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Research Article

Lateral Stability of Multistory Building having same plan configuration

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Abstract

Past earthquakes illustrate the damages due to irregularities in building configuration. Since structural system of building configuration should be confirm to earthquake resistant. The approach of design of Multistory building should be based mainly on lateral stability and deformation in static analysis because as per Bureau of Indian standard actual forces much higher than design forces during earthquake. The aim of present study is to access the lateral stability of multistory building subjected to seismic forces with different geometric plans (square, circle, equilateral triangle) under different configuration having same plan area. Further analysis is done by equivalent static method. The percentage drift and storey deflection due to seismic forces are calculated for different models having same plan area. By this above study it was found that the optimum values for storey drift and deflections are for circular shape model.

Keywords*: Multistory building, Equivalent Static method, storey drift and deflection.*

1. Introduction

Experience in past earthquakes has showed that different elevations among the adjacent building, difference in floor levels of buildings, stiffness discontinuity in the same building may lead to critical seismic effect also typical methods of construction lack basic resistance to seismic forces. To overcome the pounding effects, drift control must be necessary since plan configuration should be optimized. The aim of paper is to illustrate deflection and storey drift by taking different shape building with same plan configuration so as to achieve optimum shape for plan configuration. The methodology to overcome against the seismic forces can be achieved by good building planning and design practice. These basic parameters that to be achieved while designing earthquake resistant building:

(I) Configuration of building as per seismic zones also ground motion is also considered.
(II) Lateral Stability is considered in design of structural system.

2. Methodology

Calculation of lateral forces formed due to seismic forces is the base of earthquake resistant structure and it iscalculated by equivalent static analysis and dynamic response method

All the three shapes models are analyzed by using linear analysis or Static Equivalent Method. For Sake of analysis three different areas are selected namely Area-I ($625 m^2$), Area-II ($1225 m^2$) and Area-III ($2025 m^2$). Preliminary data assumed for equivalent static analysis as follows

Table 1: Overview of Models

Type of Structure	Multi storey Rigid Jointed frame (RC Moment Resisting Frame)
Seismic Zone	II, As Per IS 1983 Part -I
Stories	G+12
Importance Factor	All general building =1
Rock and Soil Site Factor	Medium Soil =2
Imposed Load	$3 KN/m^2$
Storey Height	3m
Size of beams	300mmx600mm
Size of Columns	600mm x 600mm
Depth of Slab	150mm thick
Specific Weight of RCC	$25 kN/m^3$
Specific Weight of Infill	$19 kN/m^3$
Infill Wall	115mm

Magnitude forces in equivalent static method are based on calculation of fundamental period and distribution of forces per Storey. As per IS 1893 part I, storey drift means displacement of one level relative to the other level above or below, and it is calculated as difference between maximum displacements of two levels or stories. To get this maximum displacement per story is calculated, and relative to height percentage drift is calculated as,

$$\%Drift = \frac{\text{Difference in Maximum Displacement in two stories} x100}{\text{Storey Height}}$$

Deflection is basic criteria for determining the optimization of multistory building. On top most storey

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the maximum deflection occurs due to seismic forces. In each shape of model maximum deflection due to seismic forces in X and Z direction i.e. EQ X and EQ Z takenand that column are selected for comparison. As per IS 1893 part I permissible limit for storey drift is not more than .004 times the height of storey.

3. Analysis and Discussion

The mythology and results of the work obtained from modeling as discussed earlier, are represented graphically explained below

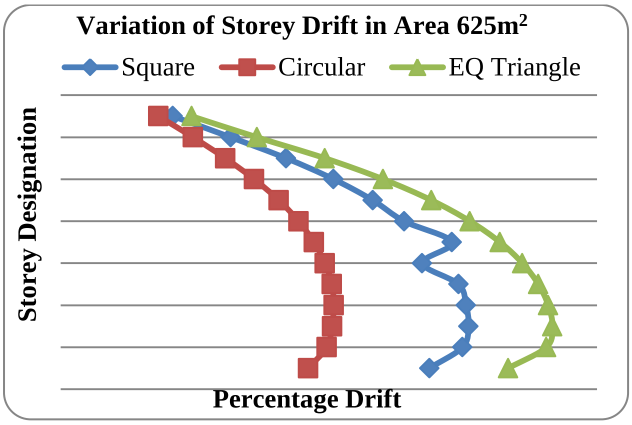

Fig.3.1 Percentage storey drifts in Area-I

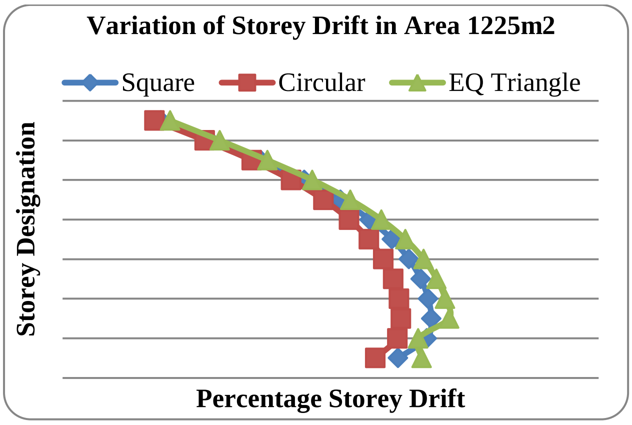

Fig.3.2 Percentage storey drifts in Area-II

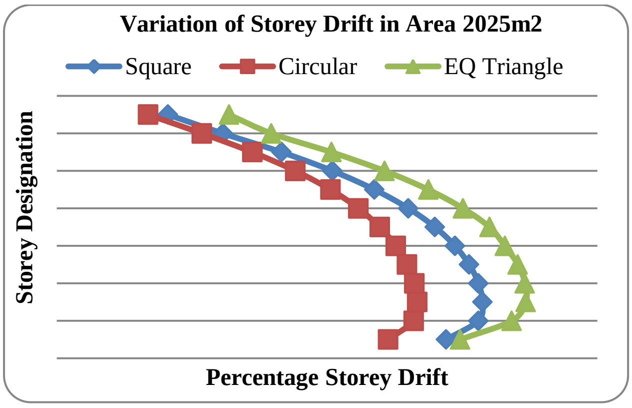

Fig.3.3 Percentage storey drifts in Area-III

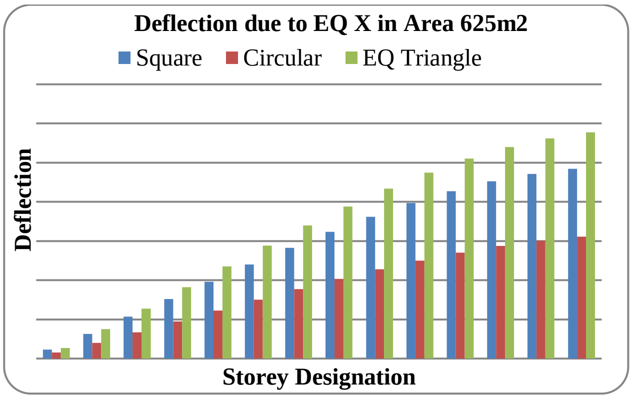

Fig.3.4 Deflection due to EQ X in Area-I

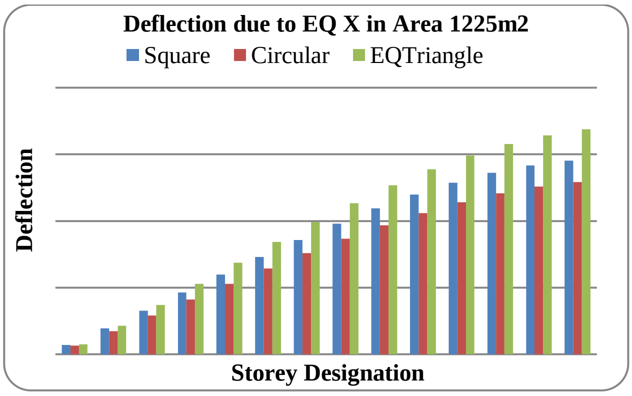

Fig.3.5 Deflection due to EQ X in Area II

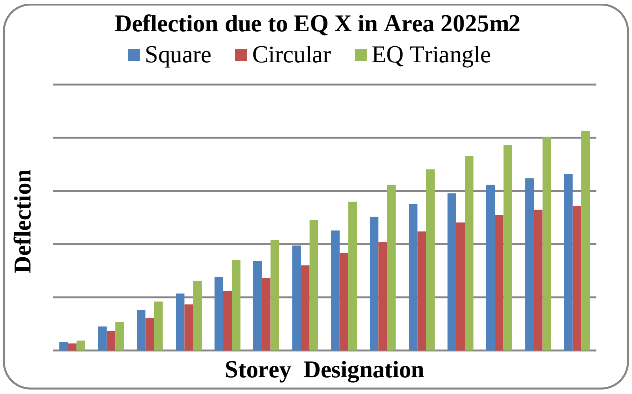

Fig.3.6 Deflection due to EQ X in Area III

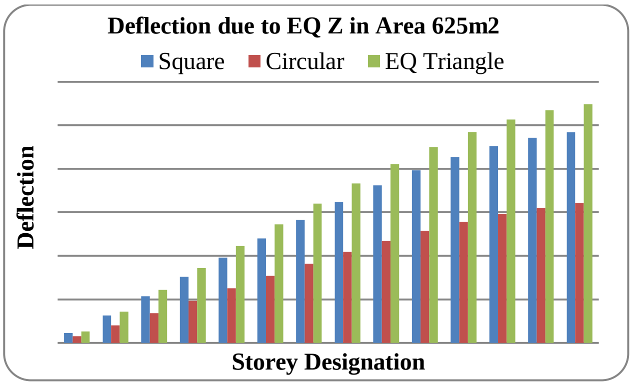

Fig.3.7 Deflection due to EQ Z in Area I

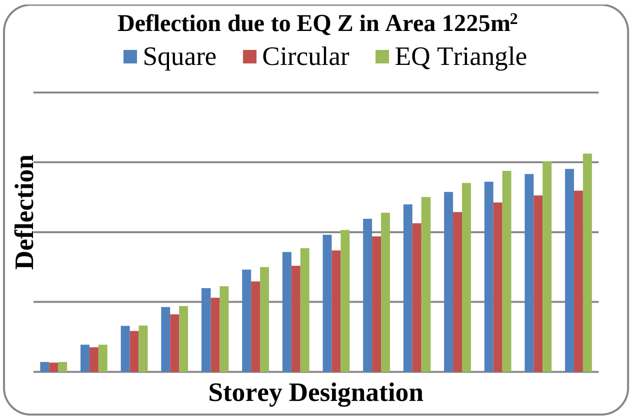

Fig.3.8 Deflection due to EQ Z in Area-II

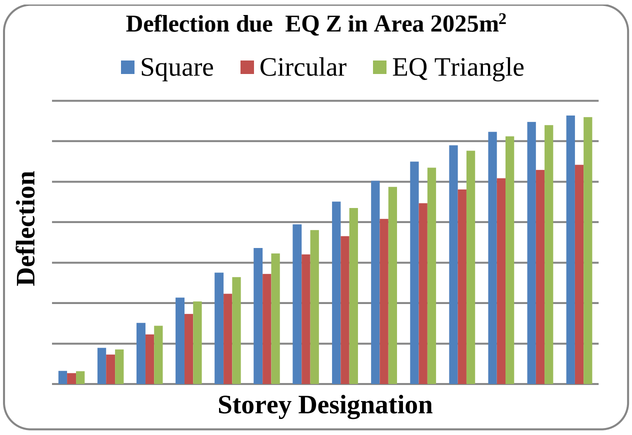

Fig.3.9 Deflection due to EQ Z in Area- III

I.StoreyDrift

i) The values of storey drift are minimum for circular shape among three shapes in Area-I (Fig. 3.1); the values are even less than half of permissible values specified by IS 1893 Part-I. Values of storey drift are highest for triangular shape.

ii) The behavior of all the shape models is same in area 1225m^{2}except circular having slightly minimum values than other two shapes (Fig.3.2).

iii) The inter storey displacement among three shapes in Area-III is minimum for circular shape. Percentage deduction compare to triangular for circular and square is 26.72and 14.18 respectively as per Fig.3.3.

II. Deflection

The deflection of the buildings having different shapes as discussed earlier, are analyze and represented graphically. From the above graph it is clearly seen that the deflection is highest in top most storey.

While considering deflection due to seismic forces in X direction in Area-I i.e. 625m^2 (Fig.3.4) The values in circular shape model vary between 1.518mm and 31.073mm from bottom storey to top most storey respectively. The deflections of circular shape are approximately half the values of triangular shape.

As both shapes, circular and square is symmetrical, deflection due to seismic forces in X and Z directions are nearly same. Area-II deflections is more than Area I, average percentage increase of deflection in triangular values 12.5 and 22.17 comparing to square and circular in seismic Forces in X direction and 3.3 and 13.78 in seismic forces in Z direction. Slight difference in deflection of area II triangular shape values of seismic forces in X and Z direction.(Fig.3.5 and Fig.3.8).

As the Area-III .i.e. 2025m^2, Deflection due to seismic forces in X direction in triangular shape building is 1.5 times the circular shape (Fig.3.6). Deflection due to seismic forces in Z direction (Fig.3.9) in triangular shape is similar to Square shape, circular is minimum among three shapes.

4. Conclusion:

i) Storey Drift is minimum for circular shape model as compare to square and triangular model.

ii) Percentage drift value increase as area increases, percentage drifts increases.

iii) As area increases for a particular shape, deflection goes on increasing.

iv) The percentage deflection due to seismic forces in Z directions (EQ Z) is less than seismic forces in Direction(EQ X) in triangular model.

v) By comparing all results of deflection and drift, it is conclude that circular shape is optimum shape.

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