **Casino and the protection wall**

* Western side of the cliff area in the peninsula

- **Museum of National History and Archeology of Constanta** – Ovid Place
- **Build space on Ovid Street**

MUNICIPIUL CONSTANTA – ZONA PENINSULARA



- limita zonei de rezervatie arheologica si de arhitectura – cod LMI2004 – a) CT-I-s-A-02553 - „ORASUL ANTIC TOMIS";
  – b) CT-II-s-B-02832 – situl urban „ZONA PENINSULARA CONSTANTA"
- obiective arheologice identificate si nominalizate in regimul de urgenta pentru lucrari de protejare si valorificare
- obiective nominalizate, incrise in lista monumentelor de arhitectura protejata
- faleze instabile cu fenomene frecvente de prabusire si afectare a frontului construit adiacent
- obiective analizate in cadrul lucrarii, ca exemple ilustrative pentru studiul de față

3.1. EASTERN SIDE OF THE PENINSULA CLIFF

3.1.1. “METAMORPHOSIS” Greek Church

- 36 Mircea cel Batran Street

Code LMI2004- item no 538 position CT-II-m-A-02826

Figure 3.2 – *“*Metamorphosis” Greek Church

Built between 1864-1867 out of the money of the Greek community, the church is the first religious place raised inside the Küstenge City *(Figure 3.2).*

The patrimony value of this building comes from its age, over 150 years and from its constant and permanent function as Christian orthodox cultural place.

Its architectural value – elements of Post byzantine influence, typical for orthodox churches since the beginning of the 19th century bult in Greek sites both in continental and insular areas.

Building design and construction

The church was built by a mason team brought from Greece. The entire construction, including the steps platform, was done from stone elements recovered from the ancient ruins. Nowadays, the elements of ancient stone, well finished, can be seen on the main front side and also in the steps. After repairing works carried out at the front side plaster, it resulted that the lifting walls were also made of ancient stone of small dimensions and irregular shapes glued with lime and sand mortar. We can think that the foundation was also made up of the same material from the ruins present in the neighborhood area, defensive walls and buildings from the Roman and Roman – Byzantine period, but we cannot say how deep and thick it is so we could assess the resistance of the construction in connection with its age of over 150 years.

3.1.2. «MIHAIL ŞUŢU » Villa

1 K. ZAMBACCIAN STREET (former MÃRII STREET)

Code LMI2004- item no 573 position CT-II-m-A-02863

Figure 3.5 – photo taken in 1902 – 1903
In the foreground we can see the rock on which the supporting wall was built with its drainage system for capturing the water at the loess basis
The Southern part of Şuţu Vila, older buildings and supporting wall of the cliff nearby destroyed at the beginning of the period between the wars due to the cliff instability *(Archives of Constanta City Hall)*

The building is located in the eastern part or the peninsula *(Figure 3.5)*, on Tomis harbor cliff, inside the urban space representing the historic centre of Constanta City.

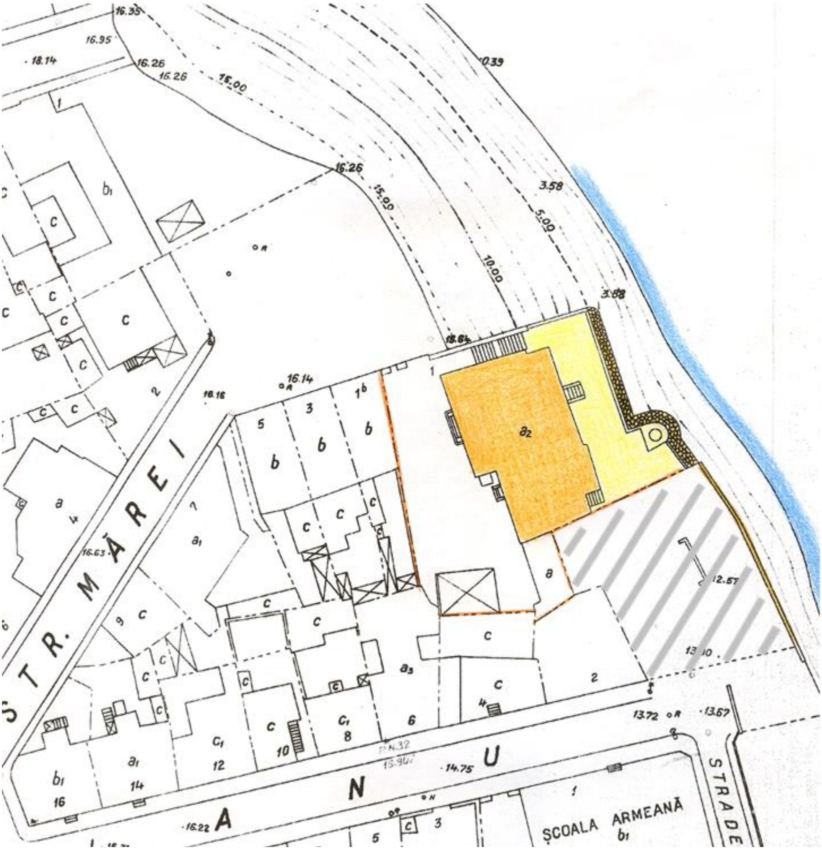
Architectural and patrimony value. It is a valuable architectural objective due to its constituent elements well personalized, a well framed volume in natural landscape and especially due to the romantic oriental and post byzantine details, becoming part of the local typical modern architecture.

Building design and construction

The design was made in 1898 by architect Grigore Cerchez.

The file no 27/1899 of the County Department of National Archives of Constanta City, contains the request for obtaining the building license of July 29th 1898, together with the original plans and building license no 684 of August 1898.

Figure 3.6 – cadastral plan of Constanta City Hall – 1936



- cladirea vilei (subsol, parter, etaj)

- zid pentru stabilizarea falezei, modificat fata de proiectul initial, pentru racordarea la zidul existent in partea de sud

- platforma de umplutura pavata

- zone construite in anii 1880 – 1890, afectate direct de instabilitatea falezei

The land on which it was built is located on the verge of the cliff, whose natural slope was of $40^0 – 45^0$ and was permanently subjected to crumbling, due both to specific geotechnical structure and also to direct action of the sea waves during powerful storms from the North and North East *(Figure 3.6)*. [75]

In order to obtain stability, works for protection and cliff stability were considered necessary: a supporting wall was built with a slight inclination degree towards internal side, provided with internal abutments and horizontal drainage system. *(Figure 3.7)*

The wall was made of semi polished stone glued with cement mortar, having a 1 m width, placed directly on the Sarmat calcareous rock after the deteriorated layer was removed from its surface (superior quota of the calcareous layer is at about 2,5 – 3,0 m from the sea level).

In comparison to the initial project, of the licensed papers, the wall line was modified as it was necessary to connect it to a similar building in order to protect older residences in the Southern area. *(Figures 3.8, 3.9, 3.10)*

Behind the wall a filled platform was built all along the building front side. The foundation of the villa was made of stone of various sizes and depths. The founding land is made up of macroporic loess sensible to humidity belonging to «A» sensibility category. *(Figure 3.5)*

The outside part of the lifting walls is made of 0.48 m brick whereas the inside part of 0.48 , 030 and 0.25 m bricks.

The floors are made of wood. The terrace floor is made of metal with ceramics.

The ceiling of the entire building is built in accessible terraces, probably made of metallic profiles « I » with ceramics. Above the living room (the South Eastern corner of the building) was built a 5,00 m dome, probably of ceramic.

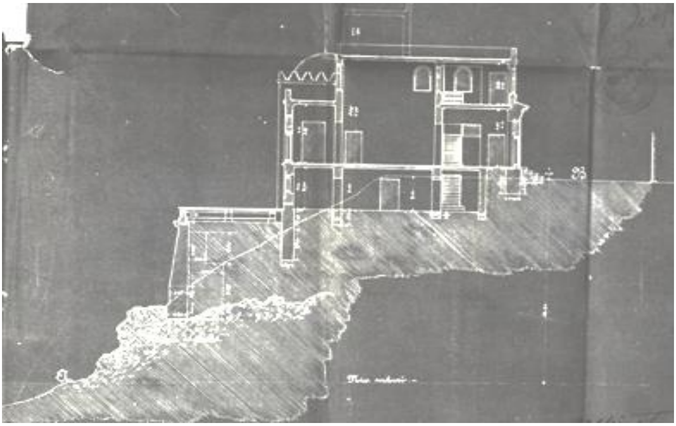
Usage of the building

In the last 60 years the building was submitted to several repairing works and current maintenance works, none of them considered capital repairing works. The last important works were made according to Pr. Nr. 6/1985, drawn up by I.P.J. Constanta. Engineers found that the resistance structure hadn't suffered alteration after special events that took place such as earthquakes of 1901, 1940, 1977, or frequent cliff instability phenomena.

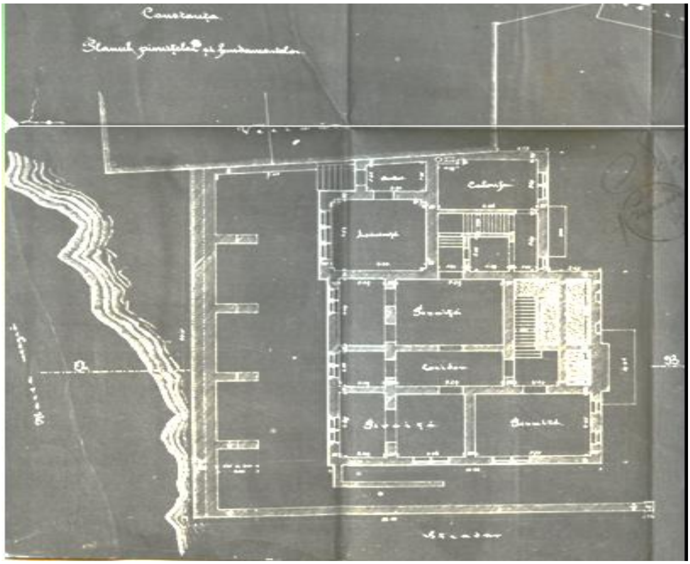
Due to the bad functioning of the sewage system in the area, the humidity level grew and mould is present in the basement rooms.

The supporting wall was very important in maintaining the cliff stability, compared to the neighboring areas where instability appeared since the inter war period.

Taking into consideration its age, over 100 years old, it is necessary to have an urgent technical report regarding the building state and also of the cliff supporting wall.



Annexed plan to the building license no 684 of August 1898
Figure 3.9 – Constanta State Archives



Annexed plan to the building license no 684 of August 1898
Figure 3.10 Constanta State Archives

3.1.3. NATIONAL BANK – CONSTANTA BRANCH

- 1 REVOLUTIEI 1989 STREET –

Code LMI 2004, item no 545, position CT-II-m-B-02834

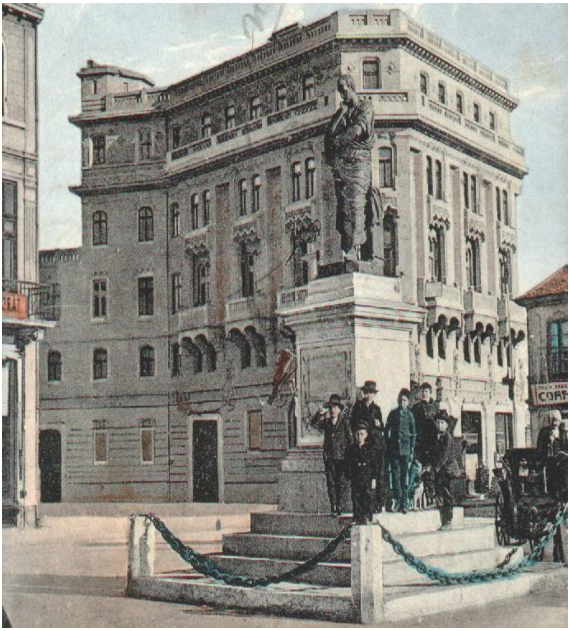


Figure 3.13 –National Bank , Archives of Constanta City Hall

It was built the South Eastern part of Ovid Place *(Figure 313)*. The building covers the margins of the high cliff: from 17,50 m front side and the side part up to about 1,20 m to the current platforme of Tomis touristic marina. *(Figure 3.14).*

Design and building of current construction

It ws built between 1913-1914 and the works were supervised by the author of the design.

Building particularities

It is a 7 storied building and a good exemple for the use of land with inclination higher than 45^o *(Figure 3.15)*, during the first stage of the modern city development.

It has continuous foundations made of concrete and stone. Due to the land, they have different depths and are fixed in different geological structures: macroporic loess sensible to humidity and Sarman calcalrous with sensible layer in the upper part.

Figure 3.14 – National Bank - front side East- 1960 photo before the beginning of the organizing works for Tomis touristis marina (Archives of Constanta City Hall)

The resistance is made up of brick lifting masonry, with no uniform distribution, but with continuity upwards the building. The wall thickness varies from one level to another starting from 0,84 m in the basement and reaching 0,28 m at the last floor.

The floors are supported by metallic beams with ceramics above the basement 2 and reinforced concrete for the remaining levels. The level 2 of the construction has ceramic pillars and arches that support the floor weights whereas the basement 1 is provided with metallic pillars.

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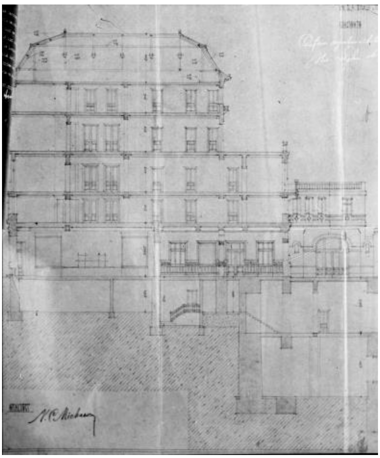


Figure 3.15 - National Bank – annexed plan to Building license no 5394 of July 5th 1913 (Archives of Constanta City Hall)

Time effects

Important modifications were made to the building during the time it was the branch of the National Bank: extension of the ground floor and the 2nd floor.

In 1958 the basement 1 and 2 were consolidated by introduction of connecting systems as there are some fissures in the resistance elements. The earthquake of 1977 badly affected the resistance structure present in basement 1 and 2.

3. 2. SOUTHERN PART OF THE PENINSULA CLIFF

3.2.1. CASINO AND THE PROTECTION WALL

This area, along Regina Elisabeta Avenue, becomes in 1879 the main important touristic objective of Constanta City, having specific facilities: small shop and terraces, the first casino.

In October 1891, a powerful storm destroyed the roof and part of the first floor of the Casino ceasing its existence.

In 1892 a new casino is built using materials from the other one destroyed by the storm (stone, brick, wood). This new building was directly subjected to waves during storms in cold season and therefore its resistance weakened quickly especially where there was contact with the sea. The building was no longer safe. *(Figure 3.17)*

The partnership between the City Hall and the engineer Anghel Saligny between 1903-1904 led to the building of the cliff protection, including the platform for the placing the current Cazino, allowing the final and safe organization promenade area. *(Figure 3.18)*

Between 1904-1905 begins the design for the current **Cazino, in perfectly safe conditions**. *(Figure 3.18)*

Figura 3.17 – The first Casino built on the rough cliff
(photo of Archives of Constanta City Hall)

Figura 3.18 – Arranged cliff with dam and the new Casino
(photo of Archives of Constanta City Hall)

3. 3. WESTERN PART OF PENINSULA CLIFFS

3.3.1. MUSEUM OF NATIONAL HISTORY AND ARCHEOLOGY - CONSTANTA – 12 OVID PLACE

Cod L.M.I. 2004 – nr. Crt.543 – CT-II-m –A– 02.831

Figure 3.19 - Museum of National History and Archeology - Constanta (Archives of Constanta City Hall)

The building process consisted of 2 steps.

At the beginning it was designed by architect V. Gh. Stephanescu in neoromanian style as the City Hall. In 1912-1914 was built the foundation, the walls, the outside plastering and the roof.

The files that can be found at the National Archives of Constanta 44/1912, 48/1912, 57/1914, 21/1920 and 14/1923, show the following interesting points for this building phase:

The foundation was dug by hand with variable depths (6,0 – 12,0 m) given the presence of a thick brick and stone density layer made up of the ancient ruines. Importan volum of ancient wall removed while digging the foundations show that the building was placed in one of the most populated area of Ancient Tomis. In 1976 the building is conferred a new function – Museum of National History and Archeology - Constanta.

Description

It is a parallelepiped volume with basement, ground floor, two floors and high attic, having a continuous foundation made of concrete and stone masonry directly built on the loess or clay layer.

Its resistance structure has transversal and longitudinal stone and brick lifting masonry. The floors are monolith reinforced concrete supported by hidden metallic beams.

It has wooden framework and tiled roof (fish scales type).

It is a building with a proportionate and unit volume, with balanced ornaments on its front sides.

Its main front side has 3 empty spaces above the entrance, high and framed by arches and masonry pillars.

Elements of Romanian traditional style are present when framing the empty spaces and when marking the cornices both on the main front side and on the other three. The two terraces also have arches supported by pillars built according to the Romanian traditional style

Time Effects

The detailed studies made for the last repairing showed that the building is in good state.

Until recent years, there were no settling phenomena given the special foundation.

The major earthquakes of 1940, 1977 and 1986 didn't leave traces on the building resistance structure.

Elements such as covering, dividing walls, vaults of some lifting walls bear the effects of these earthquakes. *(Figure 3.19) (Figure 3.21) (Figure 3.22).*

Major deteriorations were caused by climate elements, especially the salty humid sea air, leading to strong corrosion of the unprotected metallic parts that need either replacement (South porch) or protection (North porch). External painting needs also frequent maintenance works.

Figure 3.19 – Museum of National History and Archeology – Constanta
- detail cracked front side – photo 2008 –

Figure 3.22 - Museum of National History and Archeology – Constanta
- cracks of painted hall above the main ground floor hall -photo 2008
- arches fissures –

3.3.2. Built Space on Ovid Street Analysis of Cliff Stability between Gate 1 and Ovid Place and its Consequences on the Protected Cultural Patrimony

Even since the beginning of the modern town – middle of 19th century, the area closed to this cliff and even part of the cliff edge, was covered by residential buildings, with no special interest in consolidating the cliff.

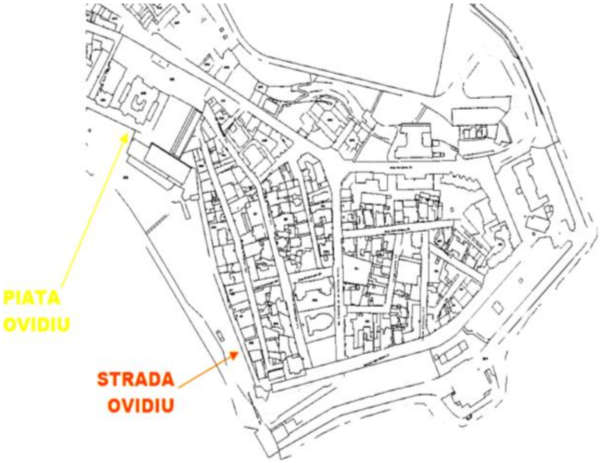


Figure 3.22 – Cliff zone between Gate 1 and Ovid Place - cadastral plan 1996 –

Figure 3.23 –Ovid Street – Archives of Constanta City Hall-

The dominant element is Ovid street *(Figure 3.22)*, with buildings on both sides in 1900 *(Figure 3.23), (Figure 4.12).*

All the constructions, made by 1900, on the South part of the street disappeared either demolished (by 1936) or collapsed due to the cliff instability (by 1960).

Land Geological Structure in Ovid Place – Constanta

1. Layer of non homogenous filling of 2-4 m result of 2000 years of continuous living
2. Layer of humidity sensitive loës;
3. Layer of greenish – brown clay of variable thickness;
4. Sarman limestone.

Cliffs are also characterized by slow immersion of the land into the sea.

Anthrop elements that participate to the instability of the land are the lack of pluvial water draining system and the lack of incorrect function of sewage systems.

Causes of the cliff are instability

- The reduced physical and mechanical features of the clay land;
- Presence of the phreatic water towards the basis of the cliff;
- Absence of pluvial water draining system;
- Works that didn't repair the cause but the effect of land sliding;
- Lack of works for to prevent land sliding.

Given these complex elements, the next projects will have to have foundation dug under the sliding plan.

Figure 3.24 –Ovid Street

Figure 3.31 34 Nicolae Titulescu Street
Front side facing Ovid Street

Figure 3.25
Lion House
historic
monument

Figure 3.27
Dr. Cantacuzino Street

Figure 3.28- 30A Nicolae Titulescu - front side facing Ovid Street

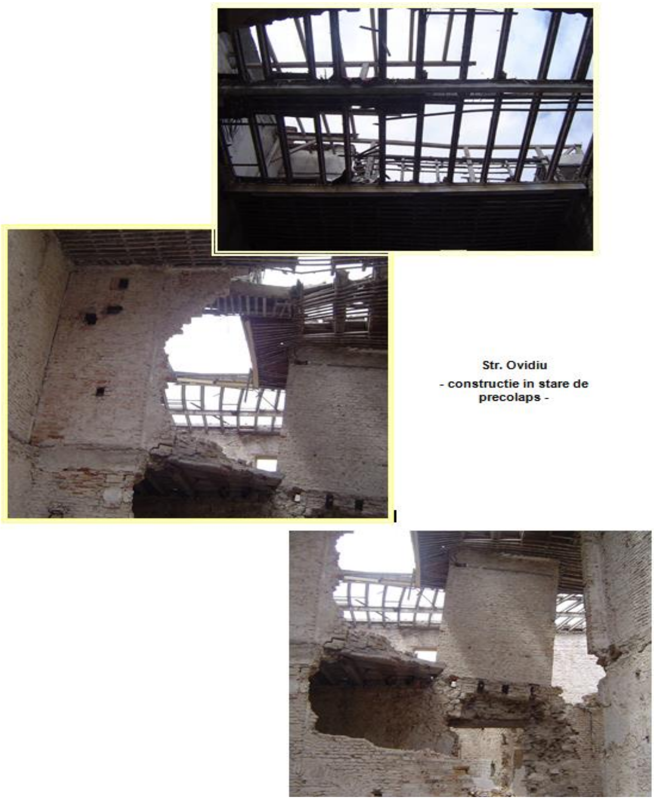


Figure 3.29 – 30 A Nicolae Titulescu- front side facing Ovid Street – severe damages -

Chapter 4. Analysis of documents, designs and works that prove the constant instability phenomena in the historic center of Constanta City

4.1. Constanta instability in cliff area

In order to have a correct assessment of this phenomenon I studied old documents which led to the idea of a constant dynamic of coast line caused by:
- high instability of cliffs
-sea currents;
-human actions.

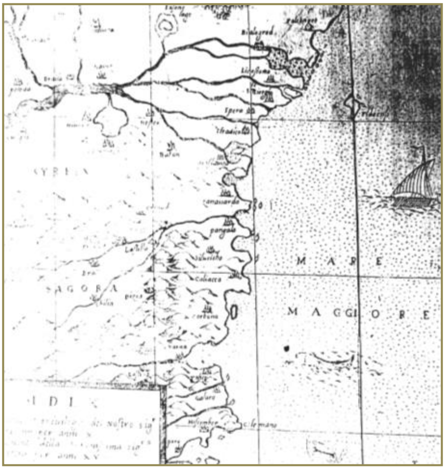


Figure 4.1 – Black Sea Coast Painted by Mattei Scutari At the beginning of the 17th century (National Archives of Constanta)

A drawing made by Dr Quesnoy in 1854 shows the form of the northern part of coast in the peninsula. The only element for comparison with the current state is the minaret of the Turkish Church built in 1828, marking the southern end of Ovid Place of these days. *Figure 4.2* shows three promontories with a much more advanced position towards north.

The shape of the Northern coast line in the peninsula is the result of:

- Frequent collapse of the cliff;
- North-Southern sea surface currents and powerful winter storms

Figure 4.2 (Archives of Constanta City Hall)
Drawing made in 1854 by MD Quesnoy showing the North part of the peninsula very different from the current one, with the rapid cliff collapsing episodes

Archeological discoveries led to important reference to constant instability of the Black Sea Coast cliff and high frequency of accidents and their consequences

In the ***Romanian Geographic Dictionary*** **tome II**, published by George Ioan Lahovari, General C.I. Bratianu and Grigore Tocilescu in 1899, it appears: ***"in Constanta we can see entrances of two underground galleries (aqueducts) used for drinkable waters from Anadalchioi and Canara (Ovidiu) together with ancient fountains connected to this gallery***

Figura 4.4

4.2. Technical projects and works carried out so far in order to stabilize the cliff frequent collapses

Complete organization of the Casino promenade involved the construction of a 20 m stone dam in the Southern part of the natural limit of the land, the building of a stone platform and a special platform for the present Casino. The works were carried out according to the project made by the engineer Anghel Saligny.

In 1904 engineer P.A. Zahariade proposed a plan for City urban development including the cliff stabilization.

Between 1961 – 1964 the Ministry of Transports starts the project *North Eastern Cliff Consolidation* , from "Metamorphosis" church up to the Military Hospital, using 15-20 m reinforced caissons as supporting system, with drainage and shaping the cliff wall for about 500 m, in the Northern part of peninsula. *(Figure 4.6)* [89]

Some places were planted and reinforced with supporting arch walls in order to stop the land sliding**.**

Figure 4.6 – Coast stabilization, East Cliff, carried out by IPTANA Bucharest between 1956-1957 –google maps – satelite

4.3. Photos and plans that show the cliff area instability evolution in time and the works undertaken

Figure 4.8 (above)
– Northern Cliff – collapsed terraces
(Archives of Constanta City Hall)
Figure 4.9

Figure 4.10 – Ovid Place Cliff, a building next to the Nationmal Bank, that collapsed
(Archives of Constanta City Hall)

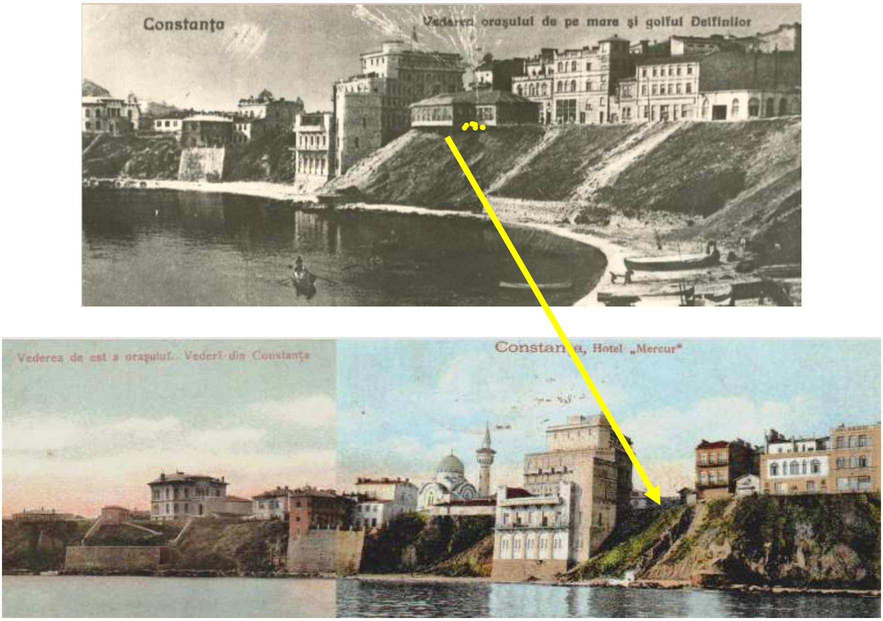


Figure 4.11 – Front display – Eastern Cliff of peninsula
We can see a change in the cliff slope after the collapse of the house next to The National Bank (Archives of Constanta City Hall)

In the Western part of the cliff, near the commercial harbor, the front raw of building collapsed by 1950 – 1960 due to instability. *(Figure 4.12)*

Figure 4.12 photo 1920 – Western cliff,between gate 1 and Ovid Place (Archives of Constanta City Hall)

- In primul plan – dreapta jos (port) – cladirile aferente depoului feroviar (dezafectate)
- In plan secund – dreapta – frontul construit de pe latura de sud a str. Ovidiu, distrus in intregime pana in anii 1950-1960 datorita fenomenelor permanente de surpare a falezelor.

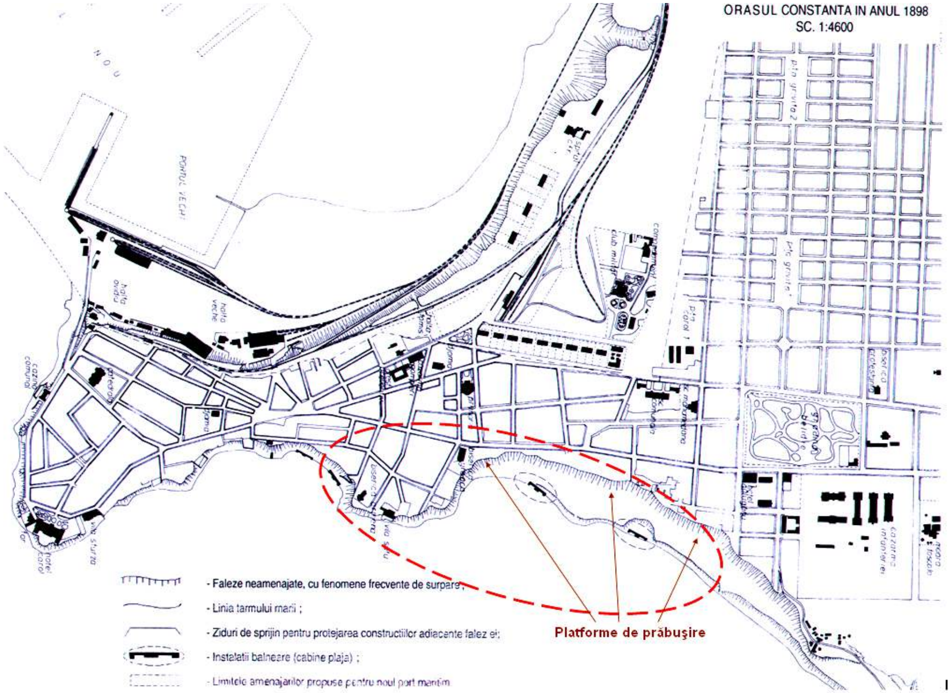


Figure 4.13 –Constanta Plan in 1898 (Archives of Constanta City Hall) [83]

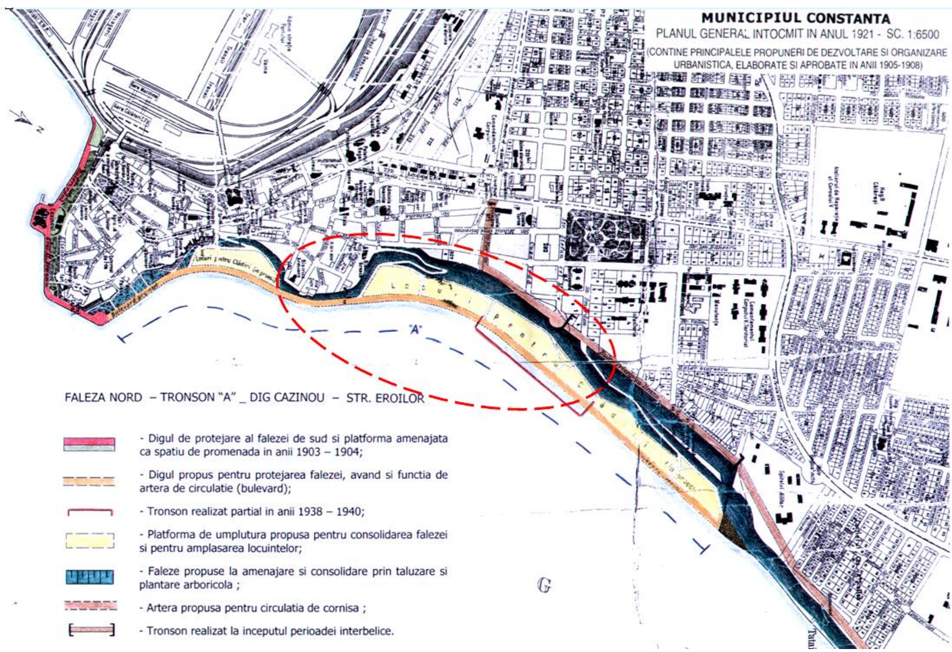
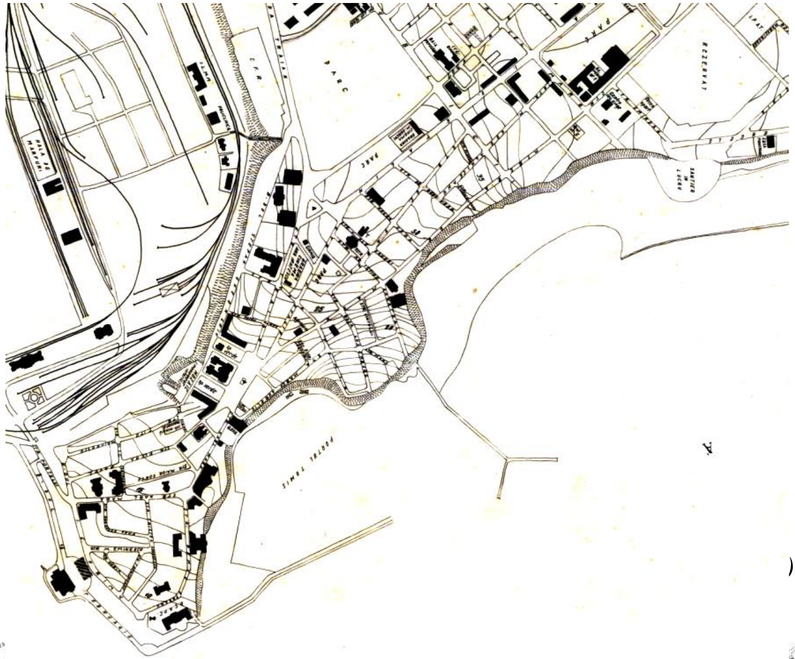


Figure 4.14 –Constanta Plan 1921 (Archives of Constanta City Hall)[84]



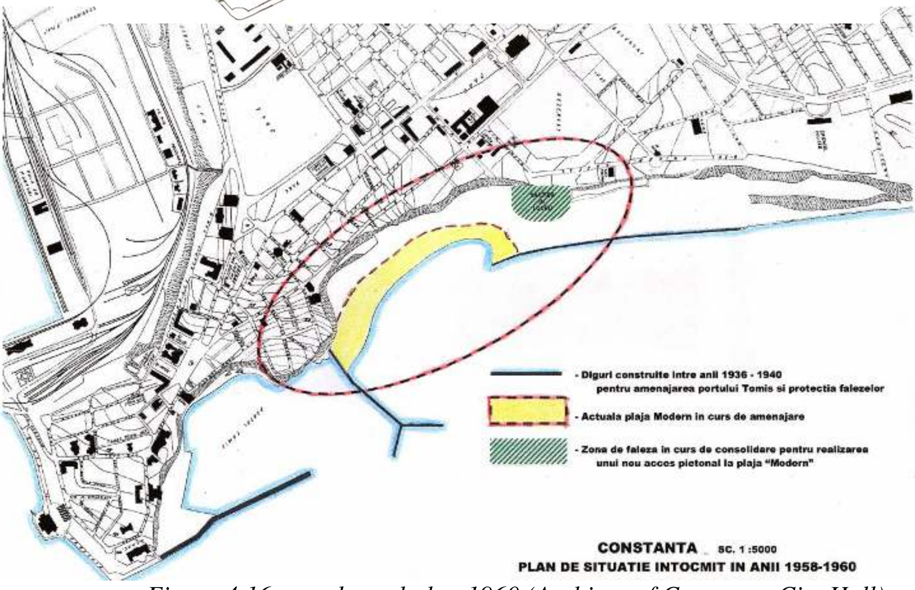
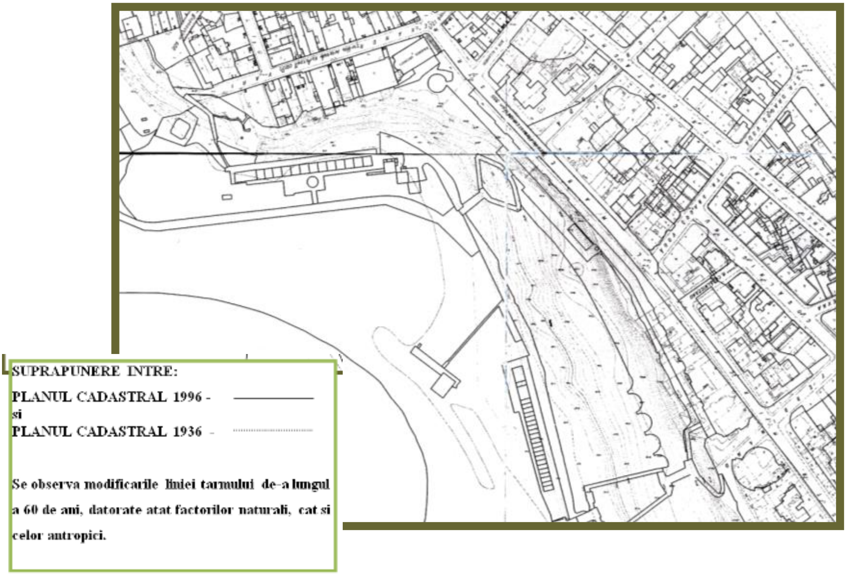


Figure 4.16 – cadastral plan 1960 (Archives of Constanta City Hall)

Figure 4.17 –cadastral plans overlaying: 1936-1996
(Archives of Constanta City Hall)



Chapter 5. Case study:

5.1. Evolution Analysis of the Instability in the North Eastern Part of the Cliff, along Mircea cel Batran Street for Protecting Measures of Endangered objectives

Figure 5.2 –google maps - sattelite

Modern time recorded a high instability level of cliff area:

1. cliff collapse along the present Negru Voda Street(*Figure 5.4);*
2. frequent cliff collapses in the North of Aristide Karatzali Street (*Figure 5.5, Figure 5.6)* ;
3. successive collapses of the built area on the Eastern side of Caramidari street *(Figure 5.3)*, last collapse – around 1970;

Figure 5.3- Caramidari Street before collapsing
(Archives of Constanta City Hall)

4. . nowadays the following are in danger of collapse requiring an immediate plan of consolidations and stabilization:

- Greek Church Metamorphosis enlisted as historic monument of national importance (cod L.M.I. 2004 CT-II-m-A-02826) and the entire cliff area on the northern side of Karatzali street;
- the cliff along Mircea cel Batran street, on the eastern side, near Negru Voda street, where there are signs of the beginning of cliff collapsing episode.

Figure 5.4 - photo taken in 1895
Foreground shows a recent cliff collapse
Close to Mircea street, in the North of Metamorphosis Church
(Archives of Constanta City Hall)

Figure 5.5 – Photo taken in 1915-1920
Foreground: Northern part of Karatzali street,clear traces of collapse and damaged buildings (Archives of Constanta City Hall)

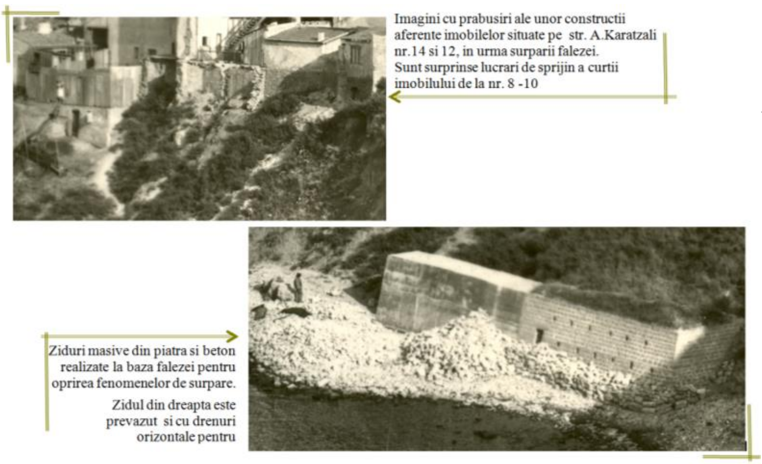


Figure 5.6 - photo 1915 – 1920 - details of clear cliff instability , affecting the buildings

5.2. Safety Assessment of the Greek Church "Metamorphosis" historic monument at 36 Mircea cel Bătrân Street - North Eastern part of the cliff

5.2.1. Current state of the building and its stability *(Figure 5.7)*

Figure 5.7 - Greek Church (Archives of Constanta City Hall)

In 2005-2006 during some repairing works, specialists analyzed the building and the cliff nearby in order to establish its effects on the construction. *(Figure 5.8)*

The North-Eastern corner of the building has deep vertical fissures marking a clear proof of collapsing

(Figure 5.9)

The South Eastern corner has rather recent fissures on the wall that supports the bell dome marking the moving tendency towards Eats of the entire building. *(Figure 5.10, 5.11)*

Thus, the following works can be done as an emergency measure:

- A detailed technical report for the entire building;
- A project to stabilize and reinforce the entire cliff close to A. Karatzali Street, along the entire Eastern line along Mircea cel Batran Street, as all the buildings from the Northern side of this street is in danger.

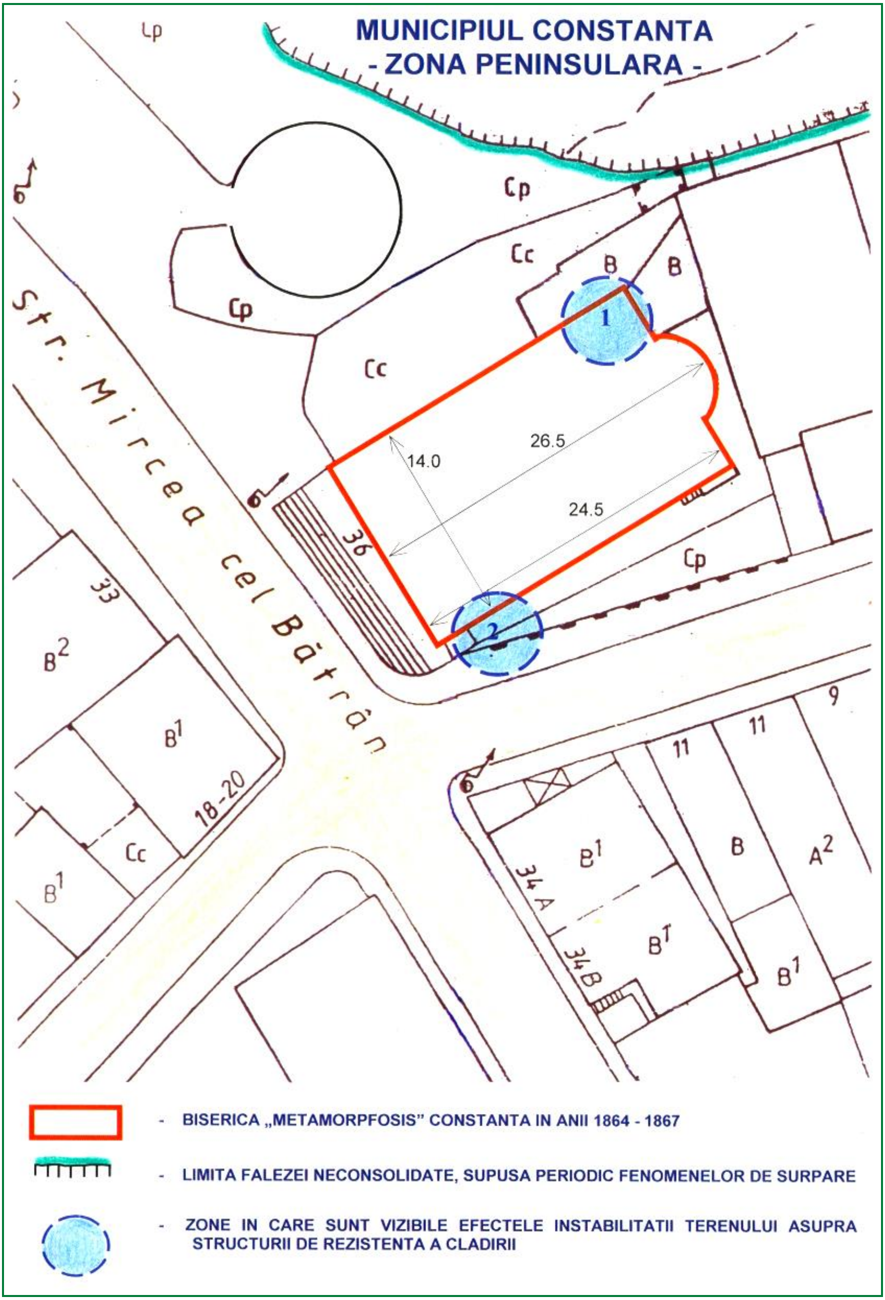


Figure 5.8 - cadastral plan 1996

Figure 5.9 – Front side of the Greek Church - details
May 2006 -

2

COLTUL DE S – V

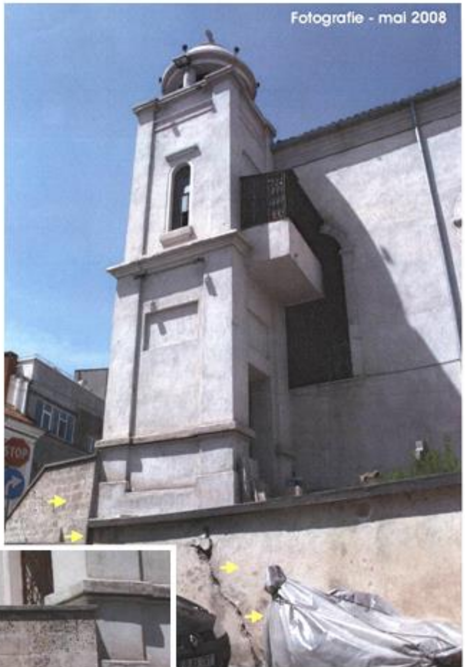


Figure 5.10

\- May 2008 -

clear
fissures S-V part

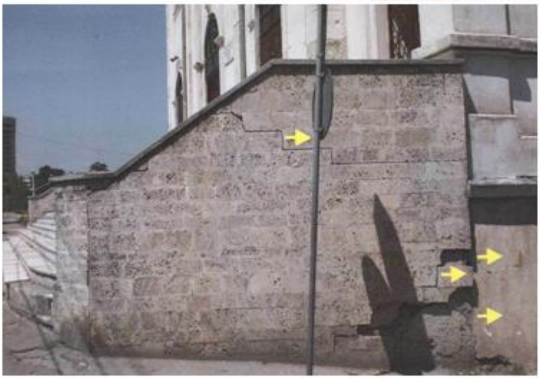


Figure 5.11

\- May 2009 -

Deeper fissures, showing
a permanent damaging
process of the building

Example of cliff wall line within 60 years:

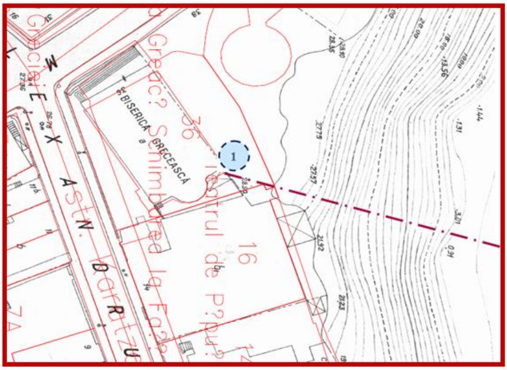


Figura 5.12 - plan cadastral 1936

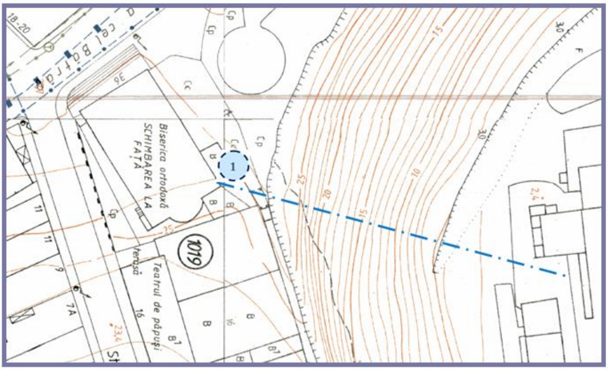


Figura 5.13 - plan cadastral 1996

X-Value	Y-Value
0	28,5
6,5	26
9,5	27
12,5	26
17,5	25
20	20
28	15
35	10
44,5	5
51,5	3
57,5	2,4
0	28,5
5	28,5
10,5	28
16	27
19	25
23,5	20
27,5	15
36	10
41	5
44	3
45	2
47,5	1

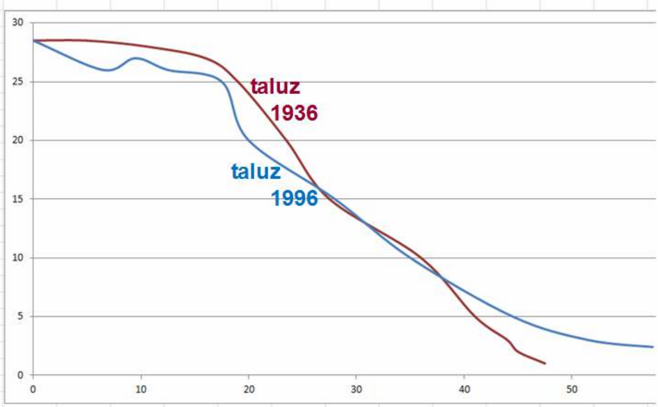


Figure 5.14 – Changing Cliff Slope Chart between 1936 - 1996

The two images, put one over the other show us that there is a tendency to reach balance state *(Figure 5.14)*

5.2.2. Building usage and undertaken works

Up to now the building suffered several interventions:

- filling the empty window spaces on the Northern part;
- general repairing in 2005-2006, according to license no 2421/17.09.2004, without complying with its main provisions:

- Annexed buildings (storages) of the North Eastern corner of the church were replaced and extended with permanent constructions as residences; *(Figure 5.15)*
- The step platform made of ancient stone as totally covered with Marmora; *(Figure 5.16)*

Figure 5.15 – Northern side of th Greek Church

Figura 5.16 - Biserica Greaca fatada principala

5.2.3. Particularities of the Underground Geotechnical Structure

The church is placed at 25 – 23 m height on a land with a first 2 – 4 m non homogenous layer followed by a loess one of variable thickness (15 – 17 m). At the basis of these layers is the phreatic water followed by green- brown clay layer of variable thickness (3 – 5 m) which causes cliff collapse when there is increased water volume; finally there is a sarman calcareous layer with weak upper parts (1 – 3 m), on which it is not recommended to dig the building foundation.

Another natural phenomenon, affecting the cliff areas is the constant slow immersion of the land annual average of 1,5 – 2,0 mm, causing also instability.

After works undertaken fissures appear showing the entire building tendency to move eastwards.

5.2.4. Technical measures and proposals for safety insurance:

1. A complex technical report to establish the stability of the cliff nearby and the necessary works.
2. A comlexe technical report for the Greek Church “Metamorphosis“ drawn up by experts authorized by the ministry of culture and national patrimony in order to establish the necessary measures and works to be done.
3. Assessment of all works and projects together with the investment level.

The same measures are needed for the building that houses the Elpis Puppet Theatre– historic monument, built on the same cliff, close to the church that has the same problems regarding stability and safety.

A drilling work done by Sc Geostud SRL Bucharest in 2010 show the composition of the cliff eastern part. [90] (*Figure 5.19)*

FISA FORAJ Ø7"							
COTA SONDAJULUI 0,00 M FATA DE MAREA NEAGRA POZITIA FORAJULUI – PICIORUL TALUZULUI, ZONA PLAJA MODERN					Proba		
					Nr. proba	Adancimea Tulb	Adancimea Netulb.
Descrierea stratului	Adancime	Grosime	Litologie	Apa subterana			
Umplutura din argila prafoasa cafeniu – negricioasa, tare, cu pietris si bolovanis	3,00	3,0		0.50	P1	2,00	
Nisip argilos galben cenusiu, plastic vartos, cu concretiuni calcaroase, saturat	5,0	2,00			P2		4,00
					P3		5,00
							8,00
Calcar compact	8,00	3.00					
Oprirea forajului in strat la adancimea de 8.00 m							

Figure 5.19 - drilling on Modern Beach Sc Geostud SRL - 2010

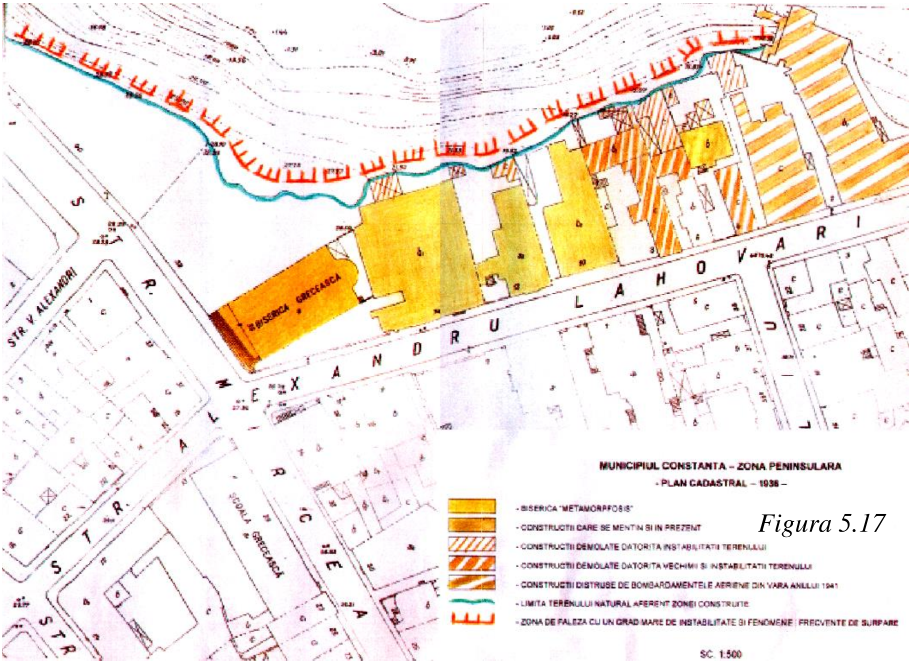


Figura 5.17

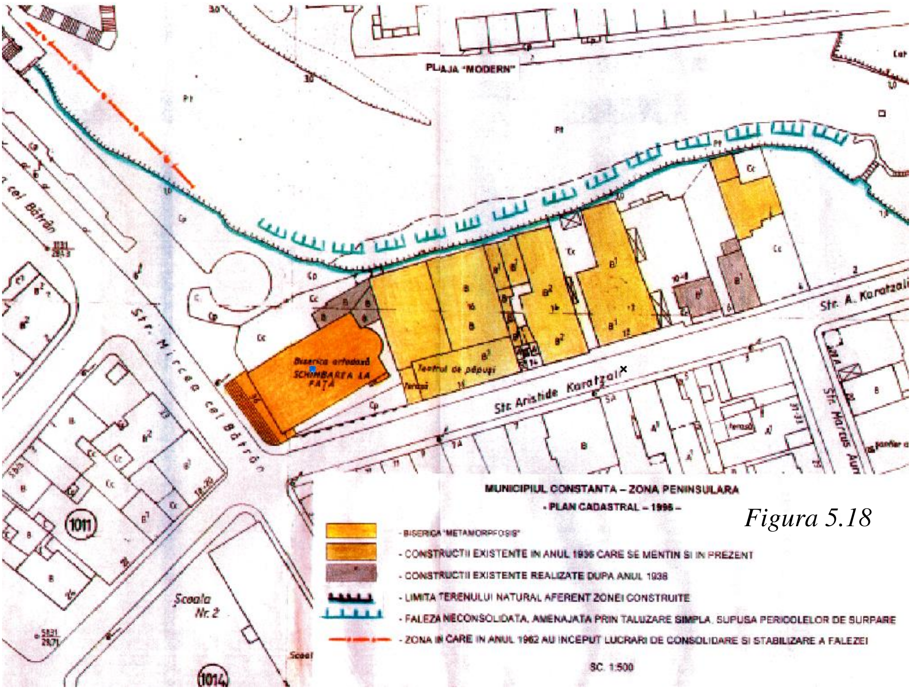


Figura 5.18

Chapter 6. Assessment of the cliff instability. Risk elements for the historic monuments built in the active area of Black Sea Cliff. Solutions for limited safety

6.1. Assessment of instability

6.1.1. Opinions on the assembly made up of buildings and cliff.

Relationship Cause - Effect.

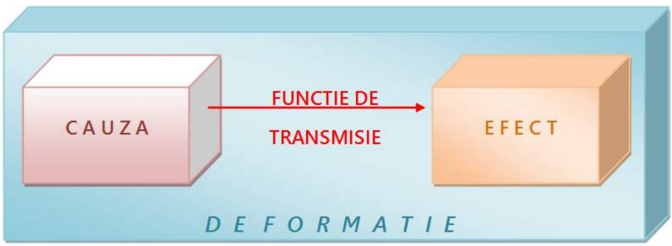
For a safety maintenance and exploitation of the historic monuments located in the cliff urban area, we need to adopt and apply some measures focused on resistance structure and cliff stability.

- Analysis of ***natural and anthropic*** elements aims at :

- studying the evolution of instability episodes;
- identifying the forces that generate instability.

- By studying the shape changes and the clear settlements of land, we can set the physical and geodynamic parameters of the construction, being able ***to avoid damages or catastrophes***.

By finding the cause of a shape change we will have the effect through the transmitted function (*Figure 6.1*)



RELATIA CAUZA – EFECT

Figure 6.1

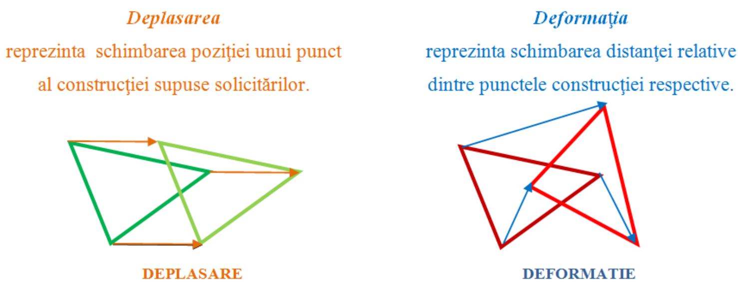


Figura 6.2

We can use the information on shapes change and measures for the safety of the building.

According to its function, a building is submitted to a demanding regime that leads to movements, and changes of shape.

Straight movements or deformations:
settlements; bulginess; arrows; slopes; fissures and cracks; horizontal movement.

Angular movements and deformations:
Building inclination and spinning.

Specific deformations:
Extensions or shortenings of building elements.

Good exploitation of a building is obtained by the experimental control of its behavior under the pressure of loadings by following its movement and deformations.

Damaged balance can lead to partial or total destruction, sometimes with important material or even human losses.

There are two complementary procedures to assess the optimal building exploitation

- experimental research on laboratory models or on building components on the field;
- observations and measurements of the building stability in time and its behavior.

Following these studies, we can show the general or typical causes of movements or deformations.

General causes are:

- geotechnical and hydro geological circumstances;
- physical and mechanical features of underground.

Typical causes are:

- insufficient volume of geotechnical and hydro geological information,
- accidental disruptive agents (deficient land immersion, hydrodynamic conglomeration, earthquakes, etc.)

By comparing all the results of specialized reports and studies we can draw up a diagnosis of the building and a prognosis of its future behavior, being able to conceive and adopt the correct **consolidating measures or continuous usage of the building**.

6.1.2. Cliff instability

Karl Terzaghi, the father of the geotechnical engineering, used to say spunea: "***if a mountain*** (here we have the historic buildings on a cliff) ***started to slide, the stopping measures must be adopted to the process that caused the sliding"***.

As it is complex phenomenon, land sliding is hard to be located so the solutions can only be provided by specialists.

The costs for cliff wall stabilization vary a lot and cannot be assessed only after the process took place.

For this case study: for the urban area with the cliff and the historic monuments on it, organizing is an incorrect, costing measure, but the surest one.

Several disciplines take part to the monitoring process of the cliff areas instability with historic monuments on them (civil engineering, geodesics, geology, topography, photometry, GPS, etc.), envisages the research in situ of both the physical phenomena and the choice of the best technical solutions for future actions.

The final objective of all these studies is to create an early warning system in order to foresee severe instability, to assure cliff stability and the safety of the building in region.

Safety measures for historic monuments are to observe the law provisions so the works shouldn't alter their structure and artistic features.

In the recent years, more and more countries adopted advanced cliff instability monitoring systems.

Knowing the possible dangerous situations helps to avoid risks.

6.1.3. Limited safety works for historic monuments subjects of natural and anthropic risk elements

Historic monuments are protected by law and treated in a special way complying with special technical regulations. For any historic lifting structure or part of it, measures must be adopted and applied before accidents as the maximum resistance and stability limit appears since the pre-collapse stage.

Immediate measures for lifting historic structures [77]:

- quality technical report - establishes the measures.

- rehabilitation of the patrimony values so that the losses be minimum.

Temporary and definitive interventions of prior necessity

- **Temporary interventions** are provisional constructions which take and transfer towards the ground settling actions.
- **Permanent interventions** are works of preservation, restoration or lifting structures, with no reduction of the patrimony value. These are adopted when it is impossible to use the temporary interventions.

Necessary papers

- **Before immediate works:** quality report, studies, previous projects, patrimony inventory, charges, technical reports, drawings.
- **After the immediate works**: works monitoring reports

Work Approval: building license issued according to the law.

We consider that it's high time a national program should be created with endangered patrimony that could be accessed and used by the Government, the local administration, cultural and educational institutions

6.1.4. Protection of historic monuments after consolidating works

After consolidation, for a good and safe usage of the historic monument, measures should be applied for protection against the environment elements.

This works focus also on the front sides of the historic buildings.

An example of homologated material by the International Scientific Congress of Berlin – 2004

is "THERMO SHIELD", a composite material, made up of porous ceramic microspheres. *(Figure 6.3)*

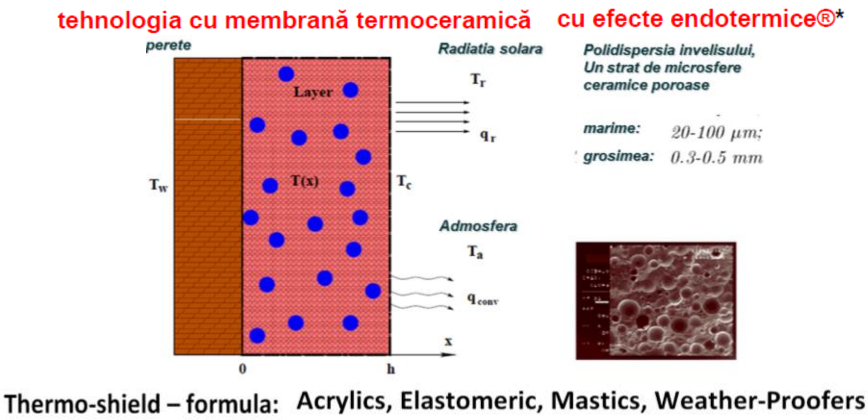


Figure 6.3 – Thermal shield

Obervations

ThermoShield effect against the heat depends on the optic features of the wall, of the environment and of the temperature regime. Here the effect can be even reversed. *(Figure 6.5) (Figure 6.6)* [117]

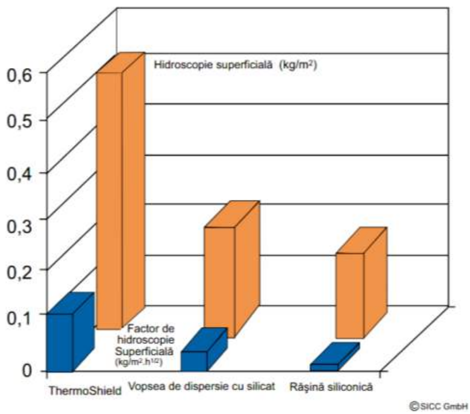


Figure 6.7 - Surface Higroscopy and artificial surface element of hygroscopy

6.2. Risk agents. Risk assessment by using behavior features and identifying vulnerabilities

6.2.1. Analysis of natural and anthrop agents and their impact on the Black Sea Cliff

This subchapter represents a synthesis based on the following studies made by Hallcrow Company in July, August 2011, at the request of A.N. Apele Romane

Administratia Bazinala de Apa Dobrogea – Litoral, in order to obtain technical assistance for European financed projects – Priory Axe 5 – major intervention field 2 – Coast erosion reduction: [92]

- *Master Plan "Coast Protection and Rehabilitation",*
- *Coast Diagnosis Report – Implementation of the right structure for preventing the natural risks – reduction of the coast erosion*

These were drawn up for the Romanian Coast rehabilitation and protection.

Environment is a major priority for Master Plan as we need to have a global view over the natural and human agents that cause coast changes and also on the relationships between them.

There are a lot of cultural and religious buildings in the Cliff area. The cliff Eastern part of the peninsula, object of our study, is mentioned in these studies as South Tomis.

- Impact of human actions

Several measures adopted and applied by humans influenced the way the coast looks today: coast protections, harbor dams.

- **Impact of the environment in case of absent intervention**

Destruction of the cliff basis and therefore their corrosion and degradation of properties placed up above the top of the cliff

Absence of action leads to beaches erosion.

Erosion increases the risk on urban buildings and infrastructure

6.3. Steps of the land sliding monitoring process:

6.3.1. Objectives

- It is done by the Central commission for prevention and defense against earthquakes and land sliding effects
- Legal frame-regulation NP044-2002, revised in 2006, on geotechnical papers
- Risk Management Process consists of risk identification and analysis and the reaction to it. [106]

Interactions between natural and human hazards with vulnerability comes up the risk concept. *(Figure 6.10)*

Absence of human community is hazard, no matter the sizes or consequences of severe on the natural space. (*Armaș, 2007*)

"Risk is present when hazard meets vulnerability" (*Cutter, 2001).*

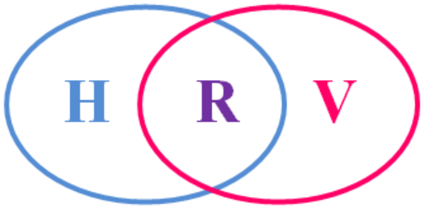


Figure 6.10

Causal relationships between risk, hazard and vulnerability.

R = H x **V** - risk conventional expression

R = H x **E** x **V** - risk mathematic expression

R – Risk

H – Hazard

V – Vulnerability

E – Risk exposed elements

NATURAL HAZARD – LAND SLIDING

Delimitation of hazard areas for land sliding is based on time and space measured data and has the following objectives:

- **Sliding Hazard Map;**
- **Risk associated with land sliding.**

- **Sliding Hazard Map** [78]

The balance state of the cliff wall is assessed using the ***stability factor*** ***(F_S)***: it's the report between the rock resitence to shearing on the most likely sliding surface and the tangential forces acting at the same level.

F_S can very between:

- critical value: $F_S = 1$

- value that makr the stable balance state .

- very high values where the cliff wall is stable at sliding: $F_S = \infty$

Instability Factor (K_m)- for hazard maps:

$K_m = 1/F_S$: - instability degree to sliding or,

- the probability to have a land sliding

- $F_S = 1 \Rightarrow K_m = 1$ or $K_m = 100\ \%$ - cliff limit balance state;
- F_S rises => K_m decreses;
- $F_S \to 0 \Rightarrow K_m \to \infty$ - cliff instability state.

For the best assessment of the land sliding we must take into account the following elements:

a – *lithologic*;

b – *geomorphologic*;

c – *structural*;

d – *hidrologic and climatic*;

e – *hydrogeological*;

f – *seismic*;

g – *silvic*;

h – *anthrop*.

Influence of these factors on the cliff balance state is expressed with K_i (i = a … h), with values between 0 and 1.

These factors don't have the same intensity. A major role is represented by lithological and geomorphologic elements, the others 6 have a smaller influence on the cliff instability. For the instability degree calculation, for land sliding, the following formula is used:

$$K_m = \sqrt{\frac{K_a \cdot K_b \left(K_c + K_d + K_e + K_f + K_g + K_h\right)}{6}}$$

The coefficients corresponding to the 8 elements that influence the cliff stability are assessed using the information from the existing studies.

In conclusion:

- K_m - represents the assessment of the land sliding potential, with values resulted from the quality analysis and the interpretation of natural and anthrop elements that influence the cliff stability.

The works depend on the sliding instability factor K_m .

It is totally forbidden to place construction on polygon like surfaces with K_m equal to high sliding potential.

Based on the geotechnical study for consolidation and extension of the National bank, it was possible to establish the factors which have influence on cliff wall sliding:

Ka = 0,78 – lithologic element (sedimentary rocks, semirocks)
– characteristic of the sliding instability: medium to high;

Kb = 0,88 – geomorphologic element (cliff wall inclination angle $> 15^0$)
- characteristic of the sliding instability: medium to high;

Kc = 0,75 – structural element (geologic structures, with faults or cleavage)
- characteristic of the sliding instability: medium;

Kd = 0,66 – hydrologic and climate element (moderate rain, erosions appear vertically and horizontally)
- characteristic of the sliding instability: medium to high;

Ke = 0,68 - hydro – geologic element (phreatic water is $> 6m$ depth)
- characteristic of the sliding instability: medium to high;

Kf = 0,50 – earthquakes (< 6 degree on M.S.K. scale)
- characteristic of the sliding instability: medium to high;

Kg = 1 – forest element (no forest)
- characteristic of the sliding instability: very high;

Kh = 0,85 – human action (leakages of the supplying systems, lack of pluvial collection system)
- characteristic of the sliding instability: high.

$$K_m = \sqrt{\frac{K_a \cdot K_b \left(K_c + K_d + K_e + K_f + K_g + K_h\right)}{6}}$$

K_m = 0,51 - high to medium sliding potential

In conclusion, the building is placed on a cliff wall with medium to high potential for land sliding activity and therefore it is necessary to take actions in order to stabilize it.

Compared to the structure of the National bank, we can see that the Greek Church, according to the influential factors, shall have K_m equal to 1, representing a high potential for land sliding activity and high vulnerability.

6.3.2. Methods to monitor the land sliding activity

- **Efficient monitoring procedures**

step I: evacuation of people and protection of goods;
step II: assuring alternatives: shelters;
step III: study the phenomenon to determine calculations for further measures
step IV: remedies using technological stages.
step V: work execution

- **Measurements and procedures**

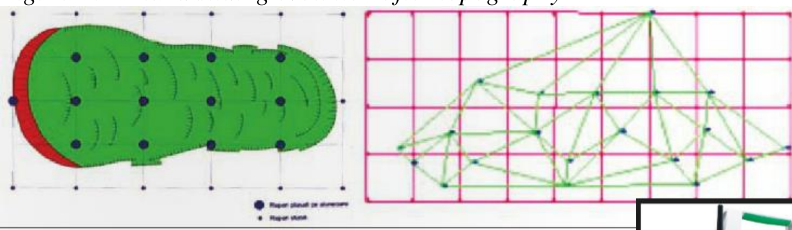
Stages for previous monitoring the risky areas:

Stage 1. Study of the sliding potential cliff wall

Stage 2. Study in time the consolidated and stabilized cliff wall:

- **direct drilling:**
- **Electromagnetic probe:**
- **Piezometry:**
- **topometry** *(Figure 6.11)*
  - after land sliding, horizontal and vertical movements are established, using the planted markers, making diagrams and charts *(Figure 6.12)*

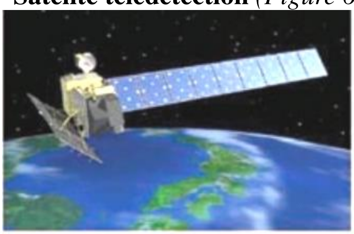
Figura 6.12- land sliding evolution after topography



- **geological map making;**
- **Terrestrial and air photogrammetry** *(Figure 6.13)*

Figure 6.13 – Air photogrammetry

- **Satelite teledetection** *(Figure 6.14)*



- ALOS PalSAR, λ=23.6 cm

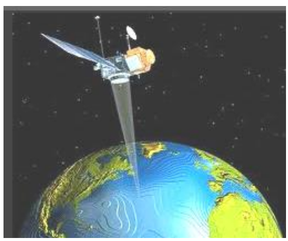


Figure 6.14 sattelite platforms

- **Terrestrial scanning laser** - 3D space images of ground objects. *(Figure 6.15)*

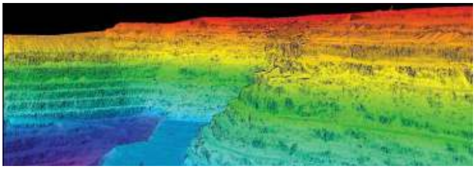


Figure 6.15 - Leica CIO scanner and 3D scanned image

Indirect methods – used for rock physical – mechanical properties, whose variation can be a marker for land sliding:

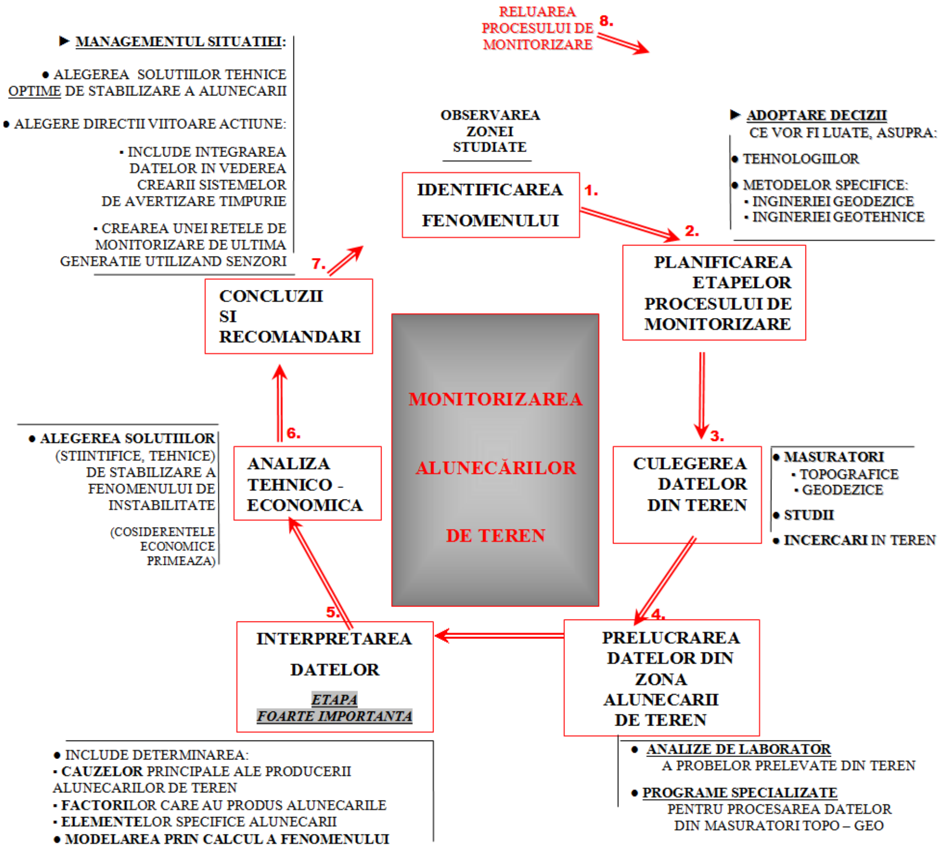
- **Analysis of ground humidity;**
- **Analysis of water minerals;**
- **Analysis of soil radioactivity;**
- **Geophysical measurements**;
- **Presure and dilatation measurement during drilling**.

▪ **Causes for cliff instability:**
Contributing and triggering agents.

▪ **Preventive measures can be grouped as it follows**:
- **modification of the cliff wall geometry;**
- **reduction of por waters**;
- **improvement of Cliff wall resistance to shearing**;
- **mechanical measures**.

▪ **Remedies:**
- **modification of the cliff wall geometry** by removing the material;
- **drainage**;
- **resistance structures**;
- **internal reinforcement of walls**.

6.3.2. **Monitoring diagram for land sliding**



Conclusions

The research program of these doctoral studies focused on quantifying as exactly as possible of the reality vulnerabilities present in Peninsula Area of Constanta City: Ovid Place and Tomis Marina – badly damaged by disruptive elements of geotechnical, environmental and human nature.

• This work tries to indentify causes of vulnerabilities in the risk areas. Those who have been identified were put into risk calculus method regarding the sliding cliff presented in Chapter 6 "Assessment of the cliff instability. Risk elements for the historic monuments built in the active area of Black Sea Cliff. ".

For the study I chose a very important historical area for Dobrogea Provincei, the historic monument space, part of the historic monuments list of 2015, Code LMI: CT-I-s-A-02553 – "tomis ancient city", an archeological site - confined by Peninsula, Ferdinand Avenue, East Cliff up to Modern Beach, Casino Building, Gate 1 of the Harbor, Commercial marina, Roman Thaerme Street and Traian Street.

The cliff in this area has a high level of vulnerability, due to sliding sections with high risk of collapse. I calculated the sliding potential of the cliff (K_m) on which there is a historic monument: many years ago a Hotel, nowadays, Constanta Branch of the National Bank, code LMI 2015: CT-II-m-B-02834, building year 2013.

I extended this analysis to the cliff on which are other historical monuments such as the Greek Church called *Metamorphosis* -Code LMI, CT-II-m-A-02826 and the Puppet Theater *Elpis* -Code LMI, CT-II-m-B-02814.

The approach was made by an interdisciplinary analysis, with natural and anthrop elements, with the risk of human casualties – around 200 persons, with the loss of community patrimony - around 3-4 buildings and the major impact on human economic and spiritual life caused by the destruction of the religious building and the puppet theater .

For the calculus formula we used natural and anthrop influencing elements that influence the slopes balance independently and at the same time: lithologic, geo-morphological, structural, hydrologic and climatical, hydro geologic, seismical, vegetal, anthrop, resulting in the cliff wall potential (K_m) close to 1, correspondent to a higher sliding degree of instability o the shore, therefore the area is characterized by a high vulnerability.

The entire thesis and the case studies emphasize the importance of the patrimony values. It is important also to develop programs with positive attitudes of preserving and protection of the existent patrimony buildings, by identifying calculus techniques for the vulnerability. Based on the results, the competent authorities should find and begin adopting measures for a better management of the patrimony; they should adopt favorable politics for preserving the national values, satisfying both the contemporary community needs and the preservation of historical evidence.

The researching program and the thesis offer valuable systems for analysis, interpretation and protection, by placing in limited safety the areas with high level of risk.

For the last 7 years, I made a lot of efforts during the research program, to identify some systems for prevention of local hazards in order to ease the impact on the community where I'm carrying out my work which is part of the sustainable development politics for Constanta City – being employee of the Urban Planning Department – Office for Urban Strategies within the City Hall.

Here I analyzed the historic buildings whose stability is badly influenced by the land sliding, with continuous deformation or with pre-crisis situations.

The thesis develops practical principles to protect patrimony buildings by reinforcing slopes after using a system innovated by the author hereof to identify critical and very vulnerable.

Thus, the thesis also has an important feature represented by identification of the risk on the shore area in order to adopt emergency measures for protection of patrimony and human life.

As we already mentioned, the vulnerability degree calculation depends on some elements that we can quantified by an advanced study of the land features. Measurement of the calculation elements presented in Chapter 6 has been assessed based on results of land studies. In many cases such studies offer a probabilistic situation, and their association is highly close to reality; thus it results necessary to undergo studies of areas which should offer elements as closely as possible to reality.

Using the researches done previously together with the activity of competent authorities in the field, I could make up a map on criteria of importance of historic buildings, of people number, of risk by cliff wall deformation, but also of identifying preventive criteria reliable for future preventive actions.

Our research had a major contribution in identifying a calculation formula for the cliff wall collapse. It is based on lithologic, geomorphologic, structural, hydrologic and climatic, hydro geologic, seismical, vegetable and anthrop elements.

So it is very important that the local community do such studies that help assess calculation formulas and at the same time quantify the vulnerability degree.

The thesis contains calculation for cliff area where lies the National Bank because I already had the necessary studies. Nowadays there are finished studies for the Greek Church called *Metmorphosis* and the Puppet Theater called *Elpis*, so that I have already been requested by the Greek community as beneficiaries, that together with Prof Eng Grămescu Ana Maria calculate the vulnerability and risk degree of the cliff wall and find a solution to place them in limited safety it and stop the lad sliding phenomena degradation of the buildings.

State institutions could use such research for the entire shore length, so that the money for patrimony constructions should be invested according to the vulnerability level.

- As a novelty, the thesis contains an analysis of the evolution of the modifications in time of the cliff areas together with their evolution behavior of patrimony buildings, being a research I did on my own and based on old and current documents used in my technical inspections. The conclusion of this research is that it is necessary to stabilize the cliffs and to place in limited safety the historic buildings.

- Using the plans for development and urban organizing of Constanta City of different times, I pointed out the works proposed for defense and reinforcement of the shores: building of the defense dam close to the shore limit; capture of the underground waters; reinforcements of the sea shores; earthworks, building slopes and balks; artificial beach.

In the last 60 years, along the cliff shore, comparing the cadastral plan of 1936 to the one of 1996 we pointed out the: modification of the land line, due to natural and anthrop elements - Figure 4.17; modification of the cliff slope, by two transversal sections between the N-E of the Metamorphosis Church and the level of the beach and noticing a change of the cliff slope with the tendency to reach the balance status. (Figure 5.14).

Following such observations/studies, I underlined the need to adopt technical measures to place in limited safety the *Metamorphosis* Church and *Elpis* Theater nearby, putting some elements to monitor the fissures in time, and the necessity to do works to stabilize the cliff on which these are built.

- Chapter 3 of this thesis studies the technical state of the historic buildings of Peninsula identifying degradations after the collapse of the foundation land, by losing the stability of the cliff shore stability (Figure 3.1): « Metamorphosis » Greek Church, « Mihail Şuţu » Vila, National Bank, Casino and the protection dam, the Museum of National History and Archeology, the buildings of Ovid Street. For each building I analyzed archives documents synthesizing: architectural and patrimony value; design and building of construction; constructive particularities, time behavior; works undertaken in time both to the building and the cliff; building exploitation; natural and anthrop factors affecting the stability of the cliff.

Given the age of the buildings, their status of historic monument and complexity of elements influencing the stability of the cliff, I emphasized the emergency solutions that must be adopted: technical expertise, solutions for placing in limited safety, works for cliff stability .

The thesis contains analytical inventory lists of monuments, pursuant the Regulation on classification and inventory methodology of historic monuments set by the Ministry of Culture of 18/04/2008 (Official Gazette, Part I no 540 of 17/07/2008), with technical data on each building.

Another phenomenon studied in this thesis was the destruction of the houses line on the Southern side of Ovid Street caused by frequent collapses.

- Case studies were researched by me based on historic facts and also on quantification of the degradation in the last 25 years.

As a important touristic destination, according to Master Plan "Protection and Rehabilitation of Coast Area" and the Diagnosis Report on Coast Line, I pointed out natural and human elements and their effect on the Black Sea Cliff based on: coast type and coast dynamic.

I showed direct methods used for monitoring areas with land sliding possibility and the most modern equipments used for measurements, necessary to assess the evolutions of sliding, the choice of calculation hypothesis and finally the adoption of measures for stabilizing the shore.

- A major help for me was the usage of some adjustable materials for thermo technical correction of the functional space, without applying front plaster and damaging the architecture. Studies showed that there are buildings in the studied area where Thermoshield membranes can be employed complying with the current legal provisions, and being a solution for exploitation of the built spaces. Sub chapter 6.1.4. on "Protection of monuments without reinforcement" presents the efficiency of this material on different surfaces horizontal or vertical, with or without the interruption of migration by capillarity of the water in the masonry mass.
- The study, the research and the investigation focused on usage of original methods for risk reduction and solutions for historic building resistance and stability located on the cliff.
- Finally I made a logical chart to monitor the land sliding with the process stages beginning with the phenomenon identification, planning of the monitoring process, gathering, processing and identifying the data of the ground, passing through technical- economical analysis and reaching the situation management, choosing the optimal technical solutions for sliding stability. For the best management of the sliding phenomenon it is important to point out the periodicity of the monitoring process. (figure 6.3.2.)
- The results of my research will be applied in the near future, being important for urban papers on the protected area of Constanta City: updating documents for Area Urban Planning for Peninsula Area, updating papers for General Urban Planning for Constanta City and other documents of urbanisms focused on Constanta cliff area.

These results can be a valuable support for the elaboration some technical prescriptions in the field of historic monuments safety works.

Results:

Published articles:

► ***"The evaluation of the state of instability of the historic monument construction Villa «Mihail Şuţu», located in the active area of the Black Sea's waterfront"***, **Simion Ancuţa Gemănaru, Grămescu Ana Maria, Indian Journal of applied Research, Volume: 6, Issue : 6, June 2016, ISSN – 2249-555X, publicaţie indexată BDI, Impact Factor: 3.919, Index Copernicus IC Value : 74.50**, http://www.worldwidejournals.com/indian-journal-of-applied-research (IJAR)/file.php?val=June_2016_1465028483__219.pdf


Certificate of Publication

ISSN No: 2249-555X | Index Copernicus (IC) Value : 74.50 | Impact Factor: 3.919

This is to certify that

Prof./Dr. Simion Gemanaru Ancuta

has contributed a paper as author/ Co-author to

INDIAN JOURNAL OF APPLIED RESEARCH

Title "THE EVALUATION OF THE STATE OF INSTABILITY OF THE HISTORIC MONUMENT CONSTRUCTION VILLA «MIHAIL SUTU» - NO.1, K. ZAMBACCIAN STREET, CONSTANTA, LOCATED IN THE ACTIVE AREA OF THE LACK SEA'S WATERFRONT"

and has got published in volume 06, Issue 06, June 2016

The Editor in Chief & The Editorial Board appreciate the Intellectual Contribution of the author/co-author

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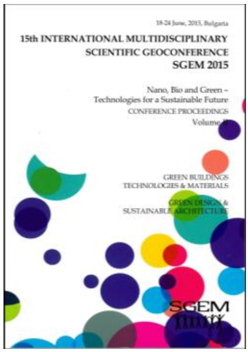

► ***"Destructive factors influencing the behavior of the constructions located in the area of the Black Sea's cliffs"*- Simion Ancuţa Gemănaru**, Grămescu Ana Maria, Constantin Anca - 15th International Multidisciplinary Scientific Geoconference SGEM 2015, Nano, Bio and Green - Technologies for a Sustainable Future , Conference Proceedings, ISBN 978-619-7105-43-8 / ISSN 1314-2704, June 18-24, 2015, Book6 Vol. 2, 413-420 pp, Conferinţă indexată **ISI Web of Knowledge, Thomson Reuters**; http://sgem.org/sgemlib/spip.php?article6783


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► Poster presentation section "Green Design and Sustenable Architecture" - Simion Ancuţa Gemănaru - 15th International Multidisciplinary Scientific Geoconference SGEM 2015, Nano, Bio and Green - Technologies for a Sustainable Future, Conference Proceedings, ISBN 978-619-7105-43-8 / ISSN 1314-2704, June 18-24, 2015, Conferinţă indexată ISI Web of Knowledge, Thomson Reuters

INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC
GEOCONFERENCES SGEM 2015
16-25 JUNE 2015, Albena Co., Bulgaria

Green Design and Sustainable Architecture

DESTRUCTIVE FACTORS INFLUENCING THE BEHAVIOR OF THE CONSTRUCTIONS LOCATED IN THE AREA OF THE BLACK SEA'S CLIFFS

PhD student Simion Ancuţa [1]
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ABSTRACT

Lately, a growing number of damage appears to buildings with heritage value located in historic urban areas. Protecting existing buildings of historic urban areas is a debt of honor for every community, an obligation arising from the application of European and national legislative framework. Built cliffs raise complex issues in ensuring stability and resistance, and identifying risk factors and adopting conservative measures for integrated protection becomes a priority.

KEYWORDS: built, cliff, destructive factors, damage, heritage, monument

From the medieval period to the modern period, the city of Constanta has faced a permanent dynamic of the seashore line mainly due to the high degree of instability of the cliffs, the effect of marine currents and human interventions during the early modern city period, which were in most cases accelerating factors to the natural ones. (figure1)

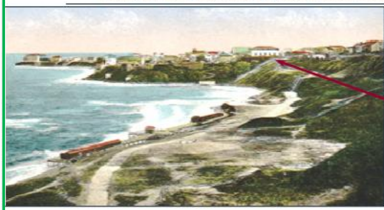
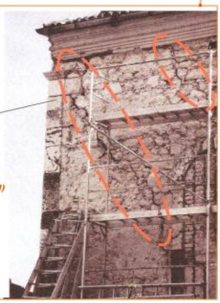


figure 1 The peninsular area–east cliff – photographical document from around 1900

Metamorpfosis Greek Church photo 1960 –1965 figure 2

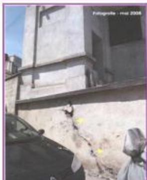
From the visible phenomena of instability of the cliffs with danger of collapse, which require urgently the implementation of a program of consolidation and stabilization works, we mention:

- the adjacent cliff to Mircea cel Batran Street, on the east side, near Negru Voda street, cracks have appeared recently that marks the beginning of a phenomenon of subsidence of the coast in the public alimentation construction area located at the top of the cliff slope (figure 3.2).
- Metamorphosis Greek (figure.2) church built In the years 1864-1867, listed as historic monuments of national importance and the whole cliff area on the north side of the street Karatzali (figure 3.1);



(figure 3.1)

*The North-East Corner
Photo May 2006
Relatively old cracks are visible, which mark the tendency of collapse building's north-east corner.
They are currently covered by new plaster.*



*The "Metamorfosis" Church Built in the years 1864-1867
Photo May 2008
The cracking is moore pronounced, highlighting theongoing process of the building's degradation.
figure 3.2.*

CONCLUSION

It seems more than anywhere else in the world, old buildings designed and made by renowned engineers and architects, undergo a drastic operating system, generated by all destructive factors, logically synthesized as follows: natural hazards (seismic movements, erosion of banks , strong winds, saline environment), or destructive factors generated by human activity (losses from pipes carrying water, lack of intervention works unexecuted on time and lack of quality, intervention works for the slopes to achieve certain goals, creating slipping plans due to the nature of the foundation terrain).

As the time passes, these dangers are imminent, unruly and difficult to remove due to the high costs. Knowing at a certain point the actual state, requires the quantification of all hazard factors, factors that alter the degree of vulnerability of the existing buildings, the development of hazard maps for the slope area for the purpose of adopting appropriate measures to diminish and even eliminate factors risk. Therefore, we are aiming two issues: removing the risk factor and adopting minimal measures on resistance structures of the buildings, their infrastructure, and on the terrain under the foundation for commissioning the limited safety.

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- **Conference**

► ***"Contributions on reducing risk factors faced by historical monuments buildings located within the active of the Black Sea cliff. Solutions for using the limited safety"***, **Simion Ancuţa Gemănaru, Grămescu Ana Maria,** International workshop – Ovidius University Constanta: **"Water, Energy, Civil Engineering and Construction Management in Portugal and Romania"**
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