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Research paper

Behavioural Analysis of L Shaped RC Columns Using Non-Dimensional Interaction Diagrams by Classical Layer Decomposition Method

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Abstract

The use of rectangular and circular column sections in the construction field are very common and it very easy to analyze and design of these types of column sections. For the design of these column sections load and moment interaction curves are available in sp-16 1980, but for the design of L-shaped column section, the load and moment interaction curves are not available in this code book. The use of L-shaped column in the construction field increases the load carrying capacity of the column. This paper contains the work carried out about the development of load moment interaction curve for L-shaped column section.

Keywords: *interaction diagram, ETABs, L shaped column model, load, moment.*

1. Introduction

Compression members are structural members subjected to an axial compressive force and hence their design is guided by considering the strength and bucking. Examples for the compression members are column, strut, wall and pedestals. Column is a vertical member primarily subjected to an axial compressive load, which transmits the load from super structures. A compression member is said to be a column, then its unsupported length shouldn't exceed sixteen times of its least lateral dimension. The column carries the load along its length in vertical direction. Column may be uni-axial or bi-axial. Columns have different types based on many criteria. They are as shown in the fig below. (fig1).

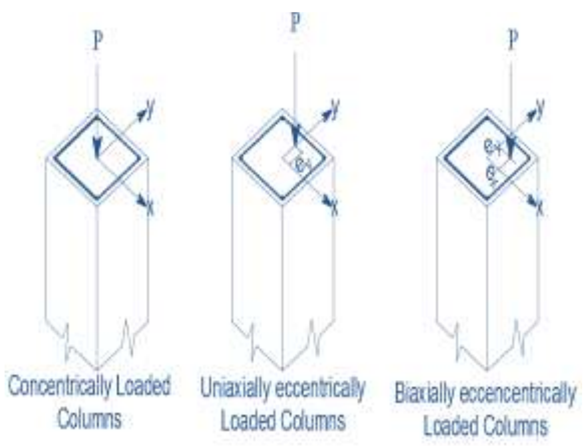

Fig 1: Types of Column Based on Loading Pattern

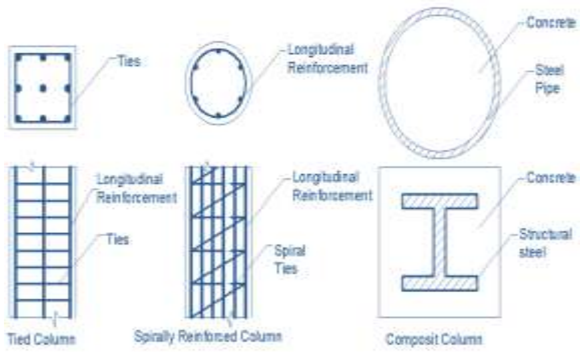

Fig 2: types of column based on types of reinforcement

Interaction diagram is nothing but it is a combination of axial load and moment for the given range values of x/h. Any combination of load and moment that falls inside the curve is safe against the failure. The salient points on the interaction diagram are explained in the fig 1.

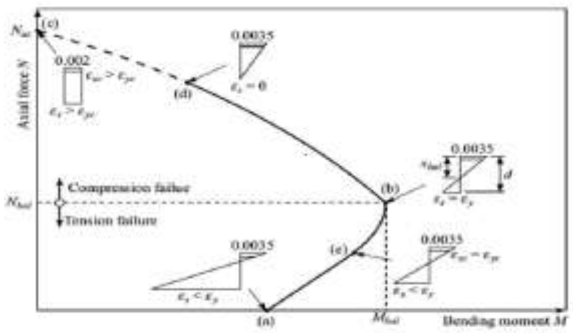

Fig 1: salient point on the interaction diagram

Working stress method and limit state method are two important design methods which are evolved in two different part of the world. In paper we have used limit state method for the analysis and design of the L-shaped column section. Typical section of L-shaped column is as shown in fig 2.

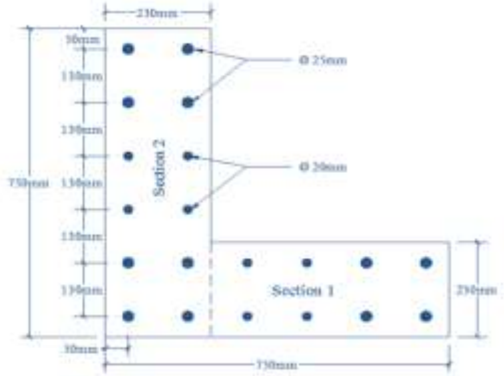

Fig 2: L-shaped column section used for analysis

2. Assumptions

a) Plane section normal to the axis of the plane always remains plane even after the deformation. b) The tensile strength of the concrete is ignored. c) for the design purpose the compressive strength of concrete is taken as $0.67f_{ck}$. in addition to the factor of safety 1.5 is applied and taken as $0.45f_{ck}$. (fig 2).

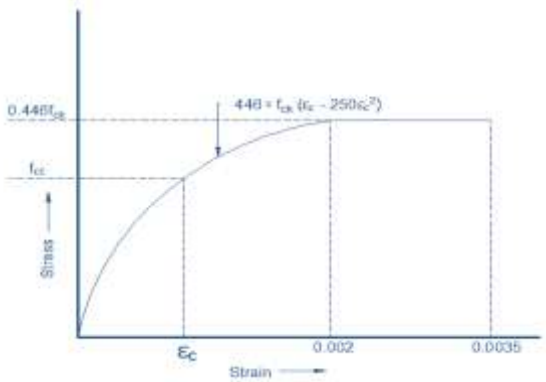

Fig 3: stress-strain curve for concrete

e) Stress in steel is obtained from the stress strain relationship of steel as shown in the fig below (fig 3).

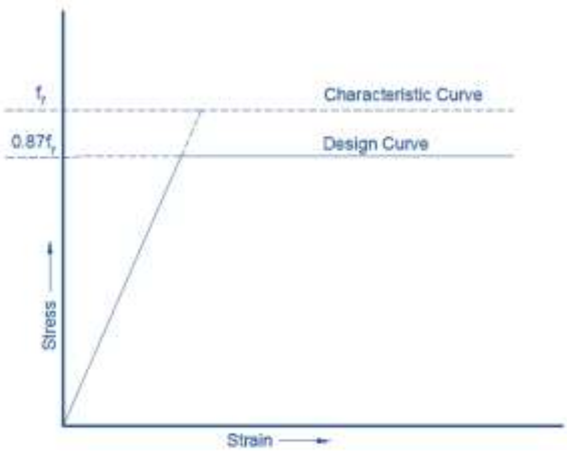

Fig 4: stress strain curve for steel

f) the maxium compressive strain in the concrete is taken as 0.002 and it is uniform throughout the section.(fig 4).

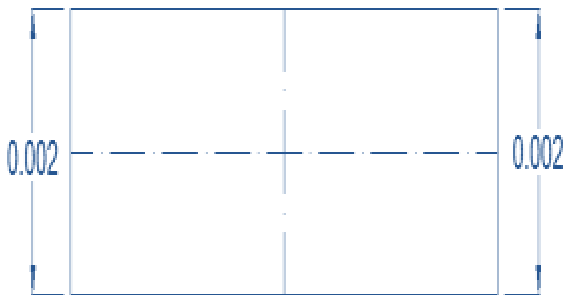

Fig 5: compressive strain in the concrete

g) when nuetral axis lies within the section, then the maxium strain in the concrete in bending at highly compressive edge is taken as 0.0035. when nuetral axis lies at the edge of the section the stain varies from 0.0035 to 0.(fig 5)

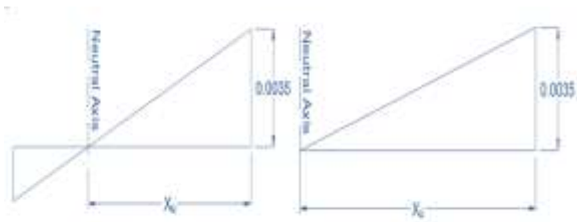

Fig 6: compressive strain in concrete

i) when nuetral axis lies outside the section, the maxium compressive strain at highly compressed edge is 0.0035-0.75 times the starin at least compreesive edge

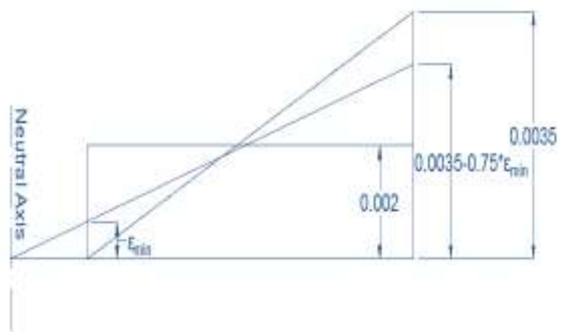

Fig 7: compressive strain when nuetral axis lies outside the Section

3. Non Dimensional Interaction Curves

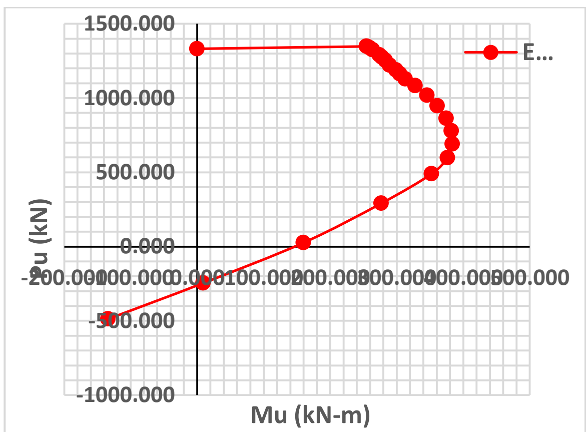

Fig 8: Non dimensional Interaction Curve for M25 and Fe415

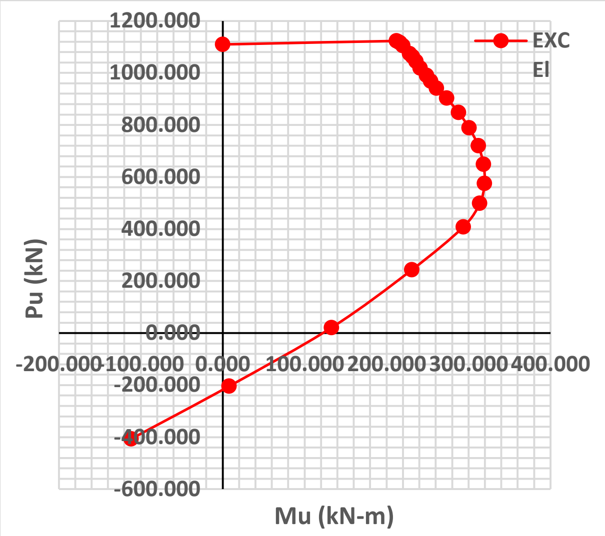

Fig 9: Non dimensional Interaction Curve for M30 and Fe415

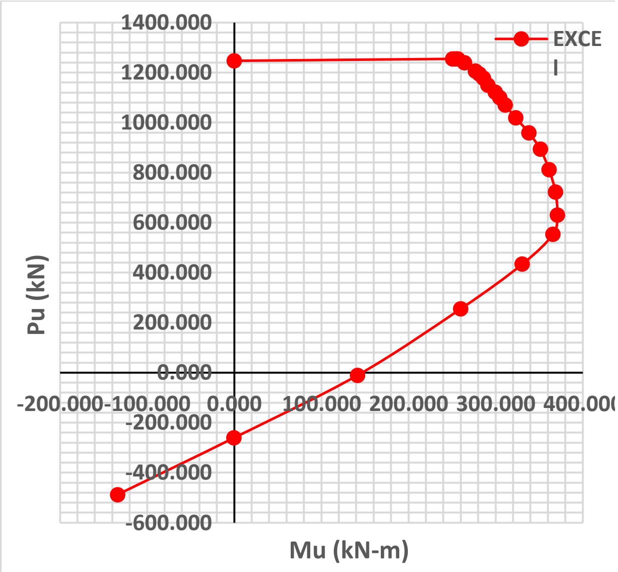

Fig 10: Non dimensional Interaction Curve for M25 and Fe500

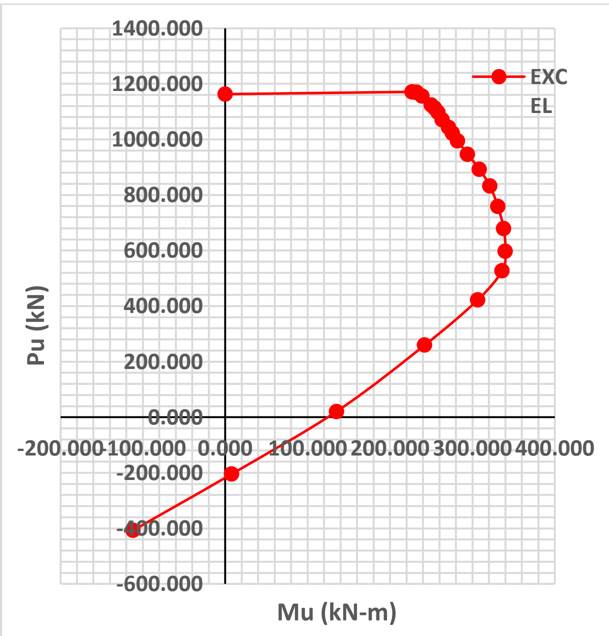

Fig 11: Non dimensional Interaction Curve for M30 and Fe500

4. Interaction Curves Using Excel Sheet

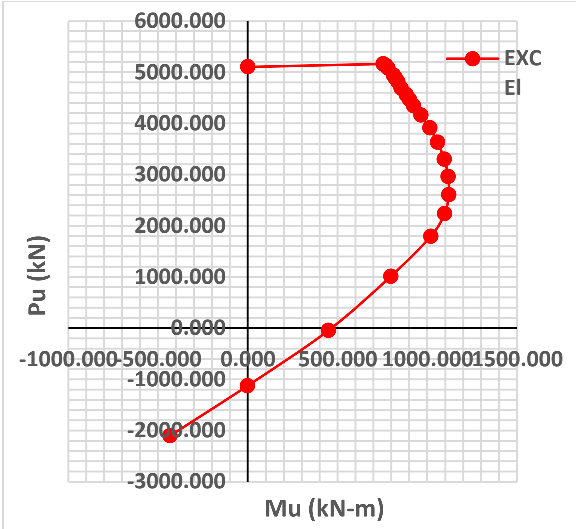

Fig 12: Interaction Curve For M25 and Fe415

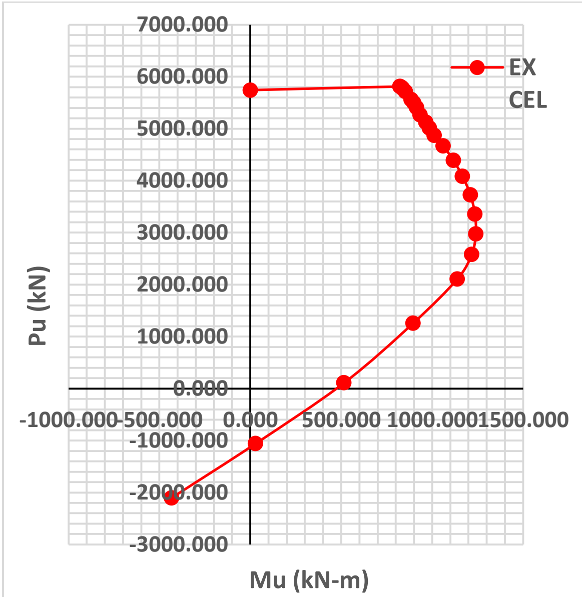

Fig 13: Interaction Curve for M30 and Fe415

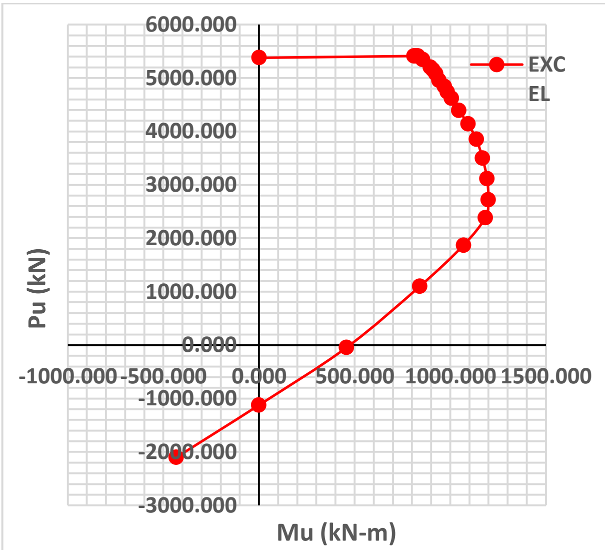

Fig. 14: Interaction Curve for M25 and Fe500

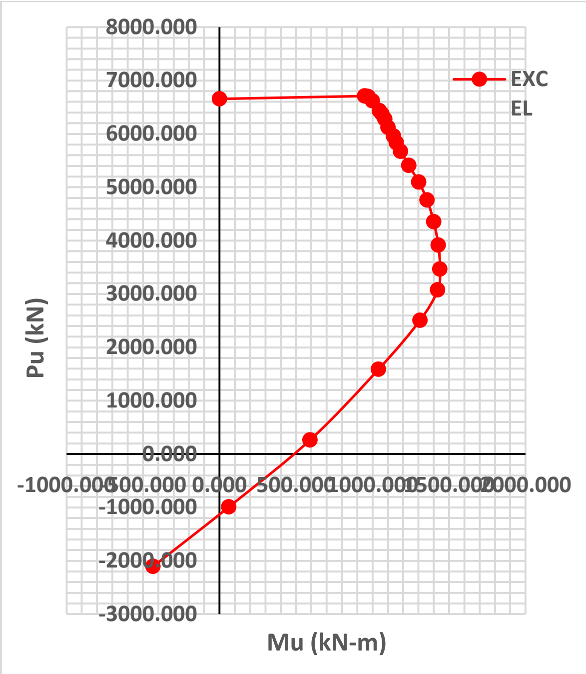

Fig. 15: Interaction Curve for M30 and Fe500

5. Interaction Curves Using Etabs

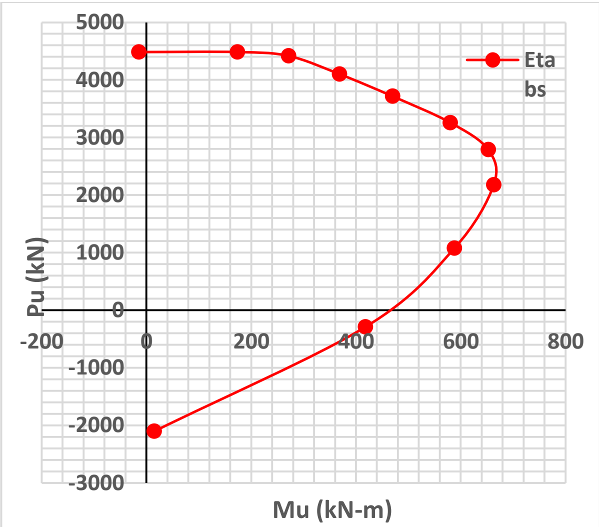

Fig. 16: Interaction Curve for M25 and Fe415

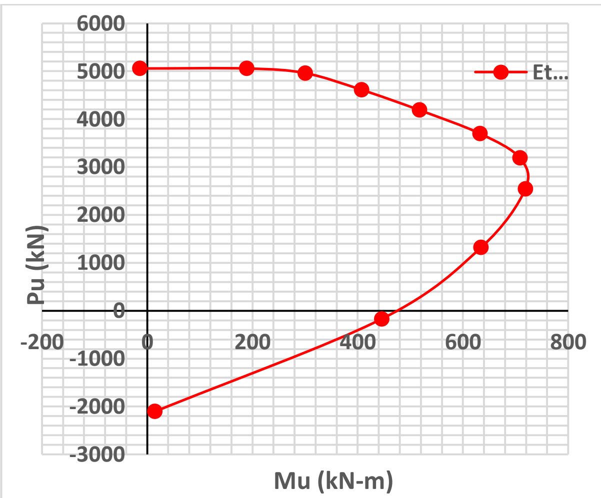

Fig. 17: Interaction Curve for M30 and Fe415

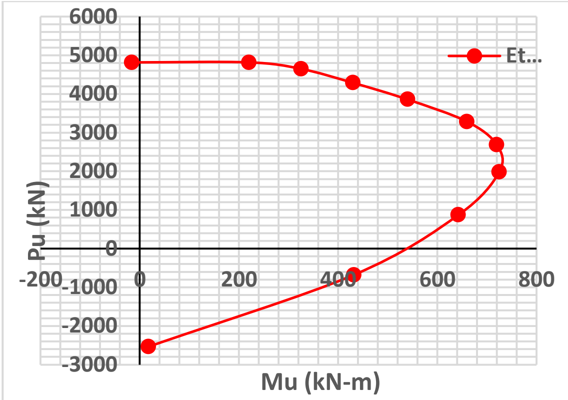

Fig. 18: Interaction Curve for M25 and Fe500

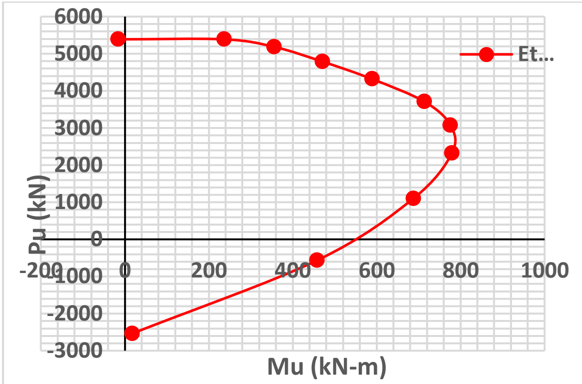

Fig. 19: Interaction Curve for M30 and Fe500

6. Comparative Study of L-Shaped Column Section Using Etabs and Excel

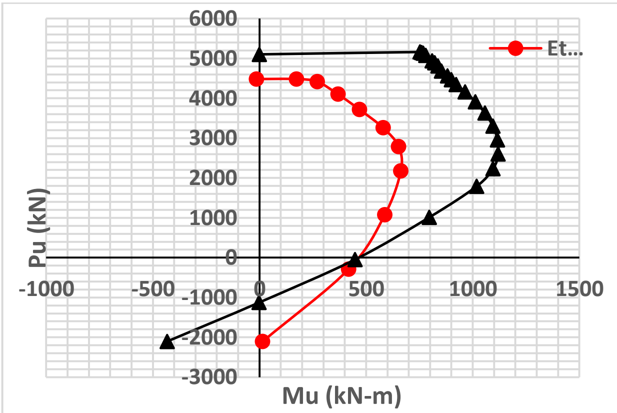

Fig. 20: Interaction Curve for M25 and Fe415

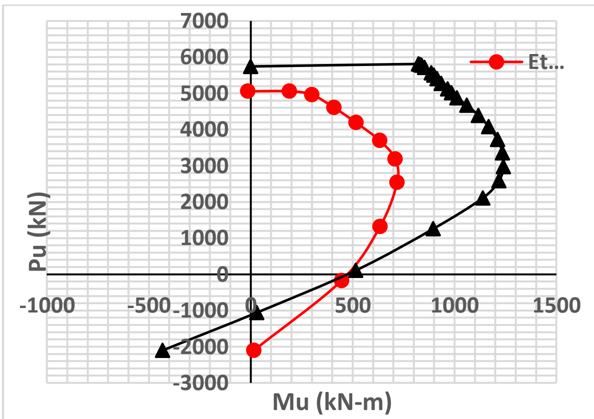

Fig. 21: Interaction Curve for M30 and Fe415

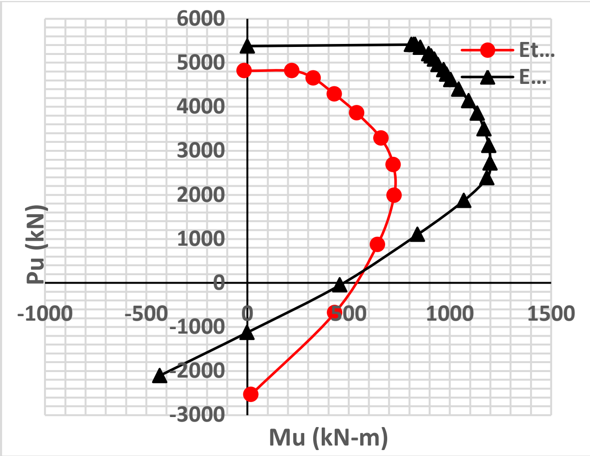

Fig. 22: Interaction Curve for M25 and Fe500

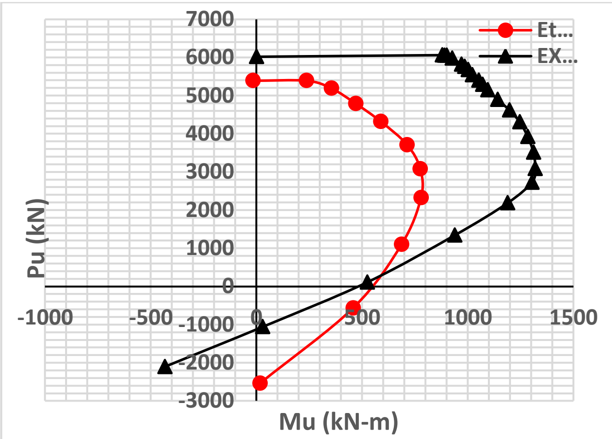

Fig. 23: Interaction Curve for M30 and Fe500

7. Conclusion

a) For the development of interaction curve, a note in the table H of sp-16 says that it is adequate to take the K values 1.05 to 1.2 since H corresponds to the minimum eccentricity. In ETABs software it considers the value K up to 1.2D, where D is the neutral axis depth, where as in excel the value of K is taken from 1.05D to 4.0D. Hence the deviation can be seen in the curve. b) One more reason for the deviation of the interaction curve is that in ETABs it calculate the stress in steel by considering the product of strain in steel and modulus of elasticity but in excel stress in steel is computed from table A of SP-16. c) In the ETABs it considers the whitney's equivalent stress block within the depth of $0.84x_u$ and in analytical calculation parabolic stress block is considered. Hence there will be deviation in the interaction curve.

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