



THE RESTORATION OF A COLLAPSED HISTORIC MONUMENT - ARCHITECTURAL AND STRUCTURAL DILLEMA

C.O. Gociman⁽¹⁾, R. Nemțeanu⁽²⁾, I. Craioveanu⁽³⁾, C. Hogeă⁽⁴⁾, V. Mocanu⁽⁵⁾, C.I. Moscu⁽⁶⁾, I. Moscu⁽⁷⁾, A. Toader⁽⁸⁾, M.G. Ene⁽⁹⁾

⁽¹⁾ PhD Arch. Professor Emeritus, "Ion Mincu" University of Architecture and Urban Planning, Bucharest, Romania, department of Architectural PhD Studies, criba_proiectare@yahoo.com

⁽²⁾ PhD Arch. Assis. Professor, "Ion Mincu" University of Architecture and Urban Planning, Bucharest, Romania, rnemteanu@yahoo.com

⁽³⁾ Engineer, Iterum Construct, iulia.craioveanu@iterumconstruct.ro

⁽⁴⁾ Architect, S.C. Criba Proiect S.R.L., chogeă@yahoo.com

⁽⁵⁾ Architect, S.C. Criba Proiect S.R.L., Romania

⁽⁶⁾ Ph.D. Arch. University assistant, "Ion Mincu" University of Architecture and Urban Planning, Bucharest, Romania, moscu_c@yahoo.com

⁽⁷⁾ Ph.D. Arch. University assistant, "Ion Mincu" University of Architecture and Urban Planning, Bucharest, Romania, irina_moscu@yahoo.com

⁽⁸⁾ Urban planner, S.C. Criba Proiect S.R.L., toader.alfred@gmail.com

⁽⁹⁾ Master student, Bucharest University of Economic Studies, Romania, Marketing Faculty, monica.ene14@gmail.com

Abstract

Oteteleşanu Castle, classified as a historical monument, represents a unique case in the Romanian built space through its permanent remodeling generated by the functional and aesthetic changes of the successive owners passing through at least six variants of spatial conformation identified. His spatial story begins in the medieval era when the estate belonged to the boyars Cojeşti (1487) and then to the house of the ruler Mihai Viteazul. The next two stages are marked by the remodeling of Ioan Oteteleşanu which remakes the castle twice. The first reconstruction of the mansion is in the neoclassical style (presumed author French architect Xavier Villacrosse) and of the park in romantic style, Swiss author architect Karl Wilhelm Mayer (1840-1850). Between 1863 and 1876 the boyar initiates a second remodeling of the mansion in the style of holiday chalets in the Italian-Austrian alpine area or of the spa resorts adding a sumptuous honor staircase and two side towers, immortalized by the German photographer Franz Duschek - the father (1863 and 1868). According to his will, all the wealth of Ion Oteteleşanu belongs to the Romanian Academy for the establishment of an Institute for poor girls. This institute was remodeled under the coordination of Kalinderu and inaugurated in 1894 in the presence of King Carol I of Romania. Its existence was marked by the presence of great Romanian writers such as Ioan Slavici and Mihai Eminescu. The Institute was remodeled in 1930 to receive a modern image. Paradoxically abolished by the communists in 1989, the "Ion Oteteleşanu" Institute becomes in 1954 the headquarters of the new Institute of Atomic Physics led by the academic Horia Hulubei, who will initiate function-specific repartitions. In 1977 the castle was severely affected by the earthquake and evacuated. In 1979 it is assigned to another Research Institute for the Physics of Materials that could not use it, the construction collapsing in 2011. The academic community, architects and plastic artists have requested the salvation of the monument and its incredible story. The proposal for consolidation, restructuring is based on a mixed variant, coming from the corroboration of two historical phases, but which give the most significant, architectural form, worn during the time of the castle, that of the Kalinderu - Slavici period 1893-1906 combined with reconstruction of the southern facade from the image of Duschek - father (1863-1868) (Oteteleşanu stage), adapted to the theme of creating a center of excellence in research and education at European level. The structural solution aimed to keep the construction in balance during the works through vertical and horizontal supports. The coating of the vertical elements from the bottom up (from the ground floor to the 2nd floor) was aimed at tightening the box. The casting of new reinforced concrete slabs using the existing slabs as a formwork in reverse order from the floor to the ground floor bound the box horizontally in keeping the supporting system. The reinforced concrete of the existing masonry foundations and the creation of the new general basement made the house underground more rigid. The realization of the central hall opened on four levels, with zenithal illuminator, the preservation of all the valuable elements discovered have posed difficult problems of spatial, functional, structural resolution, of restoration of a ruin in collapse state. The research has succeeded in maintaining and rendering a historical reference space for the scientific and academic community as well as for the national cultural heritage.

Keywords: spatial evolution, historic monument, restauration, consolidation, value recover



1. Introduction

“The cultural and natural heritage, with the related technologies, practices, skills, knowledge systems, ecosystem goods and services, can play a positive role in reducing disaster risks at all stages of the process (availability, response and return), and from now on contributes to sustainable development in general”. [1]

Françoise Choay in “The Allegory of the Heritage” highlights the relationship between the historical heritage and its acceptance by the communities as a milestone and support for continuity [2]. For Norberg Schultz, protecting and preserving the idea of “Genius loci” means maintaining the essence of a place in an ever-changing historical context. Although the structure of a place changes over time, the spirit of the place must be maintained, Norberg-Schultz defines “stabilitas loci” as an essential condition for human existence [3]. The progressive loss of the cultural monuments as a result of floods, mudslides, fire, earthquake, and other hazards has become a major concern partly because of significant role that heritage plays in contributing to social cohesion and sustainable development, particularly at times of stress. In the face of these challenges, the number of World Heritage properties that have developed a proper disaster risk reduction plan is surprisingly low. [4]

Oteteleşanu Castle is a testimony of continuity and resilience, despite resisting both legal, functional and aesthetic changes. His story was a challenge for historians, architects and artists fascinated by the multiple imprints of the memories included in the walls, that the project team had to decipher. Thus, it became a challenge for engineers in the 10-year long process of its reconstruct (2010-2020).

“To reconstruct means “to construct a new”. Normally, reconstruction of a damaged place would refer to the process of building again something that has been destroyed or lost, as could happen in a natural disaster, such as an earthquake, or in an armed conflict. In such cases, rebuilding would not necessarily mean recreating something exactly as it was before. Often, it would result in a new building in the style relevant to the period even though adjusting to the inherited context. Reconstruction will also refer to re-establishing or regenerating the social-economic condition of a place after a period of abandonment. This will include the mental process of recalling something in one’s mind and/or re-establishing an identity. It is indeed a key question when reconstructing something that has been recognized as heritage. Here, as a matter of fact, the situation can be complex.” [5]

2. The monument characteristics

2.1. Project location

The castle "Ion Oteteleşanu" from the commune of Măgurele, bordering Bucharest, is classified as a historical monument, being part of the "Ensemble of the former Oteteleşanu manor", registered in the current List of Historical Monuments (LMI), under the code IF-II-aB-15 294 The castle, the park, the church "Saints Emperors Constantin and Elena" and the archaeological site with the remains of the Grindu Monastery are part of the former mansion. [6, 7]



Fig. 1 – Location plan [8]



The mansion (castle) from Măgurele is part of a series of aristocratic endangered residences in Romania: noble residences surrounded by romantic-style parks, arranged in the first half of the 19th century. Of these, at present, only a few remain.

The castle represents a unique case by its evolution, by its remodeling, by the permanent functional and aesthetic modification according to the fashion of the time, over two centuries. The succession of owners of the mansion-castle has led to at least six transformations of spatial, stylistic and functional conformation.

2.2. Objectives

The objectives of the project were to enhance the monument building through consolidation, restoration, rehabilitation and create the typological and functional diversity required by the beneficiary by proposing a center of excellence in research and education at the European level.

2.3. Historical evolution

The castle had six different spatialization hypotheses identified by the historical study [7]. Stage I. 1487-1840 period. At the first is mansioned, the house and the court of the Cojești boyars and in XVI the Cula Stancăi Lady and Mihai Viteazul the ruler. In 1800, the nucleus of the manor house belonged to Hristodor and Iancu Vrana. [9]

Stage II. Oteteleşanu Period (1840-1888). In 1840 - the purchase of the estate by the minister Ion (Iancu) Oteteleşanu - the president of the Magistrate of Bucharest from the boyars Vrana. After the marriage to Safta Cîmpineanu - sister of Ion Cîmpineanu, prominent member of the Romanian nobility start the restoration and reconstruction of the mansion (French architect Xavier Villacrosse) in the style of neoclassical French architecture - (basement, ground floor, 1st and 2nd floor) - park design in romantic style with a lake, pavilion and statues in the center made by the German landscaper architect Karl Wilhelm Friedrich Mayer (1844 - 1845) anoted by horticulturist F. Horner. Wishing to have an inheritance, he tries a second marriage in 1850 with Elena Filipescu, another member of Romanian nobility. [9]

In the period 1863-1876 he remodeled the manor house in the style of holiday chalets in the Italian-Austrian alpine area or the spa resorts of Karlovy Vary, Herculane, adding the great honor staircase on the facade N with two allegorical statues Venus and Apollo, adding the side towers on east and west, floor 2 extension and “glazing” configuration, adding the existing terrace to the park on the 1st floor on the south façade. The photographs of the mansion made by Franz Duschek - the father (1863-1868), shows the romantic and sumptuous character of the building that became a palace [10]. In 1876 Ion Oteteleşanu dies, leaving the will of the Romanian Academy for the founding of an Institute of Poor.



Fig. 2 –Images by Franz Duschek the father (1863 - 1868) main façade and the façade to the lake [10]

Stage III. The Kalinderu-Slavici Period (1888-1908). In the period 1893-1894 - Ioan Kalinderu and Ion Cîmpineanu the testamentary executors, of Ion and Elena Oteteleşanu, establishes the Institute for Poor Girls - “Ion Oteteleşanu Institute” according to the testament of Ion Oteteleşanu. They start another remodeling of the castle first with the renunciation of the monumental staircase on the north facade, the construction of a balcony over access, the closure of the window glazing from the second floor. On 18th October 1894 was the inauguration of the Ion Oteteleşanu Institute of Girls, main participates King Carol I and the prime minister I.D. Sturdza. The study director was the novelist Ioan Slavici who writes the monograph of the Ion Oteteleşanu



Institute. The national poet Mihai Eminescu, a good friend of Ioan Slavici, was a permanent visitor of the school. [11]

Stage IV. Period of the Institute of Girls 1908-1947. In 1930 started a new remodeling, abandoning the roof and covering in the terrace and renouncing the balcony on the North. [7]

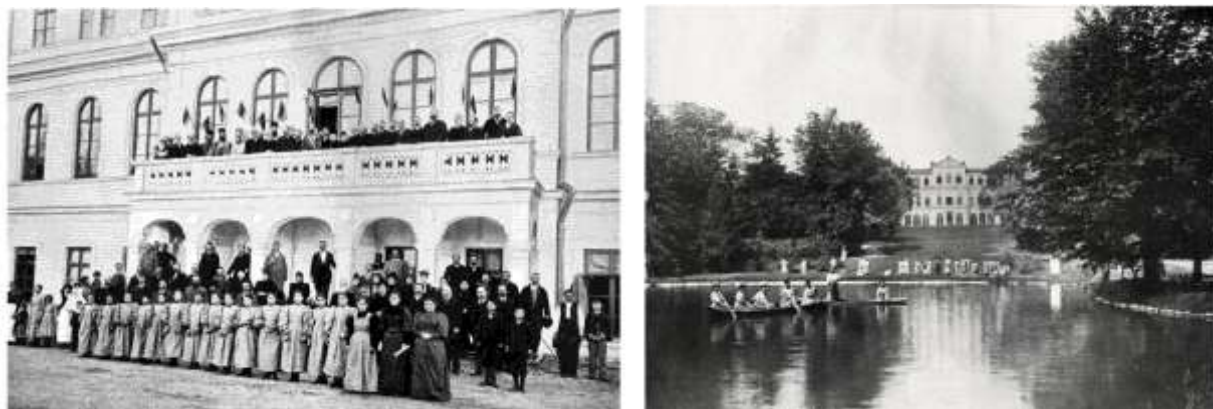


Fig. 3 – Left - Inauguration of the Institute for Poor Girls; Right - Castle View [11]

Stage V. IFA Period - Institute of Atomic Physics - 1948-1977. In 1948 in the debut of the Romanian communist period happened the paradox closing the “Ion Oteteleşanu” Institute. In 1954 - The Institute of Atomic Physics set up in 1948 by Professor Horia Hulubei moves to Oteteleşanu Castle and in 1977, the Institute is evacuated due to the damage after the earthquake. [7]

Stage VI. IFTM Period - INCDFM (1977-2019). In 1979 it becomes the Institute of Physics of Materials (IFTM-INCDFM), who used very difficult the uncertain space affected by the 1986 and 1990 earthquakes. In 2011 the east tower crash. The existing situation required either demolition or consolidation of the building.



Fig. 4 – Left - Railing detail; Right - The posterior existence facade [12]

Its rich history, the story of so many owners and the changes they have made to always adapt the space to new needs for representation or functional conformation make this monument a living mirror of the transformations of the Romanian society, in the pre-modern and modern period of the Romanian space. His evolution is marked by great personalities starting with the voivode Mihai Viteazul, the great prefect of Bucharest Ion Oteteleşanu and his wives Safta Cimpineanu and Elena Filipescu, scholars such as Ion Kalinderu, writers like Ioan Slavici, Mihai Eminescu, great leaders king Carol I and physicists like academic Horea



Hulubei. In 2012, the building was in collapse and the castle's tower collapsed. In this totally unfavorable context, the beneficiary of today started to restore the former mansion-palace institute for the function of research-scientific representation institute in relation to similar institutions in the world.



Fig. 5 – Romanian personalities who have marked the existence of the castle over the years [12]

The problem of the project of restitution of one of the possible variants was clarified with the identification in the periodic photographic documents and archives of certain situations and by consolidating and restoring the existing building based on a reasoned historical study and restoring authentic parts from the previous conformations that can be found in situ. The choice was considered the most valuable and closest to what could be returned.

The proposal is based on a mixed version, coming from the corroboration of two historical phases, but which give the most significant, architectural form, worn throughout the castle time. The project followed the spatial and functional compliance requested by the beneficiary for the creation of a center of excellence in research and education at European level, containing public, education, research spaces, museum, accommodation for scholars and in terms of enhancing the monument building by consolidation, restoration, rehabilitation.

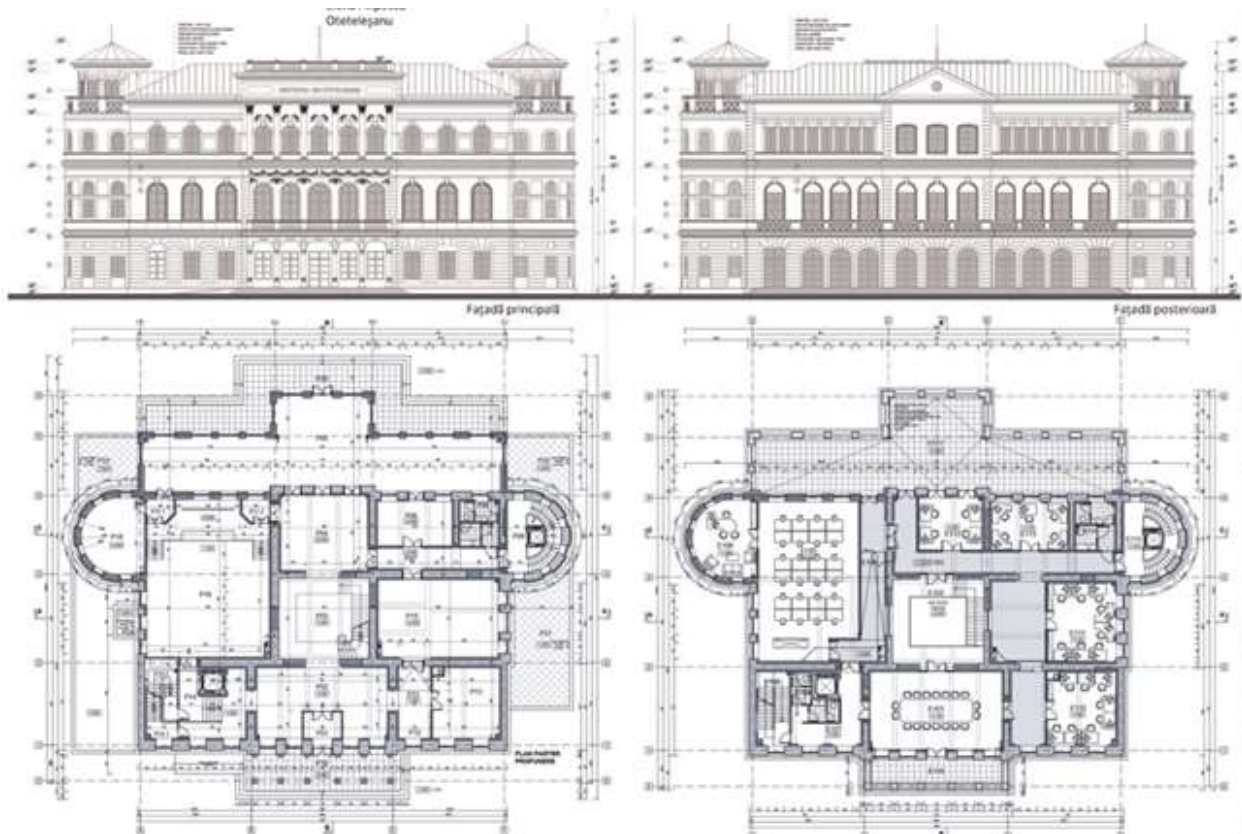


Fig. 6 – Project plans by prof. arch. Cristina Gociman Ph.D. [12]



The works of rediscovering the masonry and the existing floors revealed and confirmed the stages of construction of the former palace by finding other gaps of doors and windows bordered by masonry arches or timber beams, which were marked in by apparently left areas, in the lining and finishing of the interior walls. These traces led to the drawing up of a second relief of the building after the removal of drowned areas in the multiple transformations of the building and which considerably modified the design decisions regarding how to solve the details of embarking on control areas of the old load-bearing brick structure, details who modified the technical project. Cutting of the gaps in the floors above the ground floor and floor 1 of the central hall area and the creation of the 2 illuminators above the first floor and the attic to ensure the natural zenith illumination of the central monumental staircase, newly created, in the idea of reconstructing after the dates of an era central hall of the first mansion, they were points of architectural interest inside the restored building. The central public space, together with the museum space in the basement, the vaulted brick masonry room, preserved from the period of the castle, the spa palace, put to the team of designers and executors, and not least of the beneficiary, difficult problems of spatial, functional, restoration and reconversion concept of a ruin in a state of collapse, implicitly with substantial costs.

The exterior and interior finishes took into account the mix between a new intervention and the solidary incorporation of parts of the old historical structures, being made of suitable natural materials, based on hydraulic lime with specific additives to the recipes of the supplier companies. [12]



Fig. 7 – The images with the restored castle [13]



3. General overview of the structure

At the beginning of the design works, the year of 2011, Oteteleşanu Castle appeared as a building that was practically in a state of structural collapse. The shape and dimensions of the existing structure have resulted from a large number of modifications and extensions brought to the building, interventions that were carried out in different periods of time during the 200 years of existence. Further, the main interventions carried out to the building, before 2011, are highlighted below. These interventions influenced both the design method and the construction technology proposed for the rehabilitation and consolidation of the existing structure.

All the structural interventions carried out uncontrollably, without following the principles of the seismic conformation of a structure, by using materials with different characteristics of resistance and deformability with lack of a proper connection between them, led this historical monument into a structurally unstable building. Furthermore, these technical errors corroborated with the deficient behaviour under loads of the macro porous soil, the lack of proper maintenance of the building and the different earthquakes that took place from 1940 to 2010, culminated with the collapse of the eastern tower of the castle in 2010. [15]

3.1 Status of the building at the start of the project

As noted in the previous chapter, the analysed structure was build, extended and rehabilitated with a complete absence of the minimum measures of seismic design, taking into account only the behaviour of the structure under gravitational loads. The extensive assessment of the building highlighted a series of degradations and structural defects.



Fig. 8 — Left - Central core (ground floor); Right - North façade [14]

3.2 Assessment of the seismic risk class of the structure

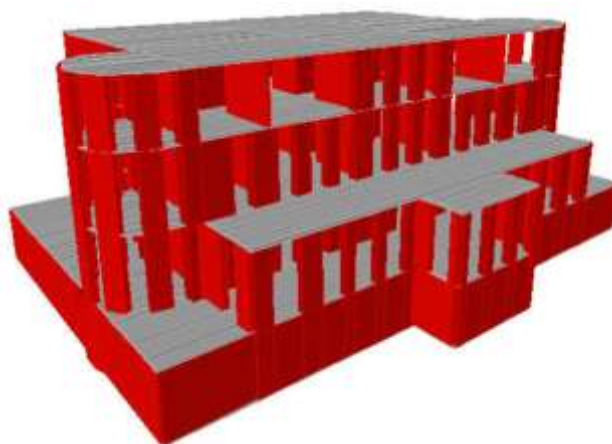


Fig. 9 – 3D design model of the structure [15]



The calculations involved in the assessment of the seismic risk class and the design of the strengthening elements were compliant to principles and criteria from Romanian technical norms and standards (considered to be more restrictive than the European codes regarding seismic design calculation). [16]

The evaluation of seismic safety and the designation of a seismic risk class are based on three categories of conditions subject to investigations and analysis in the assessment. For guidance in taking the final decision regarding safety of the structure (including in terms designating a risk class for the building) and the necessary rehabilitation measures, the three categories of conditions are quantified by means of three indicators, which are:

- Degree of compliance to the conditions for structural conformation and configuration of the structural elements and conformity to the prescriptive rules for structures subjected to seismic actions, noted as R1;
- The degree of structural damage, noted with R2, represents a measurement of the structural degradation caused by the seismic action and other causes;
- The degree of seismic structural assurance, noted with R3, represents the ratio between the seismic capacity and the structural requirement. This indicator is determined for the ultimate limit state (ULS). [17]

According to the results of the seismic assessment, Oteteleşanu Castle was included in Rs I seismic class, meaning that it is a building that under seismic actions it can undergo major structural damages including collapse.

3.3 Special considerations that were taken into account in the design phase

Besides restoring the technical performances of the building so that the structural response under the seismic actions is compatible with the seismic requirements imposed by the European design codes, the project's implementation took into account a series of architectural and functional requirements. The followings had the biggest influence in the process of carrying out the structural calculation and developing a viable working technology:

- Extension of the basement area, which practically meant the extension over the entire ground surface of the building of the partially existing basement;
- Restoration of the image of the building according to the architectural project considered to be the most representative in the history of the castle; this requirement involved demolition activities on the eastern facade area, building extensions on the southern facade area and refurbishment of the main northern facade area. Replicating the facades precisely like the ones from the 19th century was a delicate matter within the project, considering the series of past interventions made to the exterior aspect of the building;
- Preserving the integrity of the architecture of the central area, the core of the castle built before 1880, that represents the oldest part included in the current building configuration of Oteteleşanu Castle;
- The prohibited intervention upon the exterior facades motivated by the restoration of the architectural elements and the need to ensure a natural ventilation of the masonry walls.

3.4 Consolidation measures

Due to the complexity of the project, even though the majority of the consolidation and restoration solutions were given from the design stage, during the execution, simultaneously with the extension of the works regarding the removal of the masonry plaster and the demolition of the nonconforming elements, appears a series of technical problems that required local interventions but with major impact in terms of stability and resistance of the construction. The main interventions brought to the resistance structure were:

3.4.1. Main consolidation measures provided in the initial design phase:

- Full restoration of the East tower and ensuring of a correct connection between the new reinforced concrete elements with the existing masonry and the interior coatings applied on the masonry walls;
- Execution of the reinforced concrete coatings with the rebalancing of the structural overall behaviour;
- Concrete slabs demolition (total or partial) with the execution of new reinforced concrete floors and ensuring their horizontal connection with the vertical structural elements (new or existing); [15]

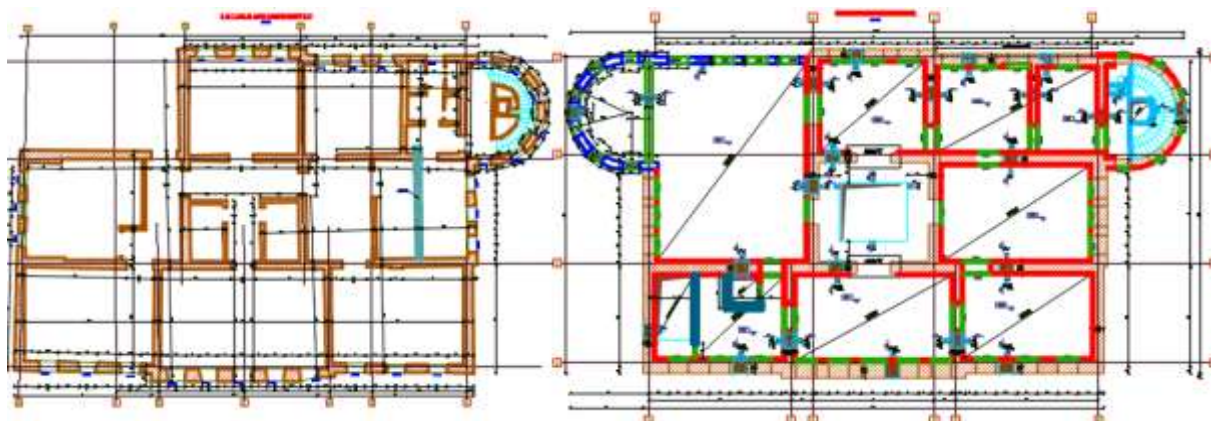


Fig. 10 – Comparison between the slabs over the 2nd floor, existing situation and consolidation measurements [15]

Consolidation of existing foundations: underpinnings made up to the level of the existing basement area and the realization of a reinforced concrete raft with the inclusion, in its mass, of the existing foundations and of the new ones created through the underpinning operations.

3.4.2. Local consolidation measures applied during the execution period

Local reinforced concrete coatings applied on the South facade at the ground floor level, due to the intense state of degradation of the masonry resulting after the walls plaster removal;

Local reinforced concrete coatings applied to the eastern facade whose degradation was mainly due to an inconstant rhythm of execution of the consolidation operations and of some massive interventions in time regarding the geometry and the arrangement of the holes in the masonry.

3.5 Work technology used in execution

The poor quality of the building materials and the intense state of degradation of the building did not allow the accomplishment of a typical consolidation operation (starting from the foundations level and, later, with development in stages of the works above the ground). The restoration of the bearing capacity of the structure was achieved through a reverse procedure, namely partial consolidation of the superstructure area until was reached a level of structural safety which allowed the implementation of major interventions brought to the foundations, without jeopardizing the stability of the building.

One of the problems encountered in this situation was to achieve a balance between the initial weight of the construction and its weight after applying the consolidation measures, so that the existing foundations would not be loaded additionally from a gravitational point of view. In the respect of the aforementioned condition, the majority of the partition walls were demolished (especially those built over time that did not comply with the continuity condition on vertical direction), the demolition (partial or integral) of some concrete slabs, with the restoration of the horizontal effect of the slabs in horizontal in plan by providing a system of horizontal steel struts, intensive support of the existing holes from windows and doors located in masonry, performing local repairs of all the severely damaged areas, removing - from the existing slabs – of the finishing layers (most often, in consistent thickness). These measures allowed, for the new floors executed above the ground floor and above the first level, to be executed by maintaining the existing slabs as a casting support (formwork) and, also, the complete restoration of the concrete slab over the second floor and the pouring of concrete slab above the new basement. The demolition and restoration of the concrete slabs were made under the conditions of full application of the consolidation measures for the vertical structural elements. Exception from the above mentions was the slab above the basement which, given the works to consolidate the foundations and to extend the existing basement, was the last executed.

The execution of the extended basement area was a very difficult and long-lasting operation that required the following operations to be performed:



- The underpinning of the existing foundations on a height of about 2.00m in order to the foundation level of the newly created basement to not exceed the foundation quota of the existing basement (-4.30m);
- Execution of the general raft in thickness of 50 cm with the incorporation, in its mass, of the existing foundations in the central area (so-called Nucleus area) and of the new foundations resulting from the underpinning operations;

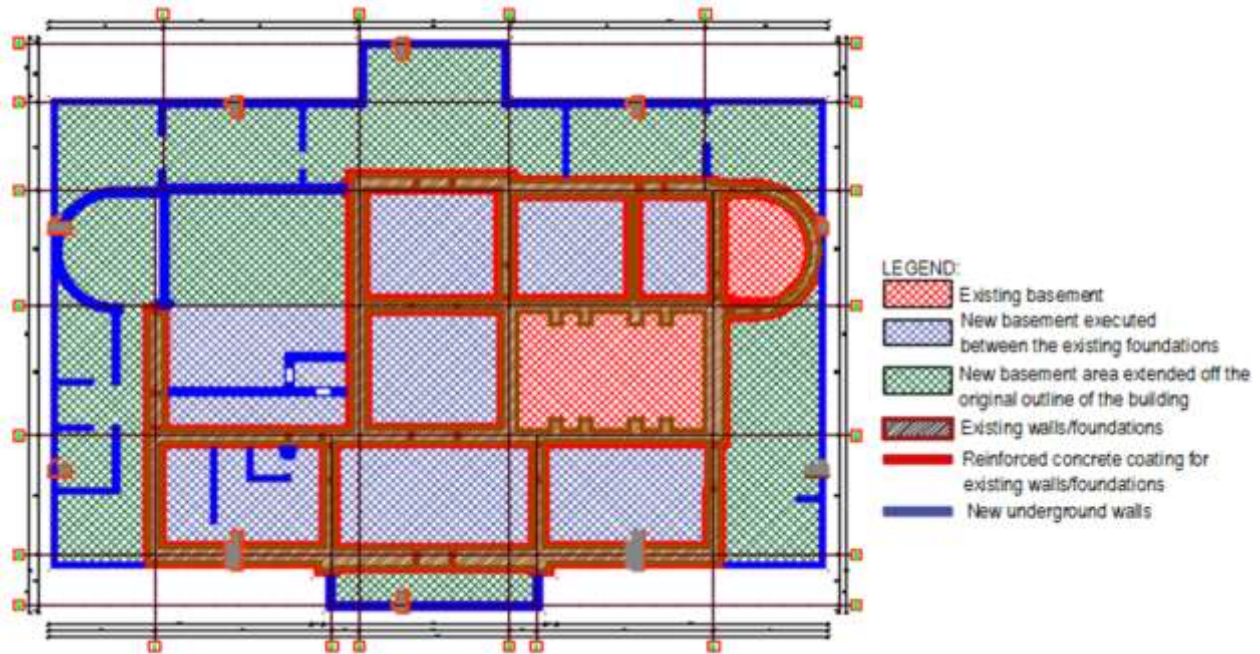
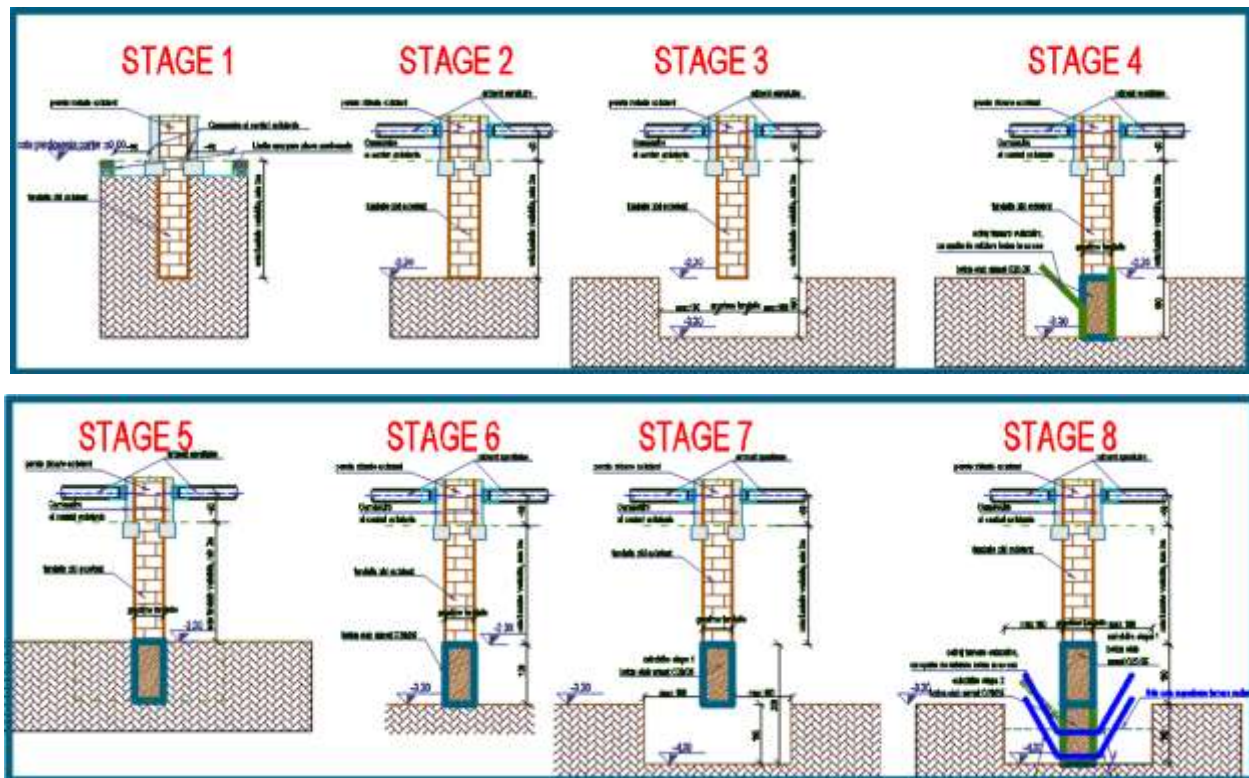


Fig. 11 – Extension areas of the existing basement [15]



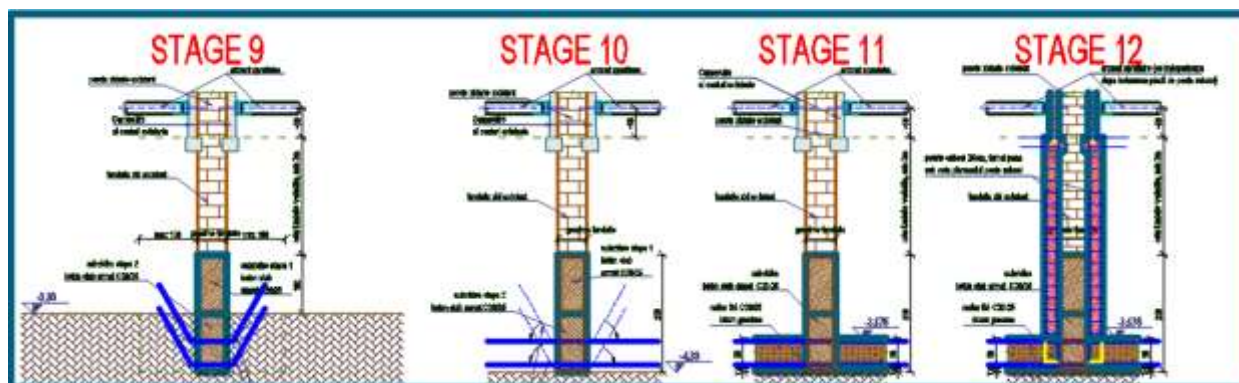


Fig. 12 – Execution stages of the basement level under the existing foundations [15]

- Consolidation of existing foundations (including the underpinnings) by double reinforced concrete coating in thickness of 30 cm, starting from the level of the raft to the slab positioned on +/- 0.00m building level (see the stages presented below);
- Execution of the new walls in underground level following the architectural design;
- Execution of the slab on +/-0.00m level and the connections between the reinforcement mounted in the underground concrete coatings with the reinforcements from the ground floor structural elements (the walls areas remain not casted);
- The removal of the horizontal bracings;
- Execution, by cutting, of the doors and windows holes in the new underground walls.

After performing these operations, the rest of the interventions (including the execution of the eastern tower) continued as in the case of a classic consolidation, the only more difficult operations remaining the repairs to the exterior facades of the building.



Fig. 13 – North façade of Oteteleşanu Castle after restauration [10]

4. Conclusion

The consolidation, rehabilitation, restoration and restructuring of Oteteleşanu Castle represent sequences from complex operations of historical, architectural research, investigation at the site of design and permanent redesign according to the new information on the site. The story of research, design and execution brings into the field of heritage a new and difficult hypothesis, that of restoring a multiple historical testimony.



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