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Effect of Near Fault Seismic Excitation on an Idealized Horizontally Irregular R/C Structure

Sanghamitra Maitra*

*(P.G Student, Civil Engineering Department, Narula Institute of Technology , Kolkata, West Bengal, India
Email: sanghamitra.ce.sit@gmail.com)

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Abstract:

Due to land scarcity the construction of irregular structures has increased. Irregularity in RC structure is created by different allotment of geometrical configuration, mass, strength or load resisting elements. Several studies show that irregular structures are more prone to damage. The main cause of early damage of one edge of irregular structure over other edge of the same structure is starting eccentricity. This current research work is an effort to find out the response of an idealized horizontally irregular RC structure under the action of near fault seismic excitation. In this work an idealized structure with three degree of freedom has been considered. Unequal stiffness is distributed over the outer edge elements to obtain eccentricity. A nonlinear analysis has been done under two near fault seismic excitation. Some significant responses are presented in normalized form. To normalize the responses a similar but symmetrical RC structure also considered.

Keywords **— Irregular Structure, Near fault seismic excitation, Eccentricity.**

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I. INTRODUCTION

In the present circumstances irregular structures are more visible than regular structures. The main reason behind the demand of irregular structure is lack of land. Due to urbanization common people are facing problems as the price of the land has increased tremendously. Irregularity is created by unequal distribution of geometrical properties just like mass, strength or load resisting elements. Irregularity is divided into two types-(a) vertical irregularity and (b) horizontal irregularity. Due to architectural demand in a R/C structure horizontal irregularity /vertical irregularity or both can be noticed .A various studies show that irregular structures are more prone to damage than regular structures under seismic excitation due to its asymmetry. A huge number of study has been done to find out the response of irregular structure under seismic excitation .Some related studies are eg- S.varadharajan(2016),Sumit kumar Paul(2016) [2] etc. Nonlinear analysis is more reliable and authentic .In this study near fault ground motions are considered because near fault ground motions are very dangerous to structures and it acts as a high single pulse. The aim of this present study is to present the response of an idealized horizontally irregular R/C structure in normalized form. To normalize the displacement responses a similar symmetrical R/C structure is also considered.

II. STRUCTURAL MODELLING DETAILS

For the purpose of this study a single storey idealized structure has been considered. It has horizontal asymmetricity with three degree of freedom(Two are translations in x direction and y direction, One is rotation).Generally, the load resisting elements are distributed evenly over the plan area. By considering this fact this idealized structure has been considered with six elements.

The exterior part is representing boundary walls and the interior part of this idealized structure is representing partition walls. Horizontal asymmetric structure has been created by uneven allotment of stiffness over the edge elements. A reference diagram has been showed in FIG.1(a &b).In some other studies similar structure has been used eg- Bhaumik, Das(2003)[3].

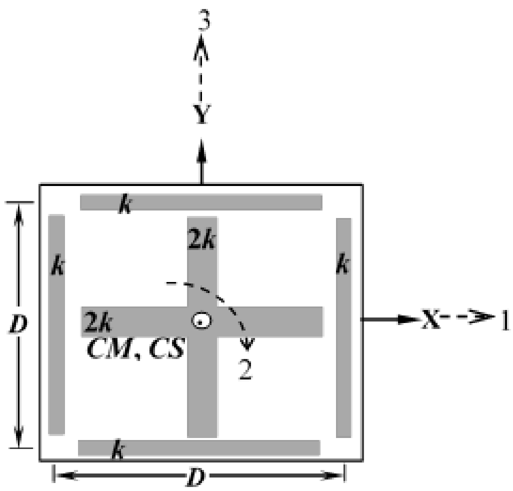

FIG.1(a):Symmetric System

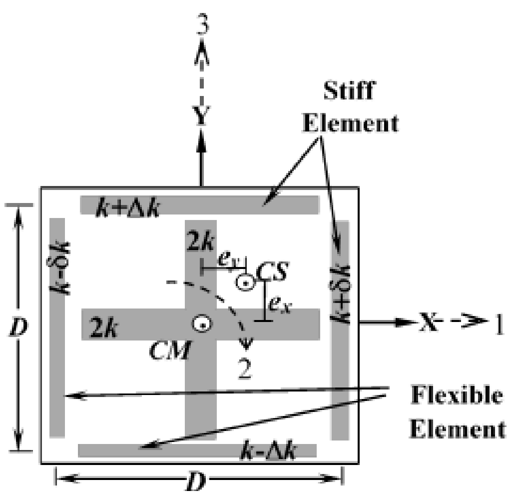

FIG.1(b):Bidirectional Asymmetric system

FIG. 1:Represents an idealized SDOF structure with 3 DOFs.

A certain amount of eccentricity can be obtained by incrementing the stiffness of one edge of lateral resisting element and decrementing of stiffness of the other edge in equal quantity. The edge section having lower stiffness is referred as flexible element and the edge section having larger stiffness is referred as stiff element. In this work three value of eccentricity have been considered e/D=0.05,e/D=0.1 ,e/D=0.2(where e= eccentricity in x or y direction and D= distance between two edge section in x/y direction). In this study maximum displacement responses of exterior parts of a horizontally asymmetric structure have been presented in normalized form. The main two factors of a structure are T(unbalanced lateral period) and Ʈ(ratio of torsional period to lateral period).Here three uncoupled lateral period has been considered T=0.1 sec,0.2sec and 1sec .Generally the value ofƮ lies 0.25-2.00 this range for small structure.

III. DETAILS OF GROUND MOTION

The ground motion details are collected from PEER database[4].Two near fault ground motions are applied. Those are-

Table:2 Details of ground motions [Nature :Forward directive (near fault)]

Table:2(a)

Sl no.	Code	Event	Station	Component ID	PGA (m/s2)
1.	EQ1	Loma prieta (10/18/1989)	Los Gatso-Lexington Dam	X-LLX Y-LLX	4.34 4.04
2.	EQ2	Landers (06/28/1992)	Lucerne	X-LL Y-LL	7.11 7.74

***1.mm/dd/yy**

Table:2(b)

Sl no.	Code	Fault type	r(km)
1.	EQ1	RV	5.5
2.	EQ2	SS	2.2

*** 2: SS – Strike Slip, RV – Reverse**

IV. RESULT AND DISCUSSION

The response of an idealized horizontally irregular structure has been presented in normalized form. The responses are produced by varying eccentricity in x direction and y direction. To normalize the displacement response a similar but regular structure has been considered. Some significant results are presented in this paper. In every graph displacement(mm) is plotted against Ţ(tau).Here DSPFLX= displacement of flexible elements in x direction, DSPFLY= displacement of flexible elements in y direction, DSPSTX=displacement of of stiff elements in x direction and DSPSTY=displacement of stiff elements in y direction.

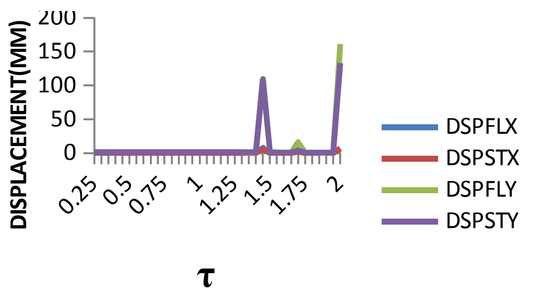

FIG3(a):Response of EQ1

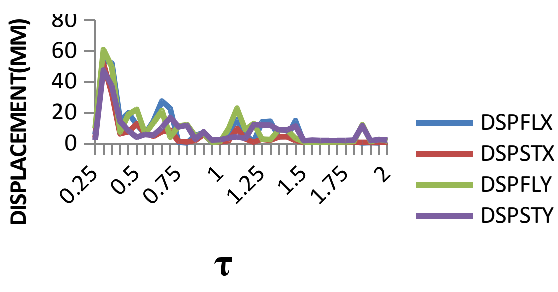

FIG3(b): Response of EQ2

FIG3 :Represents the nature of flexible and stiff elements where T=0.1 sec , ex/D=0.05 and ey/D=0.1.

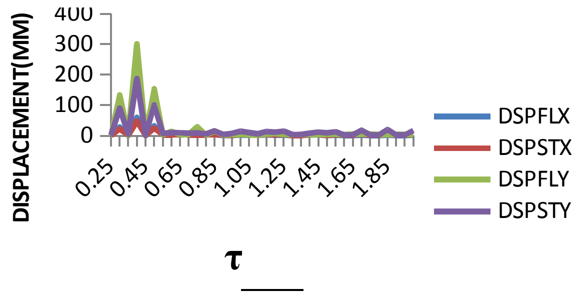

FIG4(a):Response of EQ1

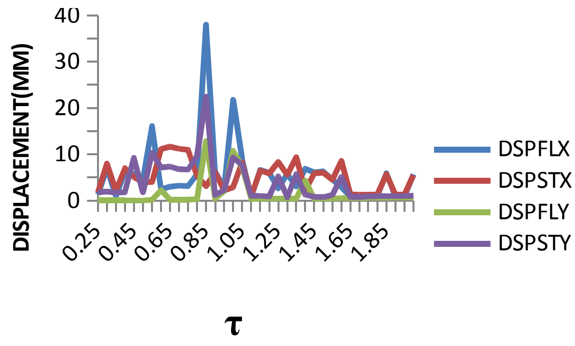

FIG4(b):Response of EQ2

FIG4: Represents the nature of flexible and stiff elements where T=0.2 sec, ex/D=0.2 and ey/D=0.1.

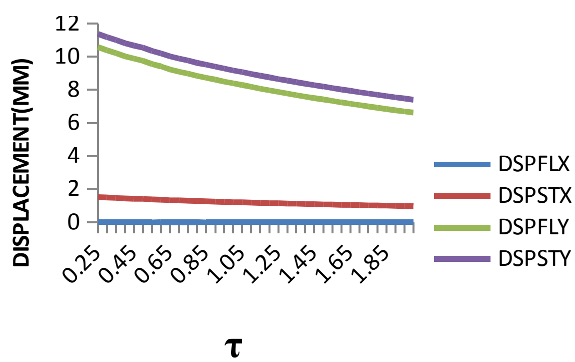

FIG5(a):Response of EQ1

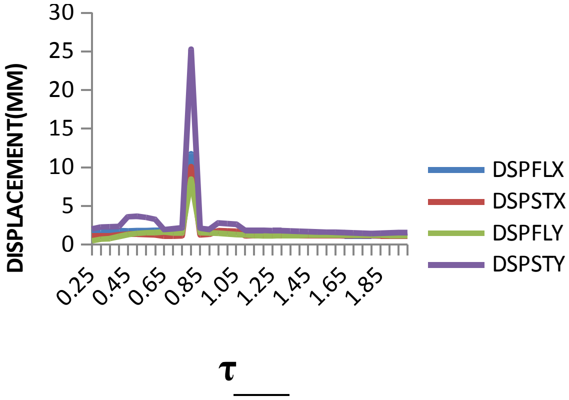

FIG5(b):Response of EQ2

FIG5:Represents the nature of flexible and stiff elements where T=1sec ,ex/D=0.05 and ey/D=0.2.

V. CONCLUSIONS

An idealized horizontally irregular structure has been analyzed under two near fault ground motions. The results are presented in normalized form. This study shows the nature of flexible and stiff elements under near fault ground motion. The variation in displacement response is observed for different ground motions .Generally flexible elements show more displacement but in this study it can be observed that the response clearly depends on the acceleration of ground.

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REFERENCES

[1] S.Varadhrajan, "Study of Irregular RC building under seismic effect (2016)".

[2] Sumit Kumar Paul, "Seismic Behavior of Horizontally irregular Structure: Consequence of Relative orientation of Accelalogram (January –March 2016".

[3] Subhayan Bhaumik and Prithwish Kumar Das, "Response of an idealized R/C asymmetric structural systems under near fault ground motions (2003)".

[4] PEER (Pacific Earthquake Research Centre),PEER strong ground motion Database.

[5] IS1893-1(2002): Criteria for Earthquake Resisting Structure.

