

EFFECT OF DIAPHRAGM DISCONTINUITY IN THE SEISMIC RESPONSE OF RESIDENTIAL BUILDING

CHUKKA RAMESH 1*, **Mr. B.RAVI KUMAR 2***

1. *II.M.Tech , Dept of CIVIL, AM Reddy Memorial College of Engineering & Technology, Petlurivaripalem.*
2. *Asst.Prof,Dept. of CIVIL, AM Reddy Memorial College of Engineering & Technology, Petlurivaripalem.*

ABSTRACT :

Many buildings in the present scenario have irregular configurations both in elevation and plan. This in future may subject to devastating earthquakes. It is necessary to identify the performance of the structures to withstand against disaster for both new and existing buildings. Now a days openings in the floors is common for many reasons like stair cases, lighting architectural etc., these openings in diaphragms cause stresses at discontinues joints with building elements. Discontinuous diaphragms are designed without stress calculations and are thought-about to be adequate ignoring any gap effects. In this thesis an attempt is made to try to know the difference between a building with diaphragm discontinuity and a building without diaphragm discontinuity.

Keywords: Seismic analysis, diaphragm discontinuity, nonlinear analysis, pushover analysis, time history analysis

INTRODUCTION

PUSHOVER ANALYSIS

The pushover analysis of a structure is a static non-linear analysis under permanent vertical loads and gradually increasing lateral loads. A plot of total base shear versus top displacement in a structure is obtained by this analysis that would indicate a premature failure or weakness. All the beams and columns which reach yield or have experienced crushing and even fracture are identified. A plot of total base shear versus inter - story drift is also obtained. A pushover analysis is performed by subjecting a structure to a monotonically increasing pattern of lateral loads that shows the inertial forces which would be experienced by the structure when subjected to ground motion. Under incrementally increasing

loads many structural elements may yield sequentially. Therefore, at each event, the structure experiences a decrease in stiffness. Using a nonlinear static pushover analysis, a representative non-linear force displacement relationship can be obtained.

Nonlinear static analysis, or pushover analysis, has been advanced over the past twenty years and has now become the most preferred analysis technique for design and seismic performance estimation purposes as this technique is comparatively simple and considers post-elastic performance. However, this technique includes certain approximations and simplifications due

to which some extent of variation is always probable to exist in the seismic demand prediction of pushover analysis.

Though, pushover analysis is known to capture vital structural response characteristics when the structure is under seismic action, however the reliability and the accuracy of pushover analysis in estimating global and local seismic demands for all of the structures have been a topic of discussion and enhanced in pushover procedures have been suggested to overcome certain limitations of traditional pushover techniques. However, the improved techniques are mostly computationally hard and theoretically complex therefore use of such techniques are impractical in engineering profession and codes. As traditional pushover analysis is used widely for the design and seismic performance estimation purposes, therefore its weaknesses, limitations and predictions accuracy in routine application must be identified by studying all the factors that the pushover prediction. That is, the applicability of pushover analysis for predicting seismic demands must be investigated for low-rise, mid-rise and high-rise structures by recognizing certain issues like modeling nonlinear member performance, computational scheme of the technique, efficiency of invariant lateral load patterns in demonstrating higher mode effects, variations in the estimations of different lateral load patterns used in traditional pushover analysis and precise estimation of target displacement where seismic demand prediction of pushover technique is executed .

4.2 Limitations

Although pushover analysis has certain advantages in comparison to elastic analysis techniques, underlying various assumptions, the accuracy of pushover predictions and the restrictions of current pushover procedures must be recognized. The estimation of target displacement, selection of the lateral load patterns and identification of failure mechanisms due to higher modes of vibration are vital issues that have an effect on the accuracy of pushover

result. Target displacement is global displacement likely in a design earth quake.

In pushover analysis, target displacement for a multi degree of freedom system is generally estimated similar to the displacement demand for corresponding equivalent single degree of freedom system. The fundamental properties of an equivalent SDOF system are gotten from a shape vector that represents the deflected shape of MDOF system. Most researchers recommend using the normalized displacement profile at target displacement level as a shape vector, but since this displacement is not known beforehand, an iteration is needed. Therefore, by most of the approaches, a fixed shape vector, elastic first mode, is utilized for simplicity without regarding higher modes. The target displacement is found by the roof displacement at mass center of the structure.

The accurate estimation of the target displacement associated with particular performance objective, has an effect on accuracy of the seismic demand predictions of pushover analysis. Furthermore, hysteretic characteristics of MDOF must be incorporated into the equivalent SDOF model, in case displacement demand is affected from stiffness degradation or pinching, strength deterioration, P- effects. Foundation uplift, torsional effects as well as semi-rigid diaphragms may also affect target displacement.

However, in pushover analysis, usually an invariant lateral load pattern is utilized that the distribution of the inertia forces is assumed to be not changing during earthquake and deformed configuration of the structure under the action of invariant lateral load pattern is likely to be similar to that which is experienced in the design earthquake. As response of the structure, therefore the capacity curve is highly sensitive to the lateral load distribution selected choice of lateral load pattern is more critical as compared to the accurate estimation of the target displacement.

In order to obtain performance points as well as the location of hinges in different stages, we can use the pushover curve. In this curve, the range AB the elastic range, B to IO the range of instant occupancy, IO to LS the range of life safety and LS to CP the range of collapse prevention.

When a hinge touches point C on its force-displacement curve then that hinge must start to drop load. The manner in which the load is released from a hinge that has reached point C is that the pushover force or the base shear is reduced till the force in that hinge is steady with the force at pint D

RESULTS AND DISCUSSIONS

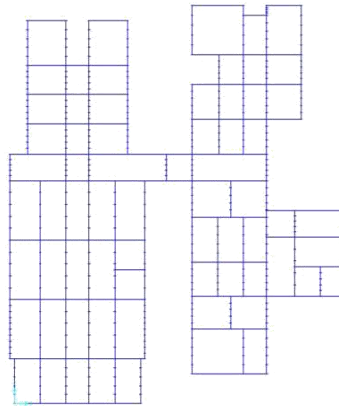
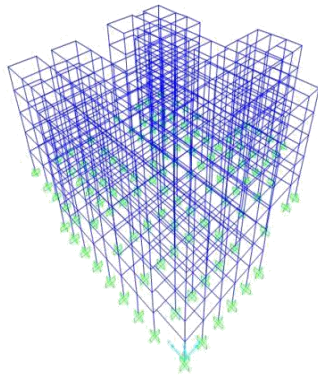
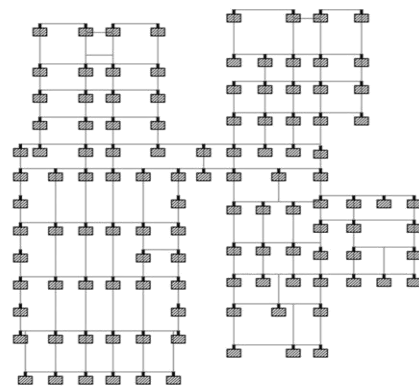
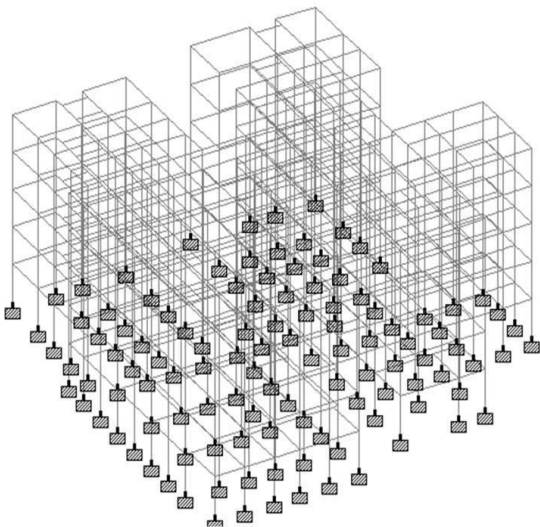


Fig 3.6 Building Model in SAP-2000



CONCLUSION

- a) Discontinuous diaphragm makes the building flexible. Fundamental period of building with diaphragm discontinuity is found to be higher than a similar building with continuous diaphragm.
- b) The empirical equation given in design codes (such as IS 1893:2002) are good for building with continuous diaphragm. The use of this equation for a building with discontinuous diaphragm can be very conservative.
- c) Modal Analysis results show that there are some unusual modes when diaphragm discontinuity modelled. However, the mass participation for those modes are found to be negligible.

Therefore, these modes will not change the response of the building significantly.

- d) Pushover Curves obtained from this study show that there is no significant difference in the response of the building for modelling discontinuous diaphragm.
- e) Base shear vs. roof displacement hysteresis relation obtained from the non-linear time history analysis for both the models studied here are found to be identical.
- f) This study indicates that modelling discontinuous diaphragm may not change the seismic behavior of framed building significantly.

REFERENCES

1. **Jain, S. K., and Jennings, P. C., (1984).** “Continuous Models for Frame and Shear-Wall Buildings with Flexible Floors,” 8 th World Conference on EQ. Eng., San Francisco, CA, Vol. 4, pp. 743-750.
2. **Aghayere, A. O. and MacGregor, J. G., (1990).** “Analysis of Concrete Plates Under Combined In-plane and Transverse Loads,” ACI Struct. J. 87 (5), pp. 539-547.
3. **Abdalla, H. and Kennedy, J. B., (1995).** “Design of Prestressed Concrete Beams with Openings,” J. Struct. Engrg. ASCE 121 (5), pp. 890-898.
4. **Aktan, A. E. and Nelson, G. E., (1988).** “Problems in Predicting Seismic Responses of RC Buildings,” J. Struct. Engrg. ASCE 114 (9), pp. 2036-2056.
5. **Philips, T. L., Itani, R. Y. and McLean, D. I., (1993).** “Lateral Load Sharing by Diaphragms in Wood-Framed Building,” J. Struct. Engrg. ASCE 119 (5), pp. 1556-1571.
6. **Park, H. and Kim, E. H., (1999).** “RC Flat Plates Under Combined In-plane and Out-ofplane Loads,” J. Struct. Engrg. ASCE 125 (10), pp. 1136-1142.
7. **Panahshahi, N., Kunnath, S. K., and Reinhorn, A. M., (1988)** “Modelling of RC Building Structures with Flexible Floor Diaphragms (IDARC2),” Technical Report NCEER-880035, State University of New York at Buffalo, Buffalo, NY.
8. **Luttrell, L., (1991).** “Steel Deck Institute Diaphragm Design Manual - 2 Ed.,” FoxRiver.