INTERSECTII
INTERSECTIONS
http://www.ce.tuiasi.ro/intersections
Young Scientists' Researches

Increasing the Safety of the Constructions placed in Seismic Regions through the Enhancement of the Energy Dissipation Capacity

Septimiu-George Luca[1]

[1] *Department of Structural Mechanics, Faculty of Civil Engineering, "Gh. Asachi" Technical University of Iasi, Romania*

- Date of submission: (29.10.2004)
- PhD. Supervisor: IOAN -PETRU CIONGRADI, Department of Structural Mechanics, Faculty of Civil Engineering, "Gh. Asachi" Technical University of Iasi, Romania
- President, NICOLAE TARANU, Dean, Faculty of Civil Engineering, "Gh. Asachi" Technical University of Iaşi, Romania
- Scientific Board:
  - MIRCEA IEREMIA, Faculty of Civil, Industrial and Agricultural Buildings, Technical University of Civil Engineering Bucharest,
  - MIHAI BUDESCU, Faculty of Civil Engineering, "Gh. Asachi" Technical University of Iasi, Romania
  - ADRIAN-CONSTANTIN DIACONU, National Institute for Building Research, Branch of Iasi, Romania

Summary

The use of control systems of the structural response represented a radical discrepancy from the classical conception of design. From the point of view of the energetic "survey", we can find two ways of improving the behaviour of constructions to seismic action. The first can be done by increasing the structural energy dissipation capacity by means of special procedures and devices with role of dampers, and the latter by diminishing the energy induced by the seism in the structure, by placing between the structure and foundation devices that insure the decupling of superstructures from the foundation; this is materialized in the concept of base isolation.

The paper presents different types of damper devices, used in the frame of passive, active and semi-active control. We focused especially on two general categories:

ISSN 1582-3024

dissipating devices based on the plastic deformation of metals and tuned systems; for each of them we presented general characteristics, the field of applicability, discussing in detail problems related to modelling. I described some numerical methods of solving the MDOF systems, presented the algorithms of programming these methods, and determined the response of some structures by the procedures mentioned, in order to underline the advantages and disadvantages of each method. I described the non-linear Wen model, used at producing a programme for solving the systems with MDOF having non-linear behaviour or equipped with hysteretic dampers. All the programmes produced were implemented in the MATLAB software. I underlined aspects related to the energy dissipating by internal damping, classifying the main types of damping and realize numerical simulations in order to calibrate the parameters necessary for evaluating the equivalent viscous damping to the SDOF systems.

We also realize numerical simulations on a structure with SDOF in order to evaluate its energetic response in several hypotheses (different damping ratios, field of post elastic behaviour, structure equipped with hysteretic devices). We realize a large number of case studies in order to analyze the behaviour of the structures with tuned mass dampers (TMD). In order to establish the optimal parameters of designing the TMD, the frequency response was studied, as well as the time response of some models with SDOF and 3 DOF having different dynamic characteristics; the representation of the dynamic system is in state spaces. In order to underline the dependence of the response of the structures equipped with such systems to the content of frequencies of the excitation, we elaborated the seismic response spectra and the Fourier spectra.

We studied, by means of the finite element method (programme ANSYS), the behaviour of a triangular metallic plate. The plate belongs to a damping device based of the plastic deformation of the metal TADAS (triangular-plate added damping and stiffness). We realize a parametric study on systems with 1 DOF and 3DOF, equipped with hysteretic devices having different characteristics, subject to different seismic actions.

The synthesis of the results performed on structures having the periods between 0.1s and 1.5s, with dampers having different parameters, at the seismic actions mentioned, was realized by comparative graphic presentation of the maximum response for all the analyzed cases. I finally presented the main conclusions drew from analytic and numerical studies carried out, underlining the author's main contributions in elaborating the paper.

Keywords: damping devices, dissipation, TMD, hysteretic, dynamic, numerical simulations

ISSN 1582-3024