

1 Introduction

Recent developments in isolation devices offer advanced options to extend the structural period into very long ranges far beyond three seconds. This trend is promoted since great reductions in the super-structural shear forces and accelerations can be achieved. Furthermore, the application of base isolation technology becomes attractive even for relatively flexible structures such as high-rise buildings. As given simplified design concepts for base isolated structures have been mostly derived by adaptation of strategies known from conventional design, the applicability under extended circumstances needs to be reviewed.

2 Modifications for improvement

Two methods for conducting a simplified design are considered based on equivalent linear models and on spectrum modifications. One method utilizes the traditional concept of response spectrum analysis using eigensolutions and mode superposition (simplified linear analysis, SLA). Another method conducts a simplified non-linear analysis (SNA) based on pushover and capacity spectrum evaluations. Both concepts follow their original outlines, but seven modifications and recommendations specified for the analysis of base isolated structures in the long period range are given as follows:

(1) For the modification of pseudo-acceleration spectra according to different equivalent damping values a period dependency of the reduction factor is incorporated. The use of an approach utilizing given period independent reduction concepts e.g. that of Eurocode 8, dependent on 5% damped pseudo-velocities and a dominant velocity is suggested.

(2) The super-structural accelerations are calculated from total acceleration spectra. A simple empirical transformation rule for calculations from pseudo-values is proposed.

(3) Traditional methods for the assessment of equivalent damping ratios lead to overestimation. Two modifications are proposed by introducing period dependent coefficients.

(4) In MDOF systems maximum accelerations do not necessarily occur simultaneously with maximum deformations. Therefore the acceleration readout period in the total acceleration spectrum is shifted. This can be accomplished with respect to the ratio of

the initial periods calculated with deformations at the base or at the top of the superstructure.

(5) For simplified non-linear methods the equivalent damping is calculated with deformations at base isolation level.

(6) The eigenvalue analysis in the nonlinear approach is carried out on the basis of reduced initial stiffness values or can be bypassed by setting the participation factor and the components of the eigenform in the superstructure to unity.

(7) To ensure compatibility between simplified methods and time history analysis, all calculations are based on mean results out of ground motion sets as well as on mean spectra.

3 Evaluation

To demonstrate the capabilities of the proposed concepts, example structures are studied. In Fig. 1 the deformations calculated with different methods for an MDOF System are compared. Several statistical tests have been conducted to prove the effectiveness of the modifications.

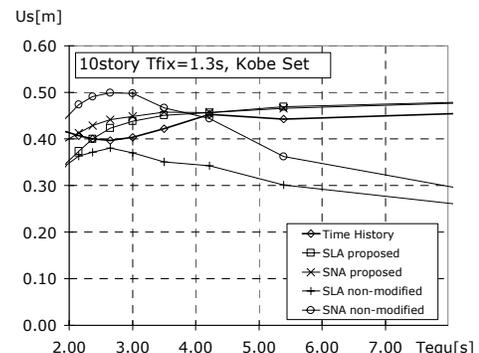


Fig.1 Comparison of roof deformations

4 Conclusions

The analyses show considerable improvements compared with traditional approaches. The proposed adjustments remain simple and fit into given design formats, so the methods can keep their attraction for engineering practice. It is demonstrated that simplified methods are computationally inexpensive, easily conducted with traditional tools and can serve as a useful complement to time history approaches. Hereby the simplified linear methods are equally qualified as non-linear strategies to assess the response of base isolated structures.