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Shear Behavior of short Eccentric LinK Subject to Seismic Loads

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ABSTRACT

The energy is absorbed by link and/or columns deforming inelastically. For the three models and the various lengths of link limits, three sets of results are considered. In the eccentric braced frames it was forced that yielding of plastic capacity was achieved.

KEYWORDS

Link deforming; Length of Link; eccentric link; plastic capacity; shear mechanism

INTRODUCTION

Concentrically braced frames are limited in their ability to absorb energy during an earthquake. However by placing the bracing members eccentric to the beam column joints, as shown in Fig. I (a) , an energy absorbing link unit is produced (James R.Libby). The energy is absorbed by the link and/or columns deforming inelastically (Egor.P.Popov, 1983, 1984, 1986).

Eccentric link are usually introduced at both ends of a bracing member as it produces a minimum energy loss conditions. AIso the shorter the link lengths the more efficient the energy absorption. AIso the stiffness of the eccentrically braced frame will be virtually the same as the braced frame (charles W.Roeder, 1989).

MODELS

Three models of a multistorey structure, shown in Fig. 2, were analysed using DRAIN - 2D computer program. Three link lengths were used in the analyses, 7, 11 and 15 inches. The structural sections used are shown in Fig. 2.

The earthquake record applied to each model was the first seven seconds of the EI centro N - S record. This was scaled to produce a peak acceralation of o.45 G. The dynamic properties of the section were taken as 80% of the static properties (John M. Biggs, 1982).

RESULTS

For the three models and the various lengths of link limits three sets of results are considered :

(a) Overall Drift
(b) Yielding pattern of Members
(c) Associated Shear and Moment Values.

Overall Drift

A maxium displacement of 100 inches was spedified for all the models. the limits taken to exceed this maximum value is in Table 1. The variation of displacements with time are shown in Fig. 3 and Fig. 4.
with one exception it can be seen that fixing the bases enables the structure to stay within the overall drift limit longer than the pinned bases. overally the double eccentricity models stay within the limits longer than the single eccentricity models.

Table 1. collapsion Time of Each Time

	single Eccentrical		double Eccentrical	
link length	fixed feet	pinned feet	fixed feet	pinned feet
7	3.76	2.09	3.79	3.21
11	3.45	3.69	3.79	3.21
15	3.45	2.1	3.62	3.2
0	7.0	5.26		

Yielding pattern of Models

Fixed Feet Models

For all nine models, as can be seen in Fig. 5 Yielding starts in the left hand base column, Then moves progressively up the model. The pattern is the same for each system of eccentricity. The concentric frame Yields progressively with time in all members up to the eighth floor level. For the single eccentricity frame, five of the column lengths have not yielded, but only one column in the double eccentric models. In all three models none of the bracing members have yielded.

Pinned Feet Models

The yield patterns for three models are shown in Fig. 6. This time the yielding starts at the first floor level and contnuous only to the second floor level. The yielding then starts again at the fifth floor level for two or three storeys. Therefore for the pinned base structures two distinct regions of yielding are produced. Again no yielding is present in the bracing members.

The earthquake record applied to each model was the first seven seconds of the EI centro N - S record. This was scaled to produce a peak acceralation of o.45 G. The dynamic properties of the section were taken as 80% of the static properties (John M. Biggs, 1982).

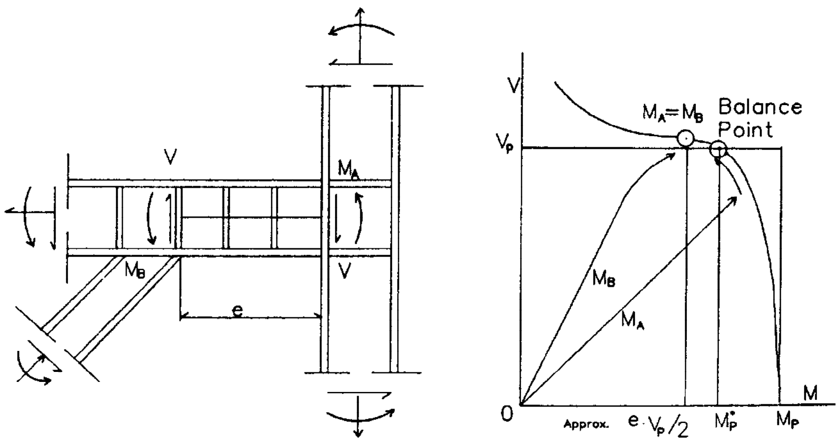

Fig. 1 (a) Typical Elastic Beam Link Moment at Column

(b) Behavior of Ideal Plastic Shear Link

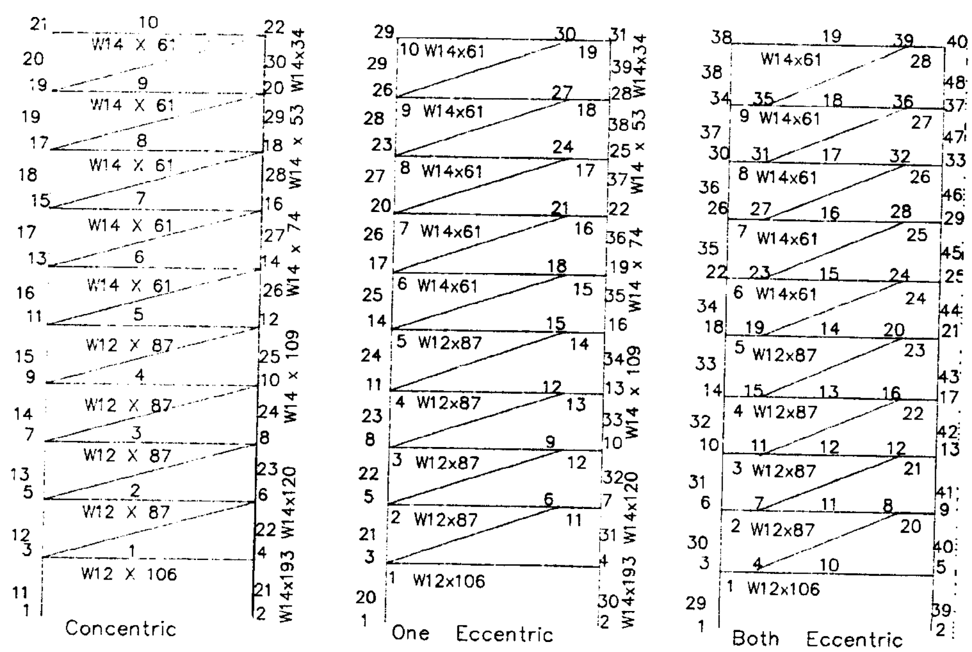

Fig. 2 Analytical Model

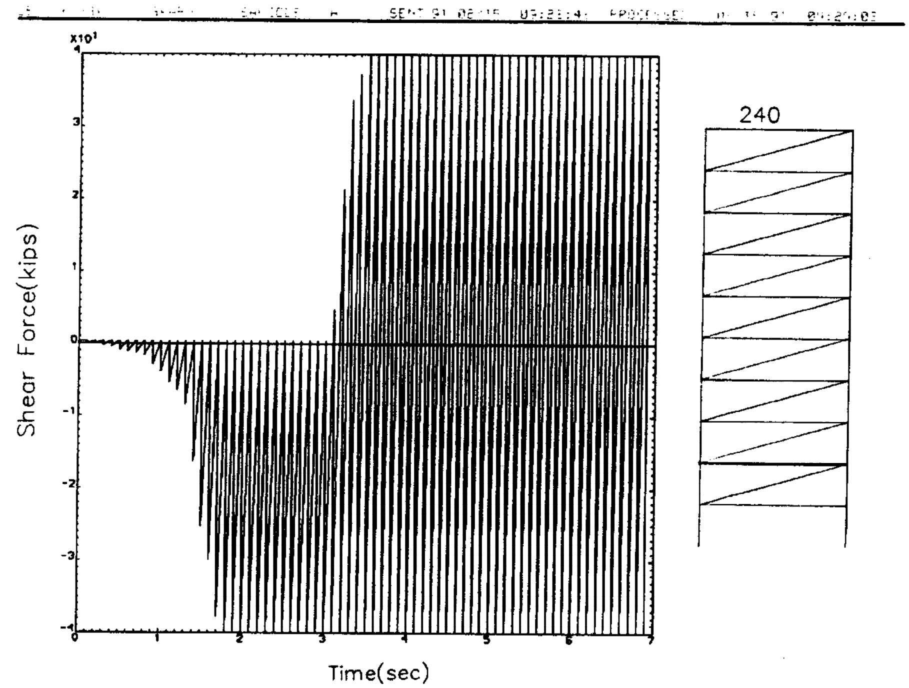

Fig. 3 Shear Graph

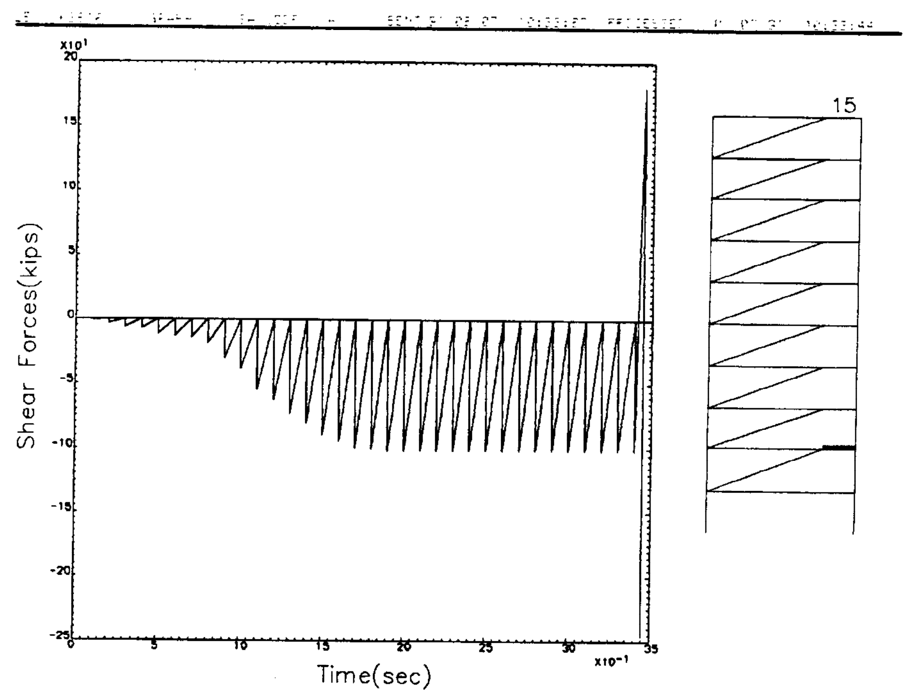

Fig. 4 Shear Graph

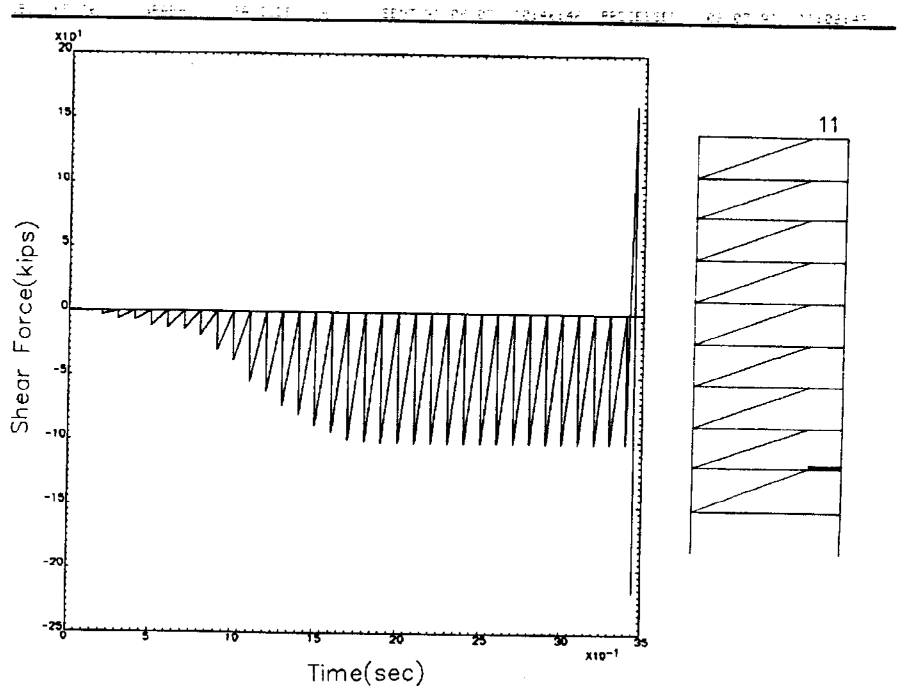

Fig. 5 Shear Graph

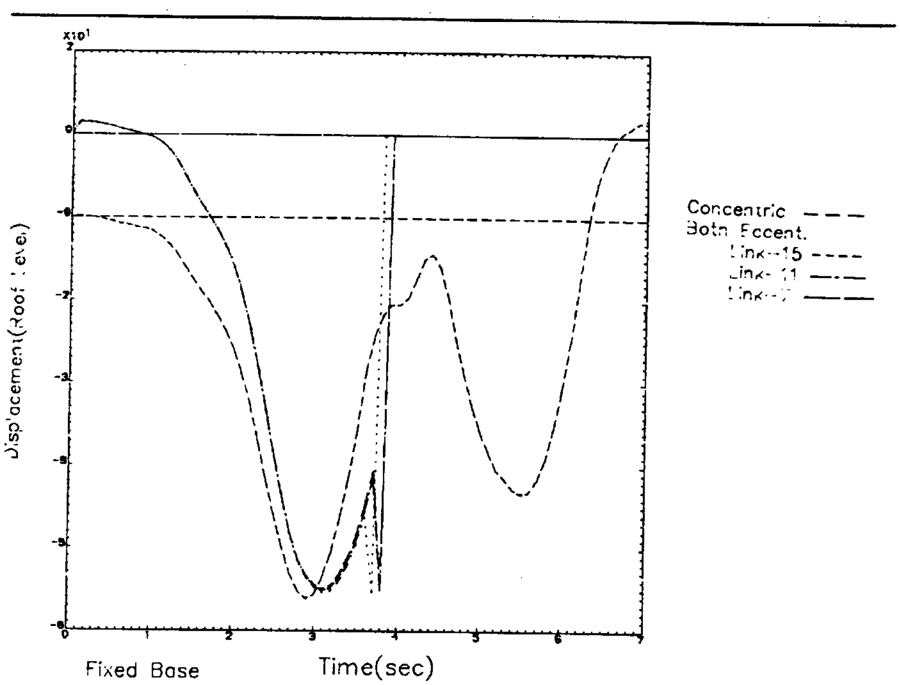

Fig. 6 Displacement Graph

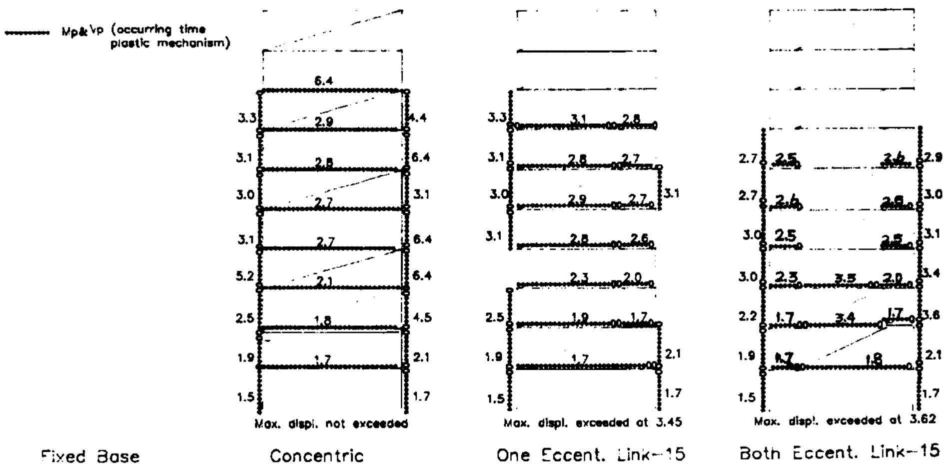

Fig. 7 Time - Dependent Mechanism of Vp & Mp Graph

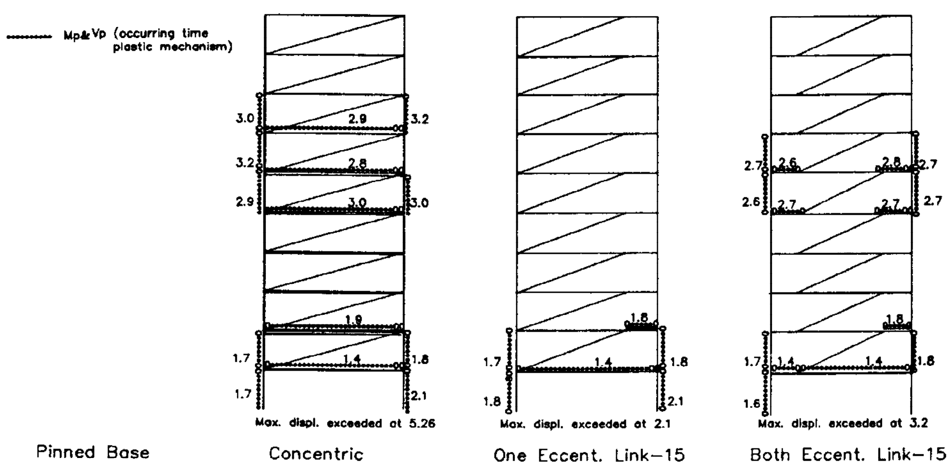

Fig. 8 Time - Dependent Mechanism of Vp & Mp Graph

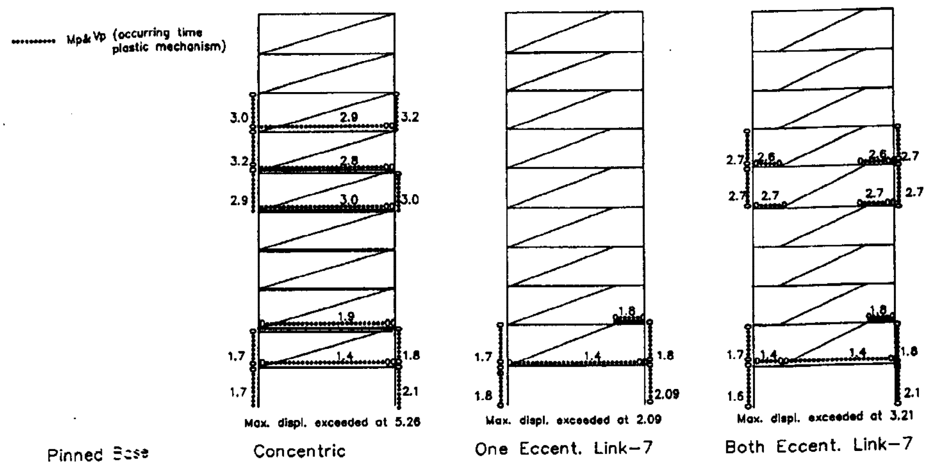

Fig. 9 Time - Dependent Mechanism of Vp & Mp Graph

Shear and Moment Values

The shear - moment relationship for an ideal shear link is shown in Fig. 1(b). In all models the right hand link at the second floor level has yielded. The values of shear and moment in this link are used for the comparison. The variation of shear force in this, during the loading, is shown in Fig. 3 and Fig, 4. Fig. 5. The up value of the link is taken as 80% of the static shear capacity. The actual values obtained in the links are shown in Table 2.

Table 2. V at Frame Failure (Kips)

Fixed	single Eccentricity	double Eccentricity
link-15	- 101.83	- 100.51
link-11	- 102.17	- 101.15
link- 7	- 102.56	- 101.96
0	- 39.13	

Pinned	single Eccentricity	double Eccentricity
link-15	- 99.35	- 99.78
link-11	- 99.97	- 100.14
link- 7	- 100.23	- 100.50
0	- 38.13	

It can be seen from the results that the shear values for a ll the eccentric frames is close to the vp value. For the concentric frames the shear values is considerably lower, about 34% of the shear capacity.

DISCUSSION

The yield patterns are shown in Fig. 5, 7, 8 and 9. However it is interesting to note the relative values of shear force and moment obtained. In the eccentric braced frames it was forced that yielding of the links occurred when both plastic moment capacity shear plastic capacity were achieved.

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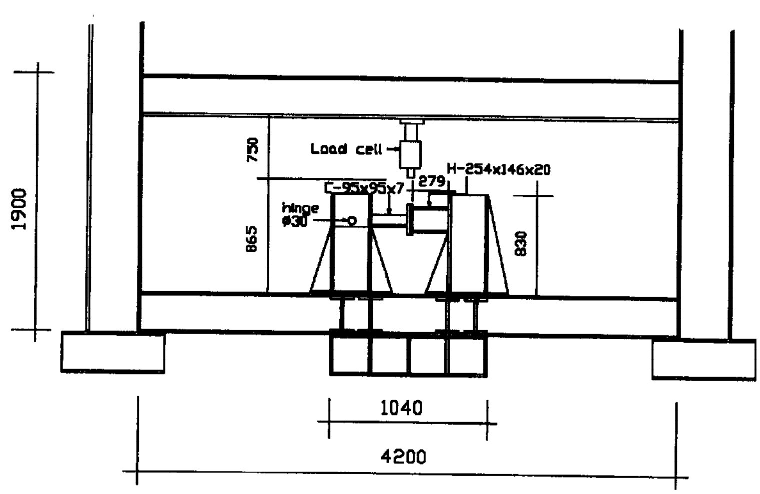
APPENDIX



Experimental Set up