EFFECT OF CONNECTION RIGIDITY ON THE BEHAVIOR OF IRREGULAR STEEL BUILDINGS UNDER LATERAL LOADING

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Conventional analysis of steel frame structures is usually carried out under the assumption that the beam-to-column connections are either fully rigid or ideally pinned (Fathi et al., 2006). However, most connections used in practical works are semi-rigid type whose behaviour lies between these two extreme cases (Kishi and Chen, 1990).

In partial fixity connection the Percent of Rigidity is determined by proportion of rotation of two side of semi rigid connection. The rigidity percent is shown in equation 1.

$$R = \frac{\alpha_b}{\alpha_c + \alpha_b} = \frac{1}{1 + {}^{3EI}/_{KL}} \qquad (1)$$

Where R is percent of rigidity which will scrutinize, E, I and L is beam propertis and K is rigidity of spring. The extra describtion is depicted in Figure 1.a.

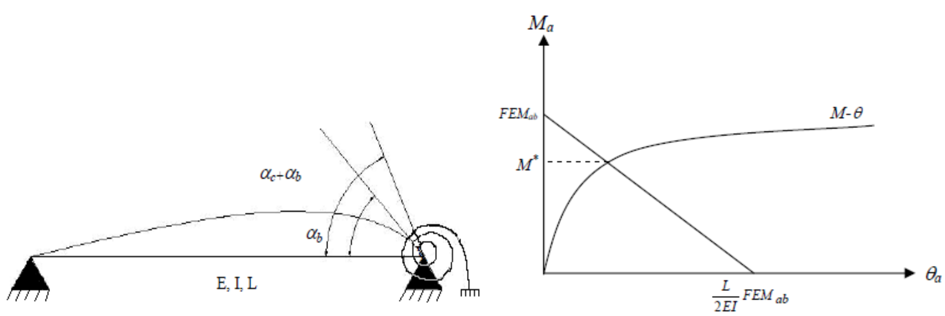


Figure 1. a) Schematic image of a semi rigid beam b) Moment- rotation curve and beam line intersection in a partial fixity connection

Beam line is a clear way to illustrate basic understanding of rigidity percent in steel structure (Louis and Robert 2005). To this aim according to slope-deflection method and symmetrical beam Figure1, the beam line equation described in Eq. 2.

$$M_{ab} = \frac{2EI}{L}\theta_a + FEM_{ab} \rightarrow if\ M_{ab} = 0.0 \rightarrow \theta_a = -\frac{L}{2EI}\theta_a . FEM_{ab}\ ; if\ \theta_a = 0.0 \rightarrow M_{ab} = FEM_{ab} \qquad (2)$$

Superposition of a partial restraint moment connection curve from with the beam line is shown in Eq.2 is attained at the intersection of these two curve, shown as M^* in Fig1.b. For the nonlinear connection curve shown, this point is not easily obtained. However if the connection were to be modeled as a straight line, then a simple mathematical solution could be easily found. The percent of rigidity is attained in Eq3 (Mazroei et al., 1378).

$$R = \frac{M^*}{FEM_{ab}} \qquad (3)$$

In this paper, the effect of rigidity percent of connections in an irregular six story steel building as shown in Figure 2, were determined. Rigidity percent of beam-to-column connection is set to 25%, 50%, 75% and 100%.

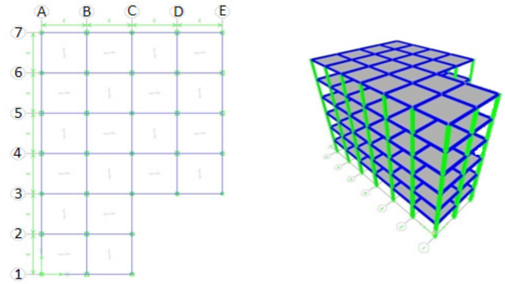


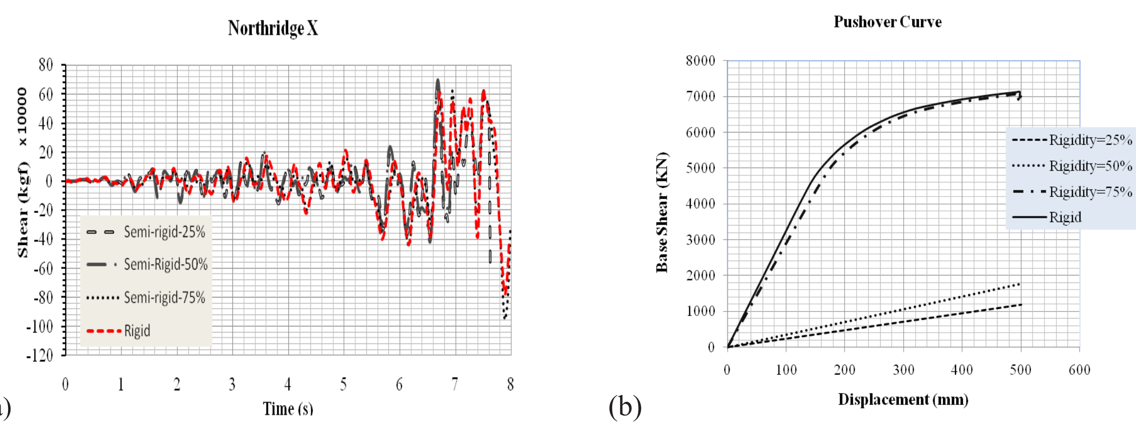
Figure 2. Plan view and 3D facing of present study

Two different analyses were performed. Nonlinear Time History Analysis (NTHA) and Nonlinear Static Analysis (NSA) are fixed to determine the inelastic responses of building. Non-linear behaviour of semi-rigid connections was kept like rigid ones, by deduction of stiffness consciously. The mathematical consumption proved that the rigidity could described by percent. So the model in semi-rigid is acted as a rigid state but with lower stiffness to gain access to a suitable response in non-linear behaviour.

In NTHA three ground motion records were scaled according to 2800 standard and used to analyze the structure. In NSA analysis two kind of load pattern based on FEMA-356 were put on structure as lateral loading to assess pushover curves and performance point. The plastic hinges were set as P-M-M for columns and M3 for beams according to acceptance criteria of FEMA-356.

To evaluating different rigidity range of connection and their effect on irregular building some dynamic properties such as hysteresis curve, response history of roof displacement and base shear, capacity curves and performance point were reported. Figure 3 represent the base shear history of Northridge record and pushover curves.

It can be concluded that rigidity of 75% and 100% have nearly same responses but the more reduction of rigidity percentage, the structure could absorb higher intensity shock by later entering to inelastic zone.



(a) (b)

Figure 3. a) Base shear history response; b) Capacity curves

The result show that reduction of R% lead to: enhancement of period, displacement and rotation. Decreasing rigidity of connection to 75% ration could promote the behaviour of structure and it is an optimum percent of rigidity.

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