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Incidența minimă a suspiciunii / Minimum incidence of suspicion

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DECREASING SEISMIC EFFECTS OF STRUCTURES USING BASE ISOLATION SYSTEMS

BY

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Abstract. This paper presents many different energy dissipating dispositives that had been proposed to assist in mitigation the harmful effects of earthquakes on structures. The general details of the isolation systems were described, and a particular situation of an isolation system formed by elastomeric supports in the case study.

Romania is a country with a strong seismicity, mainly in Vrancea zone, and the Earthquakes affect a large part of the state. To prevent any further structural damages, calamities a new method of seismic prevention was developed, called base isolation systems.

A series of tests performed tacking into account various dynamic data, to obtain the mechanical characteristics and frequencies of the damper. Based on the component tests, the theoretical model (mathematical one) realized at a smaller scale, and the behavior of the damper was obtained.

General earthquake simulations were performed on a 6 stories reinforced concrete structure. The addition of supplemental dampers will reduce the structural response in terms of period of vibration and displacements. The analytical response concludes that the obtained values are smaller, therefore this methods is a very good seismic isolation solution for structures situated in seismic zones.

This method of seismic protection is a new developing method in Romania.

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Key words: elastomers; seismic isolation; base isolation.

1. Introduction

Earthquakes have been a difficult exam for any engineer, highlighting, first the conception and execution errors, secondly the objectivity of other ways and methods of design in seismic zones, and third the efficiency and a higher degree of security in construction exploitation. Conventional seismic design, during a seismic move, has an acceptable level of building performance. This level consists of the capacity for assimilation and dissipation of energy in the most stable manner and as for many cycles. Energy diffusion takes place, for example, in the special designed zones of the beams, where plastic joints are formed, and at the columns base, elements with an important role, but also in the system, which undertakes gravitational loads. Plastic joints are actually degradation concentration zones, which usually are difficult to rectify. As a follow-up, safety of life is ensured, detaining the structural collapse and from an economic point of view, the actual orientation in rational seismic design cannot be neglected. It is necessary on a bigger scale in new construction design and in existing building consolidation.

This article focuses on the events that happen during an Earthquake. The induced energy in a system depends actually on its dynamic characteristics, deformability and the energy dissipation capacity, in tight connection with the type of the action. This means that it is possible to establish optimal solutions to regulate and adapt structural characteristics, in such a way that a minimum of induced energy will be obtained, and the response implicitly.

2. Fundamental Principle of Base Isolation

The base isolation systems represent actually a special system. The fundamental principle of base isolation develops the fact that the seismic response of the structure is to be modified that the terrain will move beneath without transmitting the movement to the structure. The ideal system consists in a total separation of the structure from the terrain, but in reality, there are necessary a few contact zones between the structure and the terrain. Placement of the isolators leads to an increase of in the base flexibility in horizontal plan; in the purpose increasing the period of vibration in such a way, that the acceleration transmitted to the structure to be considerably reduces. Comparing the variation of the displacements and the forces that act on the structure it can be observed that with the changes of the period of vibration, to the increase of

the displacements at the base level it corresponds a decrease in the forced that act on the structure (Fig. 1).

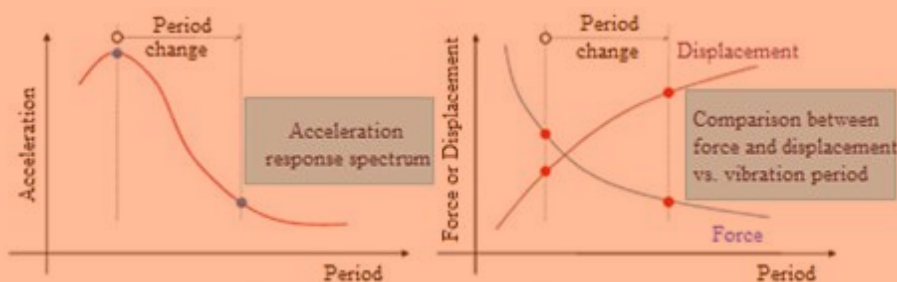


Fig. 1 – Theoretical principle of base isolation (Cruciat, 2013).

The seismic action in general has an increased degree of uncertainty, in Romania the principal source is Vrancea. Observing that some differences appear between the movement characteristics for recordings of the same Earthquake on quite close emplacements, or in the same emplacements considering movements from the same source but at different time intervals. A large band of important frequencies characterizes especially the Earthquakes from Bucharest. For a better appreciation of the movement, beside the recorded accelerograms, it is necessary to compute a series of accelerograms.

By analyzing the seismic spectra, it results that to obtain efficiency by seismic base isolation it will be necessary to avoid the zones with maximum spectra.

Leading with the accumulated experience until now in construction base seismic isolation we can observe the change from the classic design conception in the sense that the work domain from the structures at a strong seismic action must be without incursions in the plastic domain, meaning that the intake of energy consumption structural or nonstructural, does not matter. The design stages of passive base isolated structures are differentiated by the isolation system used and by the construction type.

The base passive isolation systems could have or not elements that dissipate energy. Introduction of dissipaters must be correlated with the type of seismic action and maximum displacement admissible between the infrastructure and superstructure.

3. Analysis of Multi Degree of Freedom Structures (MDOF)

3.1. Artificial Accelerograms

According to the Seismic Code P100-1/2011 the artificial accelerograms are those computed based on a elastic response spectra for