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ORIGINAL ARTICLE

Studying the Performance level of Torsional Structure with Push over Analysis

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ABSTRACT
Development of displacement–performance based designed (PBD) ,in recent years, lead to studies on different structures which most of them are on asymmetric structures in plan .In this study has been tried to review the behavior of asymmetric structure in plan based on standard 2800 ,to achieve the performance level of these structures to find how much performance level ,it covers in earthquake. To do this, we used the displacement criteria and compare it with dynamic analysis. The results that, by comparing these two mentioned method ,pushover analysis get the high score in all terms ,and structures designed based on performance level and member receipt criterion have a life safety in earthquake.
Keywords: *Asymmetric structures, push over analysis, performance level, eccentricity*

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INTRODUCTION

The drawbacks of linear static method and performance-based engineering issue caused that in recent years many attempts are made regarding the design methods and evaluation of the buildings based on displacement and direct use of non-linear analyses for real analysis of the behavior of the structures against earthquake level.
Based on the complexities of non-linear dynamic analysis calculations, one of the best methods is non-linear static analysis of push over type that is a good applied tool of developing frequency in earthquake engineering and structure and can present useful information of non-linear behavior of the structures, plastic joints formation location and forces distribution, etc.
Generally, in push over method the characteristics of non-elastic materials are entered directly into structural model and this structure model is guided under the influence of a lateral load model or two lateral load models in the presence of gravity load to achieve target displacement and internal displacements and forces are determined. The order of occurrence of failures, plastic joints and structure members failures during the process are displayed easily. This process continues until the structure exceeds the target displacement or the structure is collapsed. In this method, it is attempted that the target displacement is equal to the maximum displacement of tolerance under the earthquake. Indeed, in pushover analysis method, to evaluate the structure performance, structure capacity spectrum is compared with seismic demand spectrum.
Various methods are presented by scientists.

RESEARCHES

In 1996, a method was proposed by Saromoqadam and Tso [1] in which two push over analysis were applied and in the first analysis, the performance point was achieved and in the second analysis, the performance level and structure destructions were investigated. Then, Saromoqadam and Tso [2] in 2000 introduced a revised method to calculate the asymmetry of the structures. In revised method of Saromoqadam and Tso, the obtained displacement gave various results for robust members. Thus, a great number of displacements were achieved for structure members, thus the applied force was defined based on spectrum analysis and the effect of higher modes was considered. After defining the target displacement and the form of force, the 2-D analysis of extra load was done for the members.

In 2002, Kiler and Fajfar formulated N2 method for asymmetrical structures. The revised N_2 was consisting of two 3-D extra load analysis that force enters in the center of mass. The target displacement separately is achieved in two directions and the studied characteristic (displacement) is combined by SRSS method. According to the theory of these two scientists, this method predicts a good answer for structures solution, while the results have high distribution with dynamic analysis. If we have high asymmetry in the structure, this method is not efficient [3].

Good seismic lateral load model

The distribution method of lateral force in the height of the building during earthquake vibrations is complex. Some of the states are triangle, uniform distribution, share distribution and uniform distribution means lateral load consistent with the weight of each class and varied distribution is lateral load based on the condition of non-linear behavior of the structure in each step of increase of load is changed by a valid method and should be controlled in positive and negative directions to the structure and the relation between the base cut and displacement should be controlled and for each step, the increase of lateral forces should be registered to achieve displacement at least 1.5 times the target displacement. In the current study, gravity load is used.

The characteristics of the study models

In this study [4], two 4, 16 storey models were used and to show the centrifugal effect, mass center 10,15% is moved to the soft edge and is defined on the plan.

All the structures on the soil were type 3 and all were designed by standard 2800, 519 of Iran. Lateral load system was bending in two directions. The general plan of the structures is shown in Fig. 1 and all the structures were used of steel Fy=2400, E= 2e6kg/cm2.

In figure 1 the points 16, 145, 48 showed hard edge, mass center and soft edge. To analysis, 3-D extra load analysis was done by Performance 3D by triangle load and uniform load models. Gravity loading was consisting of low limit QG=0.9DL and QG=1.1(DL+LL) upper limit.

The results of 3-D push-over analysis are shown in table (1), (2). As

UX1: lateral triangle loading and upper bound of gravity load

UX= lateral triangle loading and Lower bound of gravity load

PX1= lateral triangle loading and upper bound of gravity load

PX= lateral triangle loading and lower bound of gravity load

Table 1- The comparison of performance points for 4-storey structure with centrifugal of 0, 15.

		% 0		%15	
		V	D	V	D
CM	PX	1936	19/28	1769	20/20
	PX1	1935	19/62	1751	20/31
	UX	2220	15/90	20/68	19/01
	UX1	2113	18	2030	18/90
FE	PX	1890	20/9	1879	29/1
	PX1	1940	22	1820	28/6
	UX	2224	18/9	2129	25/8
	UX1	2159	19	2120	22
SE	PX	1987	21/3	1879	8/80
	PX1	1940	21/5	1859	8/5
	UX	2221	17/7	2099	9/1
	UX1	2210	18/5	2155	9

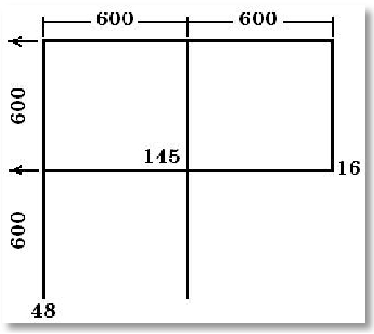
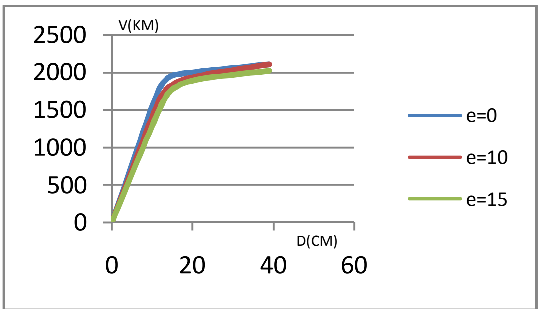


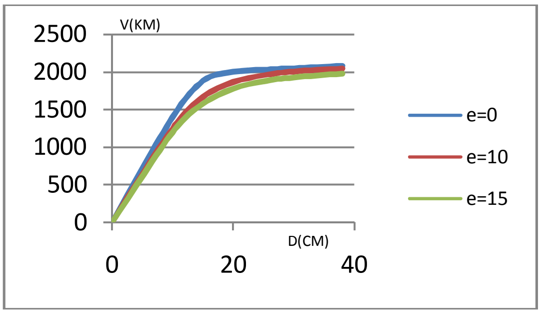
Fig. 1 General plan of 4, 16-storey structure

The investigation of push over curves with the mentioned conditions

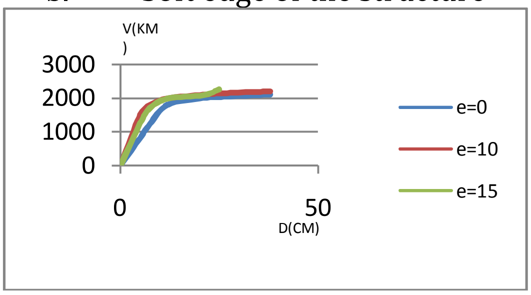
Based on the equal results in the structures, only triangle load model with upper bound of gravity loading is used.



a. Structure mass center

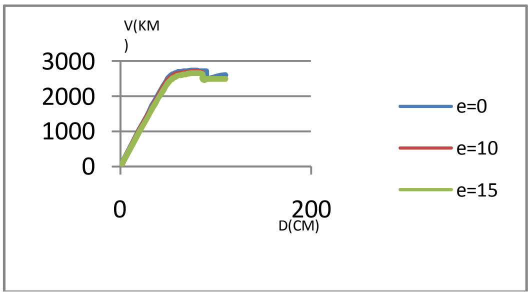


b. Soft edge of the structure

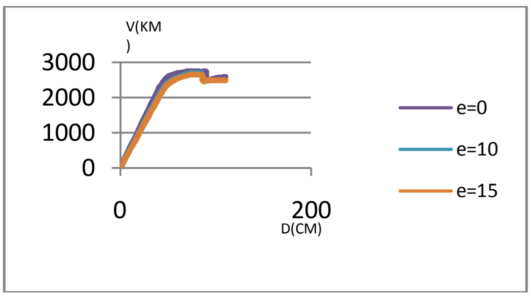


c. Hard edge of the structure

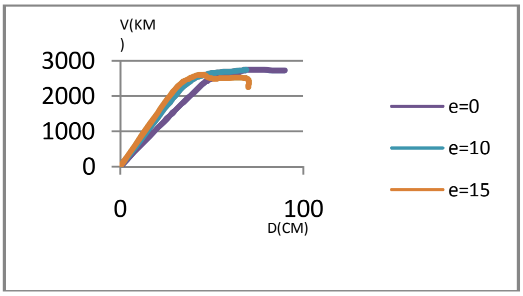
Fig. 2 The capacity of 4-storey structure



a. Structure mass center



b. Soft edge of the structure



c. Hard edge of the structure

Fig. 3 The capacity of 16-storey structure

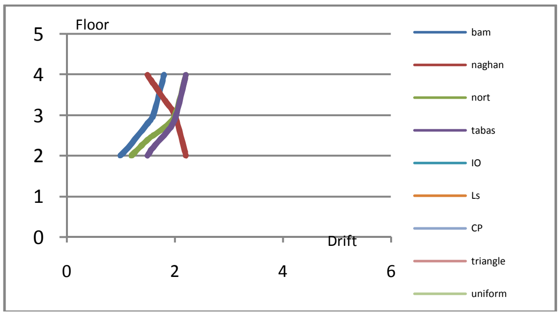
The investigation of the structure performance level based on displacement criterion

One of the methods of determining the performance of the members is investigation of the relative displacement of the storey being displaced in FEM356. For bending structures in Table 2, the performance level is written based on this attribute.

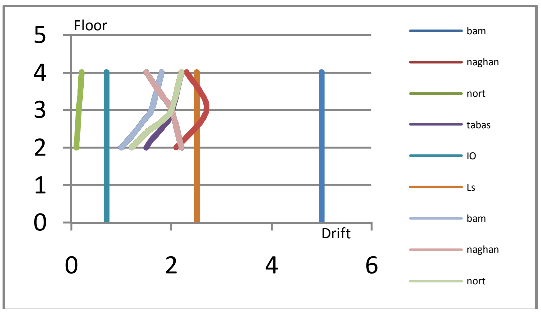
To compare this issue, besides push over analysis, dynamic analysis is used. To do this, 4 acceleration graph of Bam, Nortridg, Tabas and Naqan were used.

Table 2- The ratio of allowable lateral displacement

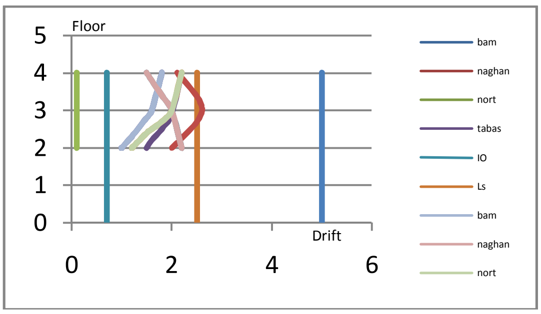
Performance level				
Collapse threshold	Life security	Finite destruction	Unduly use	
5	25	0.7-2.5	0.7	The sum of relative lateral displacement



a. For CM

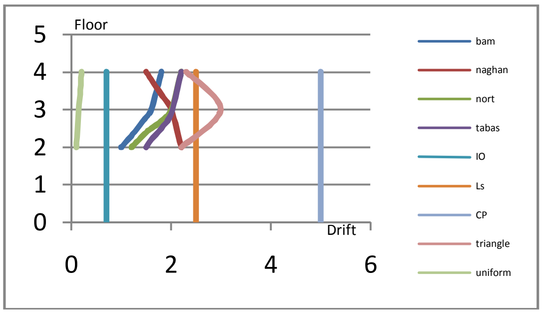


b. For FE

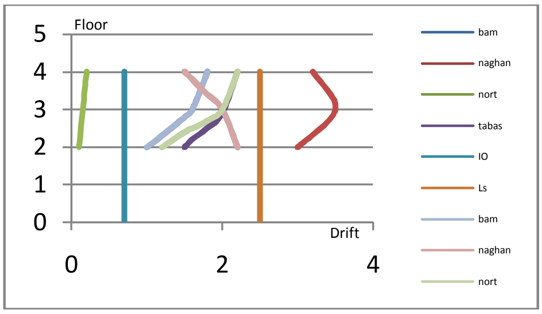


c. For SE

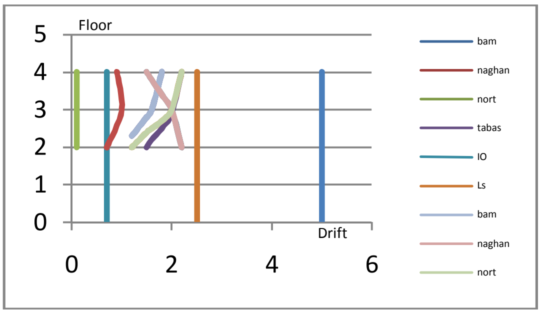
Figure 4: The relative displacement for 4-storey structure with centrifuge of zero



a. For CM

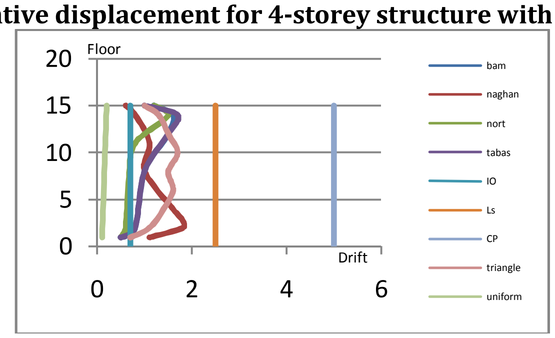


b. For FE

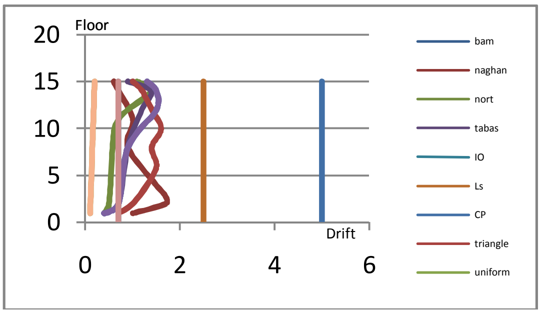


c. For SE

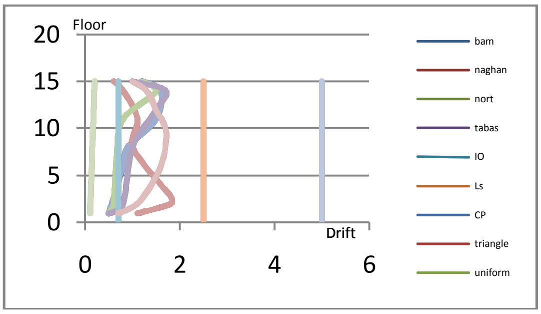
Figure 5: The relative displacement for 4-storey structure with centrifuge of 15%



a. For CM

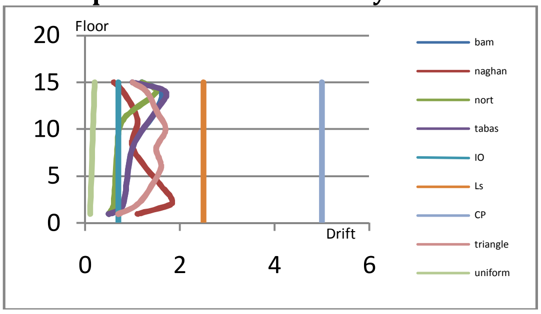


b. For FE

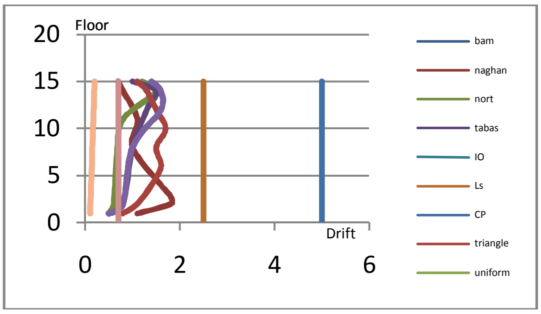


c. For SE

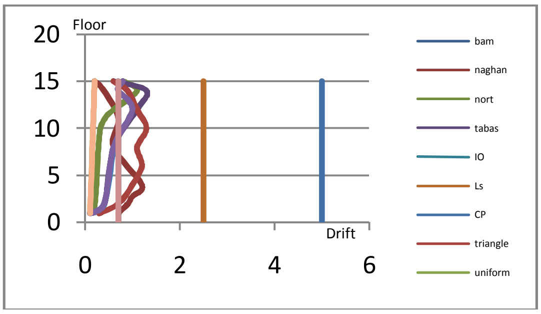
Figure 6: The relative displacement for 16-storey structure with centrifuge of 0



a. For CM



b. For FE



c. For SE

Figure 7: The relative displacement for 4-storey structure with centrifuge of 15%

RESULTS

1. The effect of gravity load on its upper and lower limit in capacity curve and performance points was little and even with high centrifugal we can use a gravity loading model.
2. Lateral load model has considerable effect in capacity curve, thus selecting a good model of lateral load in structure analysis is of great importance.
3. Based on the results we can say that various gravity loads don't have considerable effect on performance point and the results are similar.
4. The effect of lateral model to achieve performance point is high, thus selecting a good lateral load model to achieve this point is necessary.
5. The increase of centrifugal in the structures doesn't decrease the performance of the structures and only the models and numbers of joints are changed.
6. Due to centrifugal nature, the structure capacity mass is reduced in the center of mass and soft edge and increase of curve is shown in the hard edge.

7. In the designed structures it is obvious that by increase of height, the effect of centrifugal is reduced.

REFERENCE

1. Moghadam, A. S. And Tso, W. K. (1996). "Damage assessment of eccentric multistory building using 3D Push over analysis, on proceedings." World Conference On Earthquake Engineering, 11th, Acopulco, PP. 997.
2. Moghadam, A. S. And Tso, W.K. (2000). "Push over analysis for asymmetric and set-back multistory building, in proceedings." World Conference On Earthquake Engineering, 12th, Acopulco, PP. 1093.
3. Kilar, V. and Fajfar, P. (2002). "Simplified nonlinear seismic analysis of Asymmetric multistory building, in proceeding." European Conference on Earthquake Engineering, 12th Upper Hutt, PP. 1093.
4. Reza Rezapour. (2011). The evaluation of 3-D push over analysis of asymmetry structures in the plan. MA thesis, guided by Dr. Mohammad Gasem Vetr.

Citation of this Article

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