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Comparison of Earthquake and Wind Effects on Nonstructural Elements in Buildings: A Perspective Based on Eurocodes and the Albanian Context

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SUMMARY
Albania lies along the Adriatic and Ionian coast, which make it a high seismic country because the nearby Adriatic (Apulian) tectonic plate which generate grounds accelerations over 0.25g, in some zones also over 0.3g, in the major part of the territory. But, being along the sea coast, has another consequence, Albania territory, especially near the sea side, is prone to high-speed winds, with a peak speed of 31m/s, which dominates the design of light structures such as steel or timber. It is evident the zones that extend along the sea cost are affected maximally from both earthquakes and high-speed winds. Since this zone is the most denser population area of Albania, it is vital for the designers to fully understand the behavior of structures that are build and will be built in this part of Albania territory, but not only.

Keywords: wind load, seismic load, Eurocode, nonstructural elements.

1. INTRODUCTION

During the Communism era, the major part of the residential buildings in Albania were masonry construction of five to six floors, with few reinforced concrete structures or steel structures, mostly industrial buildings. For many years, Hotel Tirana, an iconic building of fifteen floors was the highest building in Albania, whose height was only surpassed after the 1990s, which coincides with the falling of Communism and construction field development. It was only in the early 2000s with the rapid growth of needs for new homes, that the first reinforced concrete residential structures, mostly 10-12 story were constructed. Since then, Albania has known a steady expansion in the construction of residential buildings, which lead to today, which is a second 'construction boom' after that of the 2000s. Unlike the past, the today structures are high rise buildings with thirty floors or more, which are build mainly in Tirana, Albania capital, but many of them are planned to build along the see side, because of the tourist interest of these zones. So, these high-rise buildings, constructed along the Adriatic or Ionian coast, but not only there, are fully exposed to high ground accelerations and high-speed winds which need a special attention during the design phase. Based on the characteristics of buildings in Albania till now, low rise reinforced concrete and masonry buildings, the seismic load is the one that governs the design of the structures. Is clear that also for high rise buildings the seismic load will be determinant for the design process, but for these types of buildings is necessary also to check the wind load effect in order to have a solid understating of structural behavior. These effects should not be

limited only on the structural elements, but also on the nonstructural elements, such as masonry infills and especially glass facades, which are the primal focus of this paper. Although legally in Albania as the design code is in use the Technical Design Codes (KTP-N2-89), the authors have chosen to write this paper based on Eurocodes approach, as a more developed and up to date design code, also an all-inclusive code since is the European design code, on which Albania endeavor to be part.

2. METHODS

All the calculations are performed based on Eurocode 1, part 4 – wind action, for the wind effect and Eurocode 8 for the seismic effect. The comparison will extend to two types of nonstructural element, a masonry infill (wall) and large glass windows. These two types of elements are chosen not only because they are the most used elements for building facades, but for the fact of the self-weight that they possess. It is well known that the seismic effect directly connected with the weight of the element, so in order to give a clear understanding of the comparison the authors has chosen to compare a heavier element, masonry wall, with a lighter element such the glass window. Since the height from the ground of the examined element affect directly the value of the action on it, the calculations are done for various height along the building, showing how the action vary with height. For the seismic design the factors taken in consideration are the seismic zone where the building lies, which determine the PGA and also the terrain category. The type of the building, which is a reinforced concrete structure, the height of the building which determine its natural period and the weight of the nonstructural element taken in consideration. Regarding the wind effect, the Albanian territory is divided in two zone, zone one with a basic wind speed of 31m/s and zone two with basic wind speed of 25m/s. All the territory within 10 km from the see sides is considered as zone one, the other territory as zone two. So, the effect of wind load depends on the zone where the building is, and also from the terrain category and building dimensions and external shape. The comparison will be done only for the windward direction since the nonstructural elements in consideration are perimetral elements with only one side exposed to the wind. For comparison effect, two cases of the same building are taken in consideration. In the first case the building is located on Tirana, with a PGA of 0.293 and zone two for the basic wind speed, and the second case the building is located in Durres, with a PGA of 0.259 and zone one for the basic wind speed.

3. RESULTS

For the two cases of building location is calculated the earthquake load and wind pressure on the nonstructural element. As it seen from the calculation, with the increase of the height of the nonstructural element from the ground (base) both the wind effect and the seismic effect increase. This increase is greater from the earthquake effect compared to that from the wind effect, which point out that the seismic load is greater compared to the wind load based on the characteristics of Tirana and Durres location.

4. DISCUSSION

The above results can be generalized for other big cities of Albania along the Adriatic and Ionian costs. This because all these cities lie on the zone one with a basic wind speed of 31m/s but with PGA values greater compared to Durres. Saranda has a PGA of 0.375, Himara has a PGA of 0.399, Vlora has a PGA of 0.317, Lezhe has a PGA of 0.261. For

other Albanian territory, considered as zone two of basic wind speed, but with low PGA values, (Krume with PGA of 0.180, Kukes with PGA of 0.209, or Bajram Curri with PGA of 0.203) the evaluation must be done accordingly. But since the structure build in these areas are in major part low rise building, this comparison is without interest because is evident that the seismic effect will be higher compared to the wind effect

5. CONCLUSION

Based on Albania territory condition, for nonstructural element, masonry walls or big glass windows which are located on a reinforced structure, the seismic effect is more dominant compared to the wind effect, so the seismic load is the one that should be taken in consideration for the design of these type of elements.

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