IMPROVING THE HOUSING STRUCTURE

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SUMMARY: The need for consolidation works of the existing constructions takes a very large scale with the passage of the years, mobilizing human and material resources comparable to those used for new investments. The consolidation of the structures must be carried out on the basis of clearly and coherently expressed principles, leading to the achievement of safe constructions with a predictable seismic vulnerability to the incidence of an earthquake of maximum probable intensity. The objective of the work is to establish the causes that lead to the degradation of the constructions, the elimination of these causes and the proposal of consolidation measures, of the degraded structural elements, following the qualitative evaluation as well as after the verification of their bearing capacity in accordance with the standards and norms in force. The present study aims to analyze the behavior of some constructions subject to seismic action.

KEYWORDS: construction degradations, consolidation solutions, elastic linear analysis, nonlinear elastic analysis, composite materials with carbon fiber.

1. Introduction

Examination of an existing building and design of the interventions required for its safety in relation to the action of future earthquakes must be taken into account the following points:

- Ensuring a favourable overall design, allowing for a response in advantageous conditions for seismic actions. It should be pointed out that in this respect, in buildings existing, and especially in the older ones, there are often problems in terms of taking over the gravitational loads in good condition, in the sense that the expertise could pull out in evidence of important malfunctions, weakening of some load-bearing elements due to deficiencies execution or due to corrosion, etc.
- Verification by calculation of the strength structure, which must include the checks strength (determination of load-bearing capacity), stiffness checks (limitation of lateral deformations under the action of seismic horizontal forces), ductility checks (the ability to develop post-elastic deformations without reaching the state of collapse).
- The composition of the structural elements and the links between them.

2. State of play

The global trend is to increase the level of safety of the construction, architectural conformation, urban dimensions, importance to the owner, or for society, this increase being made mainly by taking into account a upper level, of the current hazard level at seismic design action.

Romania is a country with important seismic activity, being on the 24th place of the the 80 states that recorded casualties from earthquakes between 1900 and 2000.

For this reason, it is necessary to structurally rehabilitate all buildings designed and made before 1977, the year that due to the devastating earthquake forced the Romanian state to impose superior requirements in the design of constructions. Design rules older had not included anti-seismic measures or had specified low levels of seismic activity.

The need for works to consolidate existing constructions is on a very large scale sea with the passage of years, mobilizing human and material resources comparable to those used for new investments. The occurrence in time of degradations as a result of aging materials, fatigue phenomena, slow flow, but also the effects of some actions extraordinary (the action of the earthquake, the action of fire or explosions), as well as the aggressiveness the environment has led to numerous cases of damage in construction, material damage and many or even human.

Consolidations of structural elements can keep the same structural scheme, increasing the sections of the elements by the addition of concrete and reinforcement, metal bars or composite materials or can be executed by introducing new elements that partially discharge the initial structure.

3. Case study

Palace Hotel in Govora Băi

Baile Govora spa resort is located in the area of the Getic Subcarpathians of Vâlcii (Fig. 1), 18 km. away from Râmnicu Vâlcea.

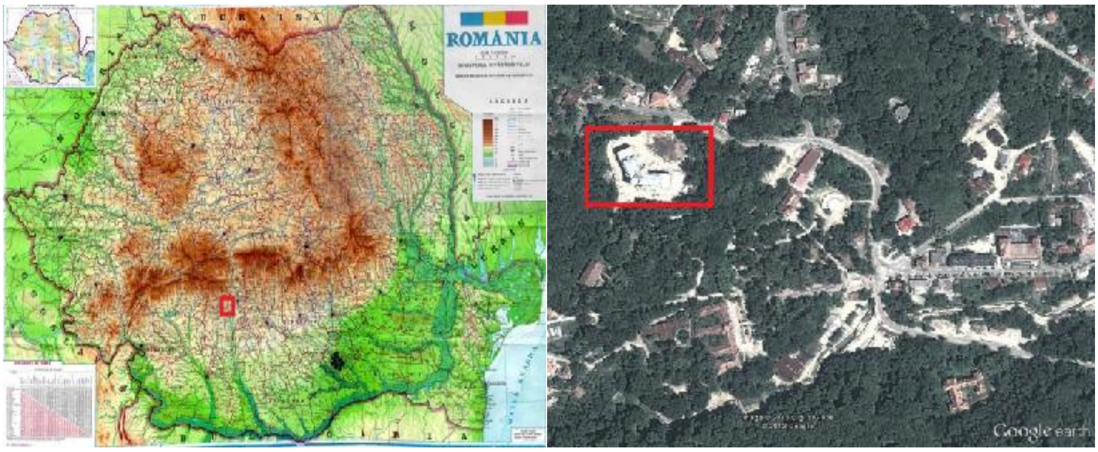

Fig. 1 Geographical positioning of the building

Historical monument, emblem of the resort, built between 1911–1914, HOTEL "PALACE" (Fig. 2) was the first hotel with a treatment base in Romania, built after the plans of the French architect Eduard Doneaud, the works being coordinated by the Romanian engineer Bratescu and the Italian engineer Pukliky. The architecture of the building is eclectic with art influences nouveau and elements of neo-Romanian architecture. For the weight of the construction to be cat smaller, the dividing walls were made of cork. The building has 365 voids (doors, windows, etc.), the figure symbolizing the number of days in a year. Luxury hotel at that time, the Palace was built in the middle of the resort park arranged by the French landscape architect E.Pinard. The furniture of the Palace Hotel was made of linden wood, bronze chandeliers and crystal mirrors. Medical equipment was brought to the treatment base from Germany, part of which is still preserved today. Initially, the hotel had no heating system, the activity being seasonal from May 15 to September 15.

Fig. 2 Hotel "Palace" (main façade and secondary façade)

Visual inspection of the construction is an important activity that helps us to we observe the possible irregularities in both the structural and non-structural elements. In following the visual inspection, the building shows a degree of wear due to age and lack of major and uniform interventions to maintain the building. In many areas (especially bathrooms) concrete from floors and beams shows segregations and lack of covering concrete, with reinforcement appearances, corroded, exterior and interior finishes are partially degraded, floors and the carpentry is partially degraded.

The strength structure of the building is made of load-bearing brick masonry with wall thickness of max 100 cm and min 70 cm in the basement. In the superstructure the load-bearing walls of bricks have a maximum thickness of 75cm and a minimum of 45cm. Also, the pillars and The beams of the structure have rigid reinforcement (metal profiles embedded in the concrete).

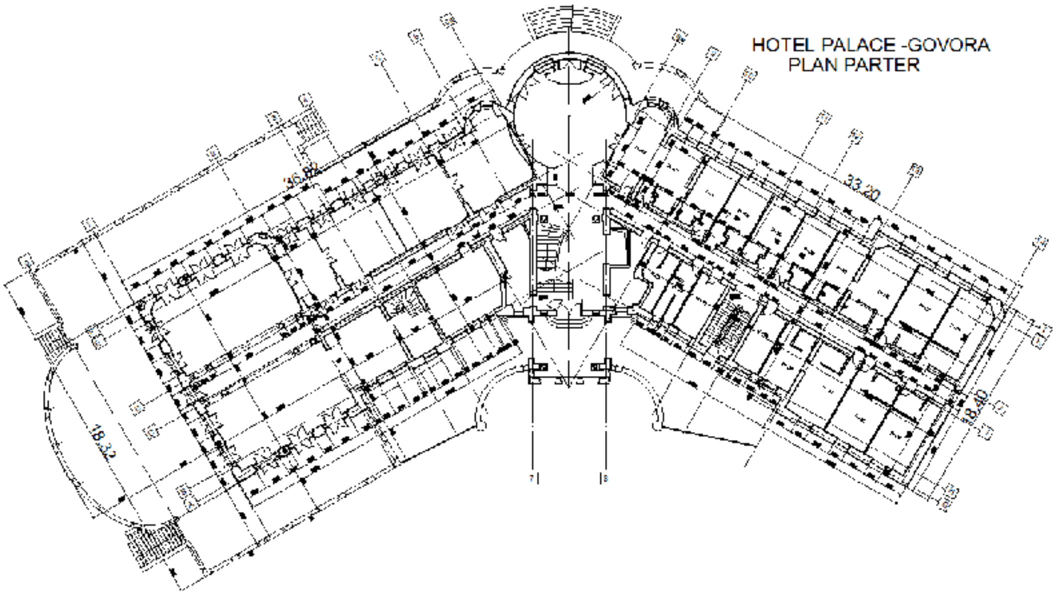

Fig. 3. Ground floor plan Palace Hotel

4. Proposed consolidation measures

The consolidation works will include:

- strengthening of brick screeds with carbon fiber;
- arrangement of closed reinforced concrete frames throughout the height of the building;
- consolidation of the floors in the basement, by cleaning with the sandblasting method or with jet of air, replacement of corroded or broken reinforcement by welding, restoration of the concrete layer by plastering and restoration of plasters;
- consolidation of the metal beams of the floor (in the basement) affected by corrosion, with metal platband welded to the bottom after cleaning them or the use of carbon fiber chips;
- consolidation of the floors on the balconies, by cleaning by sandblasting or jet of air, replacing the corroded or broken reinforcement by welding, restoring the concrete layer and restoring the plasters;
- restoration of the layers from the exterior terraces;
- strengthening the framing by replacing the damaged elements of the resistance structure;

Fig. 4. Reinforcement of the consolidation framework

Fig. 5. Strengthening masonry screeds with carbon fibers

5. Execution technology

1. Preparation of the support by mechanical means and removal of dust. It is recommended that all living edges beveled and rounded.
2. A layer of epoxy adhesive is applied to the area of consolidation.
3. Apply the carbon strip, pressing it on the adhesive using a plastic roller, so that the adhesive passes through the carbon fibers and the fabric is embedded in the adhesive.
4. The adhesive layer is finished with the gleter or trowel.

6. Assessment of the risks of injury and occupational disease – unskilled construction worker – work at a height

Table 1 – Risk factors

RISK FACTORS SPECIFIC TO THE CONTRACTOR
Improper assembly of fasteners for handling and transporting masses;
Fall from a height by stepping into the void, sliding, unbalanced;
Work in electrical installations without qualification and authorization;
Travel, parking in dangerous areas – under the load of lifting means, on the roads
Non-use of the personal protective equipment, non-verification of its integrity, degree of wear, non-replacement of it;
Non-verification of the technical condition of hand tools;
Non-synchronization of teamwork, when transporting or handling heavy materials;
Inappropriate primary relationships (unprincipled relationships between colleagues, tense states, verbal or physical aggressions, deficiencies in the communication system);
Failure to observe discipline at work by presenting to work tired or intoxicated, drinking alcohol during the program.
RISK FACTORS SPECIFIC TOTHE TASK
Non-marking or non-marking of dangerous workplaces;
Dynamic handling effort, transport, bulky load storage.;
Forced or vicious working positions producing disorders of the osteo-musculoskeletal system;
Manual handling of masses weighing more than 25 kg, without help
RISK FACTORS SPECIFIC TO THE MEANS OF PRODUCTION
Hitting by means of transport when moving the pedestrian or during the loading/unloading operation;
Use of improper hand tools;
Free fall, overturning, free leakage under the effect of gravity of objects, materials, tools located at a height;
Use of non-standard ladders and/or scaffolding that is not standardised or without bulwarks;
Not enclosing the work platforms and access stairs located at a height;
Dangerous surfaces or contours, pungent, abrasive, sharp (hand tools, etc.);
Electrocution by direct and indirect touch (defective sockets, cables with damaged insulation, uncarried equipment, etc.);
RISK FACTORS SPECIFIC TO THE WORK ENVIRONMENT
Air currents due to outdoor work;
The high air temperature during the hot period and low in the cold season;
Working at a height in adverse weather conditions;
Natural disasters (earthquakes, etc.);
Pneumoconiogenic powders (powders, dust, etc.);

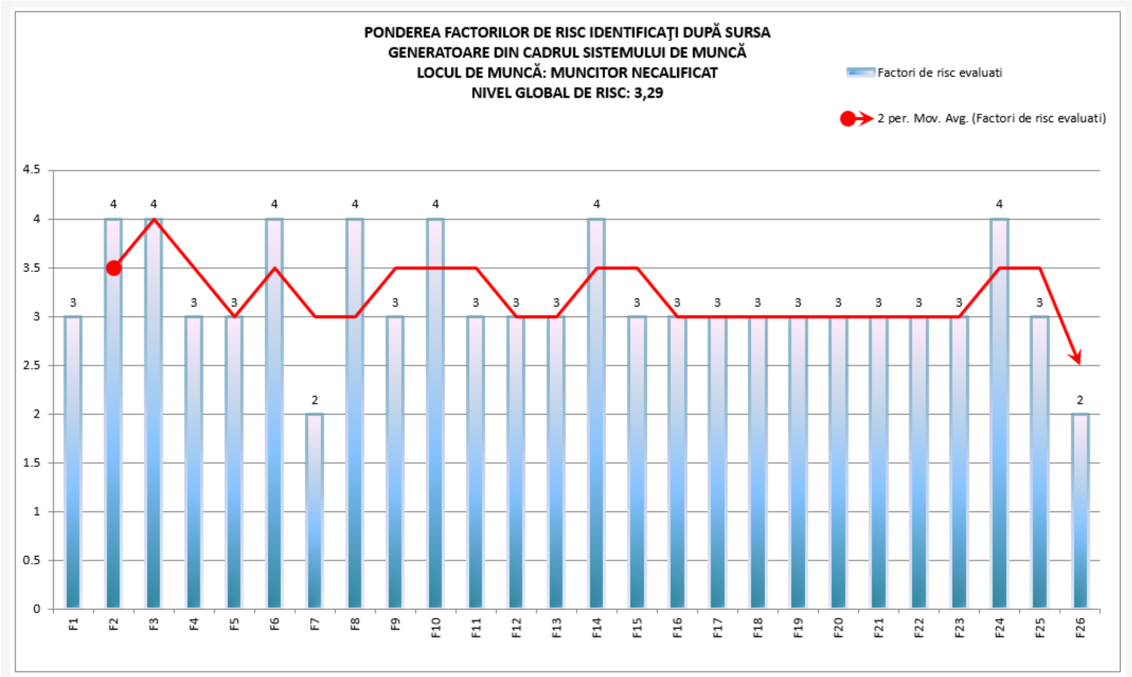

Fig. 6. Share of identified risk factors

7. Conclusions

Following the analysis of the risk factors and the evaluation carried out, the overall risk level (Ng) calculated according to the approved method has the value of 3,29 being below the acceptability limit (3,5), in the category of low risks.

A number of 26 risk factors have been identified, of which: 7 factors have partial risk level above the acceptability limit of 3.5 and 19 factors have partial levels of risk below the acceptability limit (Chart no.1). The factors for which rigorous measures must be taken to eliminate or mitigate their effects are (risk level > 4).

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