MODAL ANALYSIS FOR FLEXIBLE BASE ECCENTRIC BUILDINGS

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Keywords: Modal Analysis, Eccentric Buildings , Soil-Structure Interaction, MDOF

ABSTRACT

The modal translation and modal rotation are not the same even at elastic state for the systems with the non-classical damping. The 2DOF modal stick based on the 2DOF modal equation has been developed to deal with the seismic analysis of one-way asymmetric fixed base systems and allows the modal rotation to differ from the modal translation. In this paper the applicability of this method in the seismic linear analysis of flexible base asymmetric buildings has been studied. The results show that the efficiency of this modal method using first limited number of modes (usually three fist modes) for the structure response is very good; but for the foundation response seems that it is necessary to consider enough number of modes because of the effects of higher modes of SSI system. Also the results show that generally the estimation of this method for the displacement is better than rotation estimation.

INTRODUCTION

Considering the SSI effects, Includes the non-classical damping and frequency-dependent interaction forces. In order to encounter the non-classical damping, equivalent modal damping was calculated by quantifying the dissipated energy (Novak and Hifnawy, 1983) that was not easily to apply in a computer program. To consider the frequency-dependent interaction forces, the SSI problem was solved in the frequency domain. However, frequency domain analysis is only useful for linear responses and is not practical for engineering structures (Wolf, 1985).

Goel (2001) shows that neglecting the off-diagonal terms of the transformed damping matrix for a non-classically damped one-way fixed based asymmetric structures, may lead to Significant errors. Lin and Tsai (2007a) have studied the effectiveness of the modal analysis using two-degree-of-freedom (2DOF) modal stick based on the 2DOF modal equation (Lin and Tsai, 2007b) to deal with the seismic analysis of one-way asymmetric elastic systems with supplemental damping. This 2DOF modal stick allows that the modal translation and modal rotation to not the same even at elastic state. Comparison of this method with the exact solution and the conventional approximate method, which neglects the off-diagonal elements in the transformed damping matrix for the one-storey and three-storey buildings has lead to good results. They also investigate the 3DOF modal equation (Lin and Tsai, 2008a) for the seismic analysis of two-way asymmetric elastic systems with supplemental damping (Lin and Tsai, 2008b) and achieve to the acceptable approximation.

Lin and Tsai (2008b) proposed a new modal response history analysis procedure for the asymmetric linear soil–structure systems based on the mentioned MDOF (2DOF and 3DOF) modal equation. In this paper after the review of mentioned modal solution, the applicability of this method in the seismic linear analysis of asymmetric steel braced frames has been studied.