THE SPECTRAL ACCELERATION AMPLIFICATION EFFECTS ON THE DUCTILITY DEMAND OF SELF STANDING R.C. CHIMNEYS

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According to the construction of industrial structures in developing countries, current research is carried out on Self Standing Reinforced Concrete Chimneys, which are included amongst special structures and is used in several types of factories. For this purpose, the 3D model of an existing Reinforced Concrete chimney of 80.0 m high and a diameter of 4.0 ~5.0 m in Armenia, is modeled and analyzed using spectral analysis procedure according to the 4th revision of Iranian 2800 seismic code, taking into account the spectral acceleration level equal to S_a=0.4g. On the next step, the finite element model is analysed by the means of Time History Analysis method, using three pairs of accelerograms recorded on each soil category of Rock, Dense Soil, Loose Soil and Very Loose Soil respectively, taking into account the spectral acceleration level of S_a=0.2g ~1.0g. The Modal Pushover Analysis is carried out as well in order to determine the Yielding Displacment Δ_y. Finally, the ductility demands for all soil categories and acclerograms are computed.

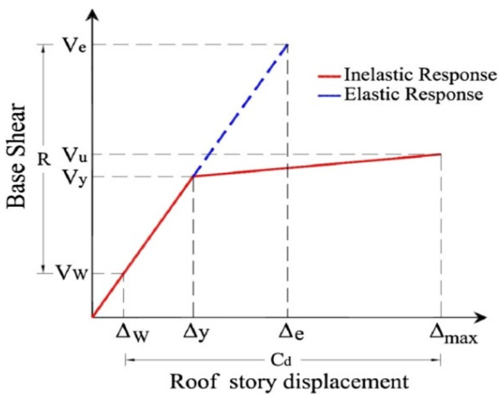

Figure 1. General seismic response of structures.

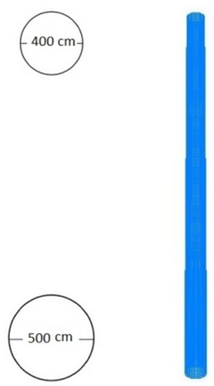

Figure 2. Conceptual analytical model.

In this research, first the computational method for ductility factor and related parameters is briefly described, according to which the previous experiences of earthquakes illustrate that many types of structures behave nonlinearly during a severe earthquake and a huge amount of input energy is mainly dissipated through the form of damping and hysteresis. Therefore, ductility factor demonstrates the amount of energy dissipation by hysteresis loops and is described as Equation 1.

$$\mu = \Delta_{max} / \Delta_y \tag{1}$$

The 3D model of a reinforced concrete chimney with above-mentioned dimensions is modeled and the design was checked due to Iranian 2800 seismic code, for soil types I~IV and S_a=0.20g ~1.0g spectral acceleration levels. In Figure 3, push-over diagram of estimated 3D finite element model of R.C. chimney is shown, which illustrates the seismic induced energy dissipation category.

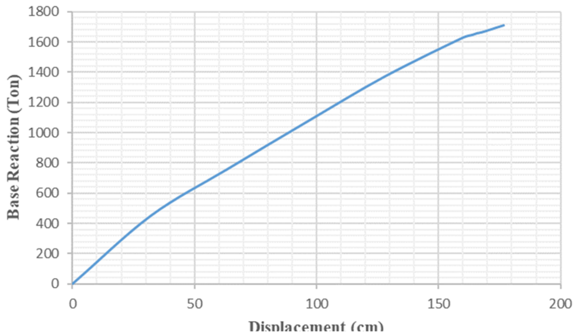

Figure 3. Push-over Diagram of the Model.

The results of ductility demands are based on soil specifications and spectral acceleration levels as shown in Table 1 and Figure 4 respectively.

Table 1. Summerized mean values of ductility demand factors.

Soil Type	Mean Values				
	0.20g	0.40g	0.60g	0.80g	1.0g
I	------	1.76	2.17	1.63	3.72
II	------	1.46	1.81	1.60	3.10
III	------	1.59	2.32	1.74	3.97
IV	------	1.85	2.70	2.02	4.63

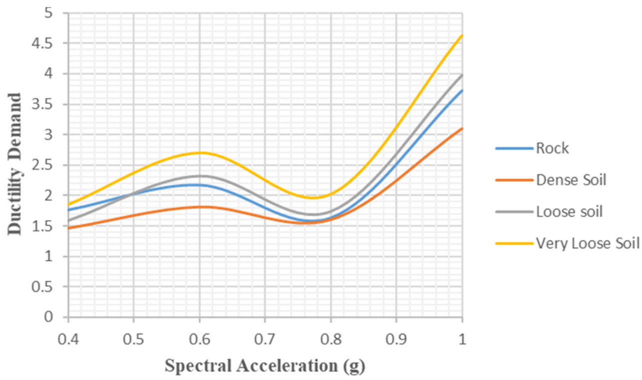

Figure 4. Diagrams of mean ductility demand versus spectral acceleration.

The computational results of finite element analysis of estimated structure illustrate that by degrading the soil category the ductility demand increases, regardless of the frequency content effects of the earthquake records. All diagrams of ductility demand versus spectral acceleration show two turning points at 0.60g and 0.75g. Generally the randomness of results decrease while the soil category degrades, regardless of frequency contents of earthquake records. Ductility demand amplification due to soil category degradation, illustrates the effect of the nonlinear structural behaviour in filtering of low frequency content of selected accelerograms.

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