



## **Architectural layout and vulnerability to earthquakes of housing buildings of the Modernism**

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Bucharest, the capital of Romania, lays in a high seismic risk zone, being affected about three times a century by strong earthquakes. These occur in the mountainous region of Vrancea, at about 150 km from Bucharest, but given the fact that Bucharest is situated on alluvial soil deposits the effect of the earthquakes is stronger than in other regions of the country. In the 20th century damaging earthquakes occurred in 1940 and 1977. In both of them mostly affected were the interwar buildings, built 1920-1940 in the style of Romanian Modernism.

There is little data about the 1940 earthquake, but the effects of the 1977 earthquake were extensively studied and last year 30 years since this earthquake passed.

Scope of this contribution is to examine the architectural characteristics of the buildings of Modernism which lead to this high vulnerability, more precisely the criterion of zoning in the layout of the plans. This is the scope of a research project funded 2007-2010 by the European Commission with a Marie Curie Reintegration Grant; contract MERG-CT-2007-200636. Not only the buildings from Bucharest will be considered, but also from Athens, Greece and from Milan, Italy. Both Greece and Italy are countries with high seismic risk; however, Athens did not experience such damaging earthquakes until 1999 and Milan ever.

The buildings of Romanian Modernism are characterised by a highly irregular shape in plan in both the overall contour as well as in the distribution of columns and beams. This is due to the following the architectural layout as well as to a lacking local seismic culture to apply at high rise buildings. It will be explained that Vrancea earthquakes, with their specific vibration periods, affect high rise buildings, and previously the style of living in Romania was the single family house, low rise, and thus less affected. Strong earthquakes used to affect slender high constructions, like the towers of churches, for example, and this is where the local seismic culture developed. The buildings of Greek Modernism and those of the Milanese Novecento however, are more regular in shape and in the distribution of columns and beams. It will be investigated if this is a consequence of the local seismic culture or if it was simply allowed by the regular shape of the lots in the urban tissue. Buildings of Greek Modernism were raised, unlike those in Bucharest, in more peripheral zones of the city, mainly in the neighbourhood of the train station. In Bucharest they were raised in the city centre, following a major urban redevelopment. The buildings of Milanese Novecento, however, are spread over the whole city and here it is more difficult to find a reason in the argumentative discourse. It will be looked at the vernacular types of the houses in the country.

The Modernist buildings were raised in a time when no seismic codes yet were released. All of the mentioned building types have a reinforced concrete skeleton. When conducting studies about historical buildings, mainly those with masonry structure are considered, for which reason the project CA'REDIVIVUS was run 2005-2007, with support from the European Commission, aiming exactly at this: the preservation of historic housing buildings with reinforced concrete structure across Europe. This research aims to continue that research, considering buildings from the same geographical locations but from the point of view of the way of living which led to the architectural shape which rendered vulnerable or not these buildings.

It is an argumentative discourse to be conducted about to which amount the Modernism negated the historical links and thus also the vernacular one. Sure is, that at least on Romania, there had to be a change in living habits to move from single family to multi-family building. These buildings were also not typical for Modernism in Europe, since they were thought for luxus dwellings in the city centre. In Western Europe it was social housing at the periphery. Previous to this research a study was conducted to compare the vernacular housing and the Modernist housing in multi-storey dwellings in South-West Germany.