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Problems and potentials of the building stock in Bucharest. Romania. from inventory to strategic planning

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

This paper attempts to create an inventory of the building stock in Bucharest, Romania, for the purpose of assessing problems and potentials of an 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 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 existing sites. Such interventions can be retrofit with influence on the exterior appearance of buildings or demolishment and rebuilding. In an urban regulation, in Romania, different zones are foreseen and for these specified which: the construction permit, the construction regime, the height category, the terrain occupancy, the coefficient on terrain usage, the minimal parcel 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 are an alternative (information) instrument 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 into a lower importance class 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 least vulnerable structures can be found, depending on the structural type.

Therefore the survey further concentrated 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. Those elements which contain references to the aspects of the building which have to be investigated are called here 'relevant building elements'.

Some 'relevant building elements' also contain references to the architectural style. There was a corresponding construction practice to a building style and thus the structure, not only the age, can be determined this way. In what concerns the age, sometimes the certain construction year is specified at the main entrance, either over 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 passed through and might left traces and in the best cases the code according to which it was built. For example all Romanian buildings erected before 1950 were designed for gravitational loads only but buildings from between 1941 and 1950 have not suffered under the shaking of the earthquake in 1940. Earthquake degradations have cumulative character. The resistance of materials also varies in time under effects of corrosion, permanent loads like traffic or accidental loads like those from war or earthquakes.

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

in places with removed finishing

typical for a certain construction type from studies previous to the survey action.

Construction details useful to recognise a building type can be determined observing partly demolished or unfinished structures at buildings of the same kind, buildings of the same kind undergoing a retrofit process or old photographs. Literature can be a valuable help in what concerns the description of details depending on structural types: for example how were consoled fixed or which characteristics describe a bearing wall as such. In many cases the side facade to 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 all places where a section through the finished building is seen. Besides these, places with bare structure are relevant in the same way. When buildings aren't well maintained, they present many such places. It is especially important to look at the walls, downside of floors and at the corners of the buildings. A good place to get information is the part of the 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 out of which material and infills out of which material;

- load-bearing wall construction out of which material, pre-cast or not, if masonry reinforced or not;

- mixed structure of frame and load-bearing walls;

- floors out of which materials;

- construction time.

The result is a classification of the building stock in Bucharest in nine building types, mainly dictated by the 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.

References:

1. S. Brzev and M. Greene (Ed.), World Housing Encyclopedia – Summary Publication 2004, Earthquake Engineering Research Institute, USA, 2004.