APPLICATION OF VELOCITY SPECTRAL ORDINATES TO ESTIMATE SEISMIC DISPLACEMENT DEMANDS OF STRUCTURES

Seyed Bahram BEHESHTI AVAL
Associate Professor, Civil Engineering Department, K.N.Toosi University of Technology, Tehran, Iran
Beheshti@kntu.ac.ir

S. J. KAMALI FIROUZABADI
M.Sc. in Earthquake Engineering, K.N.Toosi University of Technology, Tehran, Iran
Jkamali270@yahoo.com

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Inherent seismic design drawbacks of structural design codes in ignoring some important factors, including potential of damage to structure and properties of strong ground motions have eventuated that the seismic design methodology moved toward nonlinear analyses which were based on displacement methods (Kotanidis and Doudoumis, 2008). In recent years, some displacement-based methods have been proposed for more precise evaluation of structural performance e.g., substituted structures methods (COLA 95), coefficient methods (FEMA 356), capacity spectra method (ATC40) and modal pushover analysis (MPA). The accuracy of these methods in estimating the structural responses is influenced by the type of seismic excitation. In all of the mentioned methods, acceleration spectra characterize seismic intensity in determining the target displacement of a structure. Velocity ordinates for all the records contain more information to diagnose near and far field ground motions. In this paper, to consider the effect of seismic excitation type, a method is introduced using velocity records. In this method, the velocity spectra are utilized as the representative of seismic intensity in velocity-displacement-response-spectra framework (VDRS) for estimating target displacement of structures (Leelataviwat et al., 2009; Beheshti-aval and Firouzabadi, 2011; Leelataviwat et al., 2008). Figure 1 shows the estimation method for final displacement of an equivalent single degree of freedom structure. This displacement is obtained using the intersection point of seismic demand curve of the specific earthquake record and structure capacity curve in VDRS coordinates (Kotanidis and Doudoumis, 2008; Leelataviwat et al., 2009).

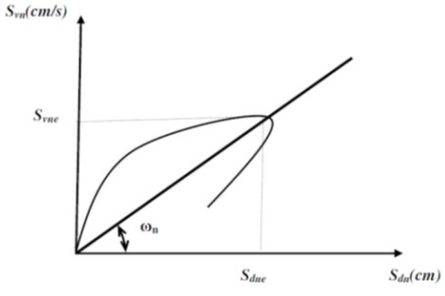

Figure 1. Estimation method for final displacement of an equivalent single degree of freedom structure in *VDRS* framework

Two moment resisting steel frames of 3-10 stories under two records with far and near field characteristics were used to study the accuracy of the introduced method. Nonlinear time history analysis was used as the evaluation criterion of results' accuracy. Figure 2 shows the results of the proposed method compared for 3 and 10-storey frames. (Beheshti-Aval and Firouzabadi, 2011; Leelataviwat et al., 2002).

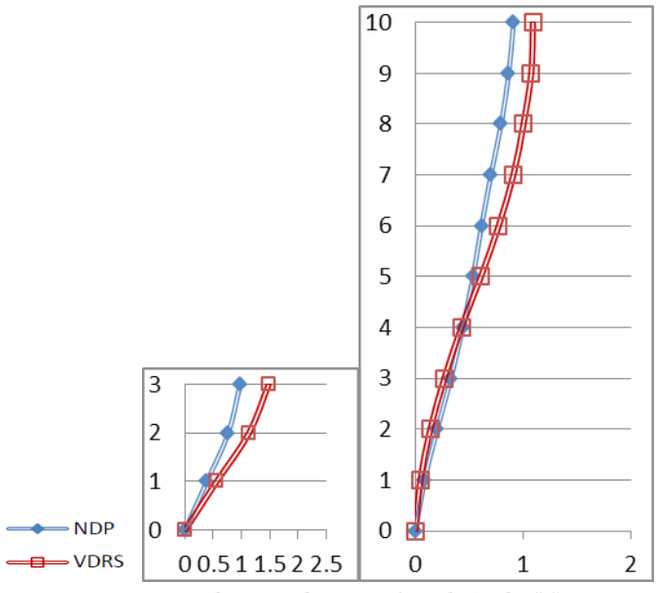

Figure 2. Floor displacements and story drifts from different analysis procedures

Finally, the accuracy of the results obtained by this method is compared with those of the other displacement and energy based methods. The investigations show that the proposed method is more accurate for determining target displacement of structures than those the current methods. Table 1 compares the accuracy of results of the proposed method and results of time-history analysis results.

Table 1. Results of the proposed method and time-history analysis

Earthquake	Parkfield		
Structures	NDP (%)	VDRS (%)	Diff. (%)
3 St	0.975	1.48	51.8
10 St	0.91	1.09	19.8

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