DAMAGE ENERGY SPECTRUM OF TWO SOUTHAMERICAN EARTHQUAKES

by

J.S. Carmona* , J. Herrera C.** and H. Giuliani**

ABSTRACT

Two damage energy spectra for ductility 4 and 6 are presented. They correspond to two southamerican accelerograms: one is that recorded at Lima, Perú on October 3, 1974 with a duration of nearly 90 sec. and a maximum acceleration of 22.6% g,the other is the one recorded at Salta , Argentina, on November 19 , 1973, with a duration of only 8 sec. and 11,6% g. of maximum acceleration. Damage energy shows the influence of the duration of the accelerogram, and it is a measurement of the plastic fatigue developed in buildings by the earthquake.

DAMAGE ENERGY

Ductility, defined as the ratio between maximum deformation and elastic limit deformation, estimates in a simple way the degrees of plastic deformation developed in the vibrator during the earthquake, but it does not measure the number of times plastic deformation has occurred. Damage energy is defined as the ratio between the energy absorbed by the anelastic deformation of the structure throughout the earthquake and the energy absorbed up to the elastic limit of deformation. According to this definition, damage energy increases with the continuity of occurrence of plastic deformations and consequently it measures the duration of the intense part of the earthquake.

In terms of failing criteria ductility would correspond to condition of maximum deformation while damage energy would do so to maximum energy condition.

PLASTIC FATIGUE FACTOR

The unitary damage energy is that corresponding to a full loop of deformation and it is directly related with the ductility. For the classical elasto-plastic ideal vibrator , this relation is as follows :

$$\text{Unitary Damage Energy} = 8\ (\text{Ductility} - 1)$$

The ratio between the computed damage energy and the unitary damage energy gives the plastic fatigue factor which is the number of equivalent loops where plastic deformations are developed with the given ductility.

Constancy of plastic fatigue factor in an interval of periods of the vibrator is the equivalence between both failing criteria.

RESULTS

From the accelerograms under consideration, in the interval 0.1 - 1 sec. of periods of the vibrator, plastic fatigue factors approximately twice the value for Lima than for Salta are obtained. As for Lima ,values are as high as 3 for ductility 4 and even 5 for ductility 6 . It shows that for this interval of periods (0.1 - 1 sec.) the plastic fatigue factor is not proportional to the duration of the two analyzed accelero grams.

(*) Director and (**) Researcher Instituto de Investigaciones Antisísmicas "Ing. Aldo Bruschi" -Universidad Nacional de San Juan - San Juan - ARGENTINA.