Historical constructions – Authenticity and adaptation to the modern demands

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ABSTRACT: The study deals with the possibilities of rehabilitation of historical buildings while preserving their authenticity, as much as possible. It starts with a comprehensive definition of the historical constructions and emphasizes the features of their authenticity. The study shows that the issue of historical constructions is included in the overall problem of rehabilitation, but with specific requirements regarding authenticity. It presents the basic principles of the historical buildings’ rehabilitation. Case studies regarding the structural strengthening and the possibilities of preserving the authenticity of historical buildings during their rehabilitation are presented. They are ordered increasingly, according to the degree of the intervention needed.

1 INTRODUCTION

Historical buildings are specific for a former human culture whose product they are. They include representative values for a certain epoch, place, human community, from the perspective of constructive art, knowledge, materials and workmanship, techniques and technologies etc., being influenced by environmental conditions, local traditions, spirituality of the local community, previous and neighboring cultures, social and political background and so on. Therefore, historical buildings exhibit many features that together may constitute the authenticity of the construction and the base for its significance.

Actual elements of the authenticity of a historical construction could refer to their fitting into the surrounding environment, general composition of the building, organizing the inner spaces, external aspect and proportions, architectural details and ornaments, structural conformation, structural elements and details, materials and technologies of putting into work. Generally speaking, each construction and thus also the historical ones come into being as a result of a social command. It incorporates many performance characteristics responding to the beneficiary’s exigencies. In general, they may refer to architectural aspects of functionality, aesthetics, details etc., to structural demands of stability and serviceability, fire and explosions safety, durability as well as economy.

Each performance characteristic has a certain design value that normally decreases to an allowed minimum during the service life of the construction (Fig. 1).

There could be some differences between the theoretical degradation of one or more performance characteristics of the building and the real process of degradation, marked by repeated depreciation-repair cycles. An operation of rehabilitation becomes necessary (Fig. 2) in the case of an accidental downfall of one or more performance characteristics under the necessary minimum, because of an unexpected
action (ground sliding, severe earthquake, environmental catastrophe etc.). The rehabilitation is also needed when one wants to keep the building functional, beyond its normal service life. This is the overall case of the historical constructions.

2 REHABILITATION OF HISTORICAL CONSTRUCTIONS PRESERVING AUTHENTICITY

Obviously, the built environment may suffer various changes imposed by urban planning necessities. At the same time, due to its moral wear, each construction should periodically undergo modernization, functional improvement and even functional modification. Moreover, different deficiencies and damages could intervene during the life, inclusively over the normal service life of the construction. In other words, the needs of functional changes can overlap with the general worn condition of the construction. All these factors lead to a decision of rehabilitation.

All interventions on a historical building have to be performed very carefully. Besides the general demands concerning the functionality as well as structural reliability (resistance and stability, serviceability, durability and maintenance), the rehabilitation process has to respond to some specific requirements regarding authenticity.

At first, the rehabilitated building should harmonize with the surrounding environment. Then, the rehabilitation solution has to respect the architectural style, the geometrical proportions, the aspect and atmosphere of the inside, the external and internal ornaments.

The structural interventions have to assure structural compatibility with the original structure. It is recommended to keep the original structural form, as much as possible while performing the necessary repairs and strengthening. Modified or new structural elements should not disturb the architectural appearance and the aesthetics of the building. The repairing or strengthening materials should be compatible with the original ones both from the physical and chemical point of view. They should have, at least, the same degree of durability as the original ones. In order to perform a correct intervention one has to take into account the different stages of the construction, each with its own style representing a certain epoch, that should be respected (Bucur-Horváth, 2006).

These basic principles of preserving authenticity often come in conflict with the real needs of functional development of the construction and fundamental requirements of reliability that have to be fulfilled. In these cases it is necessary to put in balance all objective data and scientific arguments. In order to preserve the signs of authenticity of the historical construction, as much as possible, assuring the structural reliability at the same time, the rehabilitation decision on the structural interventions could be a compromise.

Sometimes, the necessary functional improvement of an old building implies adding new blocks, preserving the structural and architectural authenticity of the original one.

As a general demand, it is to be mentioned that the added structures and structural elements should have an appropriate degree of reliability with those of the original structure.

3 CASE STUDIES

The above presented principles and possibilities of preserving authenticity of historical buildings during their rehabilitation are exemplified in case studies of structural strengthening. They are presented gradually, in increasing order depending on the degree of intervention.

Table 1 presents structural interventions for retrofitting the bearing capacity of a structure or structural element, preserving the entire original structure. The table includes cases of structural strengthening carried out on the masonry structure of Baroque buildings. The most common solution for improving the bearing capacity of the structural elements is to increase their transverse sections with a covering or to embed strengthening elements in a proper way. In these cases, it is very important to take into consideration the physical and chemical compatibility between the original and the strengthening material.

Table 2 includes examples of structural strengthening by modifying the original structure with compatible structural elements. Normally, they consist of additional elements that do not essentially alter the static behavior of the structure.

Often, metallic tie-rods shall provide for horizontal thrusts of arched and vaulted structures. These tie-roads can be of several types or in several positions (a, b, c), according to the structural form, height of supports, accessibility, aesthetic consideration etc.

Joining girder (ring beam) of reinforced concrete has to be added on the slabs level of the old masonry structures, in many cases.

The strengthening solution with tie-bar system can be used to reestablish the moment bearing capacity of large-spanned beams.

Table 3 contains examples of indirect strengthening of historical structures. In order to maintain the original structure or structural element, additional bearing elements are provided.

The basic idea is to maintain the original structure, but due to its weakness or very poor technical condition, to discharge it from an important part of the vertical load by an additional bearing system. The
<table>
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<tr>
<th>Case</th>
<th>Deficiency</th>
<th>Strengthening solution</th>
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| Masonry vaulted structure  
Theater of Turda, Romania  
(Bucur-Horváth 2007) | Precarious technical state of the masonry pillars and arches of the basement | Partial covering with reinforced concrete using Pozzolanic cement                      |
| Masonry structure in brick vaults  
Orăștie, Romania  
(Bucur-Horváth 2001) | Cracks on the masonry vaults and arches | Covering with reinforced mortar with Pozzolanic cement                                |
| Alternative solution of strengthening Bohemian brick vaults  
(Bucur-Horváth 2004) | Cracking of the arches and vaults | Brutt Saver system: embedded steel spirals fixed with special mortar                   |
Table 2. Strengthening, adding compatible structural elements.

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<th>Case</th>
<th>Deficiency</th>
<th>Strengthening solution</th>
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<tr>
<td>Arch and vault structures</td>
<td>Horizontal displacement of the supporting structural element (wall, column)</td>
<td>Metallic tie-rods of convenient type and position (a, b, c)</td>
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<td>Multi-storied masonry building</td>
<td>Lateral displacements of the external walls</td>
<td>Joining girder of reinforced concrete at the level of the slab and foundation</td>
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<td>Precarious technical state of the elevation wall</td>
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<td>Mine railway bridge</td>
<td>Unacceptable vertical deflection and cracks in the middle of the span</td>
<td>Strengthening with a special tie-bar system</td>
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<td>Continuous beam of reinforced concrete</td>
<td>Insufficient moment capacity</td>
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<td>Bălan, Romania</td>
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<tr>
<td>Case</td>
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<td>Saint Michael Church Chuj, Romania</td>
<td>Insufficient lateral stiffness of the supporting walls</td>
<td>The Gothic vaults are hung on a supplementary slab system lying on the perimeter walls</td>
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<td>Masonry arches and vaults Basement of the Theater, Turda, Romania</td>
<td>Precarious technical state of the masonry</td>
<td>Composite slab of reinforced concrete and steel deck on metallic beams</td>
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<tr>
<td>Masonry arches and vaults Basement of the Palace of Justice, Odorheiu-Secuișe, Romania</td>
<td>Cracks and breaks, detached bricks, important vertical displacement</td>
<td>Reinforced concrete slab on metal beams</td>
</tr>
<tr>
<td>Palace of Justice in Odorheiu-Secuișe, Romania Timber slab with ornamental ceiling (Bucur-Horváth 2007)</td>
<td>Great deflection of the slab, cracks in the ornamental plastering of the ceiling</td>
<td>Lifting girder of reinforced concrete with its additional supporting timber structure</td>
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original structure shall be repaired or restored. From that point on, it has to carry only its own weight.

Another idea is that of using additional helping system in order to correct displacements or deflections that affect valuable elements of authenticity of the historical building.

Sometimes, the necessary functional improvement of an old building could imply adding new blocks to the building, preserving the structural and architectural authenticity of the original one.

For instance, in the case of the Palace of Justice in Odorheiu Secuiesc, Romania, built in 1835, belonging to the architectural heritage, an improvement of the circulation flux was necessary, responding to the current requirements concerning emergency exits (Bucur-Horváth 2007). A new staircase made of reinforced concrete and glass was added to the initial building (Figs 3–4). Placed in the inner courtyard, this very effective modern solution emphasizes the historical character of the old building.

4 CONCLUSIONS

Any intervention on a historical building has to be performed with great attention. Besides the general demands concerning functionality, as well as structural reliability, the rehabilitation process has to respond to some specific requirements regarding authenticity. In this sense, the rehabilitation decision and technical solution should respect some basic principles, but every case represents a new challenge. The specialist has to establish the priorities in preserving authenticity, without neglecting the functional and structural reliability of the building.

REFERENCES


