

PROBLEMS AND POTENTIALS OF THE BUILDING STOCK IN BUCHAREST, ROMANIA. FROM INVENTORY TO STRATEGIC PLANNING

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In South East Europe cultural heritage needs to be protected against earthquakes. Cultural heritage means not just outstanding monuments but also urban historic tissue.

This paper attempts to create an inventory of the building stock in Bucharest, Romania, for the purpose of assessing problems and potentials of the urban housing construction type practiced in Bucharest, Romania, useful for seismic vulnerability diagnosis and the seismic retrofit 'mission'. Similarly to the environmental impact assessment, a study of the impact is performed before promoting an architectural project, an intervention on a building, site or neighbourhood. In order to help assessing the impact, the following characteristics were mapped:

- Quality of urban elements and spaces;
- Functions;
- Hierarchy of the elements and of the façade;
- Architectural style;
- Height and vegetation;
- Building material and maintenance state.

These maps are useful in order to measure the impact of interventions on the existing sites. Such interventions can be retrofit with influence on the exterior appearance of buildings or demolition and rebuilding. In urban regulation, in Romania, different zones are foreseen with specifications for: the construction permit, the construction regime, the height category, the terrain occupancy, the coefficient on terrain usage, the minimal plot width, along with supplementary observations to the above. Conclusions are drawn regarding implications on the investigated element, recommendations (function; conformation: height, façade, parcel), and the impact assessed. The intention is to develop an (information) instrument alternative to the classical indicators: the 'seismic print'.

The paper proceeds with defining additional criteria for an area wide survey of the building stock which may permit recognising the structural system. For the assessment of the vulnerability of buildings, some of the characteristics mapped in the impact study are useful:

- The function of the building can be changed in order to result in a class of lower importance and lower vulnerability;
- The architectural style can determine the period when the building was raised and hence its age;
- The building height presents certain interdependencies with the period of vibration;
- The building material is to a certain extent linked to the vulnerability of buildings, although in both reinforced concrete and in masonry load bearing systems the most vulnerable and the least vulnerable structures can be found, depending on the structural type.

Therefore the survey further focussed on determining the structural type. Nevertheless, the information on the mapped characteristics can be useful in determining the over-ordered building class and thus restricting the structural system types to look for. The elements containing references to the aspects of the building which have to be investigated are called 'relevant building elements'.

Some 'relevant building elements' also contain references to the architectural style. A construction practice corresponded to a building style and thus the structure, not only the age, can be determined this way. In relation to the age, the construction year is sometimes specified near the main entrance, either above the door or on the floor of the hall. Conclusions about the age can lead to further information concerning the structural type which was usual in that time, earthquakes the building withstood and left traces and in the best case, the code according to which it was built. E.g., all Romanian buildings erected before 1950 were designed for gravitational loads only but buildings from between 1941 and 1950 have not suffered the earthquake in 1940. Degradation due to earthquakes has a cumulative character. The resistance of materials also varies in time under effects of corrosion, permanent loads such as traffic or accidental loads like those from war or earthquakes.

If the style of a building is not defined, it is critical to decide which details need to be surveyed. A special attention was given to photographs of structural details, later called 'key structural elements'. Structural details can be identified in two situations:

- In areas with removed finish,
- If typical for a certain construction type, as concluded from studies previous to the survey.

The construction details useful to recognise the building type can be determined by observation of partly demolished or unfinished structures of buildings of the same kind, buildings of the same kind undergoing a retrofit process or old photographs. The literature can be of valuable help in view of description of details of structural types: how consoles were fixed or which characteristics describe a bearing wall as such. In many

cases the side facade facing the court is richer in relevant elements. Facade walls must be compared to the interior ones when possible. Staircases, fire walls, windows, balconies, loggias and floors belong to places rich in relevant building elements. These are places where a section through the finished building is seen. Beside these, places with bare structure are relevant in the same way. When buildings are not well maintained, many such places are evident. It is especially important to look at the walls, below the floors and at the corners of the buildings. A good place to get information is the part of wall corresponding to floor change. It is the in-between place from visible masonry or stone plating to the bare structure parts which helps avoiding evaluation mistakes. Both in case of deciding the floor structure after the balcony/loggia section or from internal observation more floors have to be looked at and compared. It is important to date buildings.

In order to determine the structural type the following characteristics were collected:

- Material of the structure;
- Frame construction with structure and infills and materials thereof;
- Load-bearing wall construction and materials thereof, pre-cast or not, masonry reinforced or not;
- Mixed structure of frame and load-bearing walls;
- Floors and materials thereof;
- Construction period.

The result is a classification of the building stock in Bucharest into nine building types, mainly dictated by historic development. The results were technical reports on almost all building types present in the city, even if the categorisation is broad and does not take into account building sub-classes, such as for example pure residential and mixed use for interwar buildings or sub-classes based on height. The material collected was included in the World Housing Encyclopedia.¹ The types considered were:

1. Wagon house;
2. a. Two-storey house;
 - b. Art Nouveau multi-storey;
3. Interwar block of flats;
4. Block of flats with RC frame structure with diagonal bracings;
5. a. OD building type;
 - b. Y building type;
6. Pre-cast building;
7. Moment resisting frame building.

In the paper for each type the characteristics are reviewed and the seismic deficiencies, the earthquake resilient features, the damage patterns and the strengthening technologies presented more in detail and

compared. Seismic deficiencies are seen as problems and earthquake resilient features as opportunities. They are put in connection by means of the diagnosis.

Reference

1. S. Brzev, M. Greene, Eds., *World Housing Encyclopedia – Summary Publication 2004*, Earthquake Engineering Research Institute, USA, 2004.