Study and Comparison of Steel Haunched and Tapered Beam

V. Jeyasudha, Satheesh Kumar KRP

Abstract -Steel framed buildings are flexible, ductile and light weight compared to that of reinforced concrete buildings. Intense research had been conducted in the last decades regardingthe fatigue and ductility behaviour of structural steel beam. Prismatic beams are the beams with uniform cross-section in the entire span of the beam. Non-prismatic beams are used to increase the efficiency of the beam, by increasing the strength per unit mass than that of prismatic beam. In this study, the load-deformation, stress-strain analysis, the fatigue and ductile behaviour of non-prismatic steel beams with hunched and tapered ends was compared with prismatic beam for different loading condition. The beams were subjected to static loading conditions during analysis.

Keywords: Prismatic beam, non-prismatic beam, stress-strain analysis, static loading, fatigue and ductile behavior.

I.INTRODUCTION

Steel framed buildings are flexible, ductile and light weight compared to that of reinforced concrete buildings. Intense research had been conducted in the last decades regarding the fatigue and ductility behaviour of structural steel beam. Prismatic beams are the beams with uniform cross-section in the entire span of the beam. I-shaped section is very efficient for carrying bending and shear in the plane of web. The web of the I-section resists the shear forces, while the flange resist most of the bending moments. The uniform cross-section of the prismatic beam has a reduced capacity of resistance in the transverse direction. Members those do not have the same cross-sectional properties from one end to the other, and those do not have a straight axis are known as Non-prismatic beams. Non-prismatic beams are used to increase the efficiency of the beam, by increasing the strength per unit mass than that of prismatic beam.

In this study, the load-deformation, stress-strain analysis, the fatigue and ductile behaviour of non-prismatic steel beams with hunched and tapered ends was compared with prismatic beam for different loading condition. The beams were subjected to static loading conditions during analysis.

A. Objective

The main objectives of this study were to

- Develop a simplified model of prismatic and non-prismatic beam, in order to analyse them.
- Study the behavior of hunched and tapered steel beam under static loading condition.

Analyze the fatigue and ductility behavior of hunched and tapered steel beam under static loading

II. MODELING OF STEEL PRISMATIC BEAM, HAUNCHED AND TAPERED BEAM BY USING ANSYS

A prismatic steel beam, haunched beam and tapered beam was modeled and analyzed in ANSYS.

A. Description Of Analytical Model

ISMB 300 was taken
Weight =442N
Depth =300mm
Width of flange=140mm
Thickness of flange=13.10mm
Thickness of web=7.70mm
Haunch angle 45^0

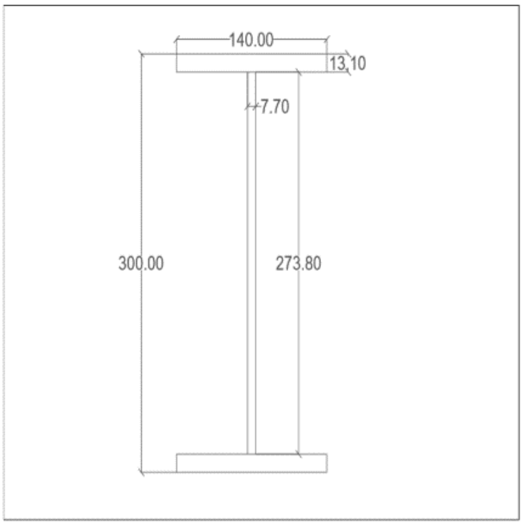

FIG-1: I-section dimensions

B. MESHING

To obtain good result from the steel element the use of hexagonal mesh was done. There for the mesh was set up such that the elements were created. A suitable mesh size is chosen to achieve sufficient accuracy.

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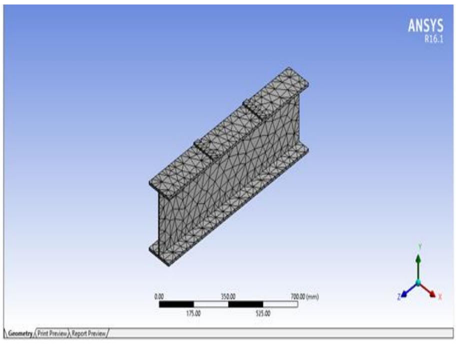

FIG-2: Mesh model of steel prismatic beam

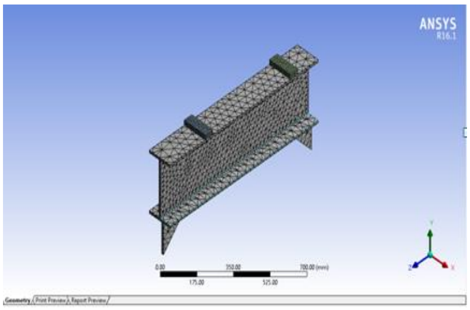

FIG-3:Mesh model of steel haunched beam

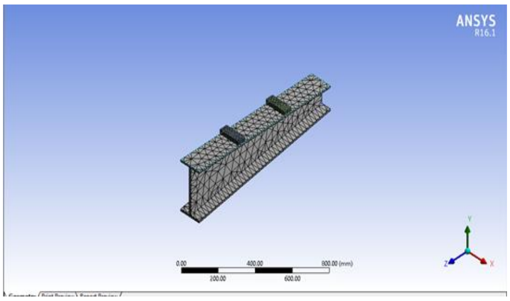

FIG-4: Mesh model of steel tapered beam

III.METHODOLOGY

Elastic and plastic properties were used in the analysis to recognize the ductility and fatigue behavior of steel structures. The load and deformation, stress and strain curve were also analyzed.

A. Analysis

The properties that are considered for the analyzing processes are physical properties, linear elastic, plasticity, stress life parameters and strength. The above properties are used for steel prismatic beam, haunched beam, tapered beam.

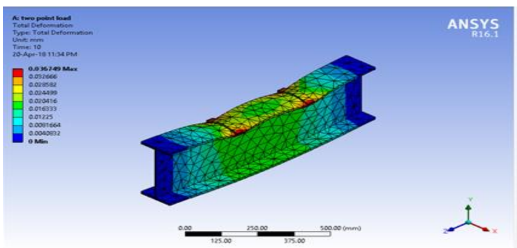

FIG-5: Analysis of steel prismatic beam

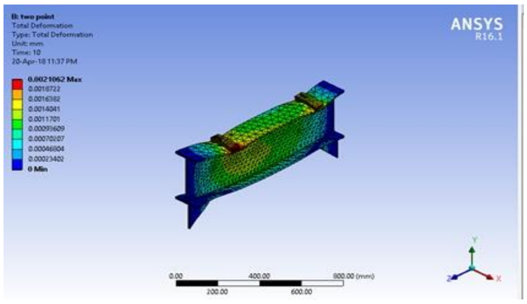

FIG-6: Analysis of steel haunched beam

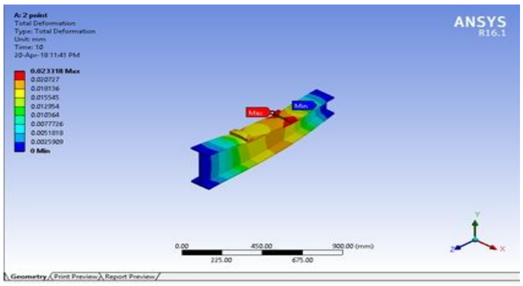

FIG-7: Analysis of steel tapered beam

IV.RESULT AND DISCUSSION

A. Load Versus Deflection

Haunched Beam

The following figure 8 represents the load versus deflection curve for haunched beam.

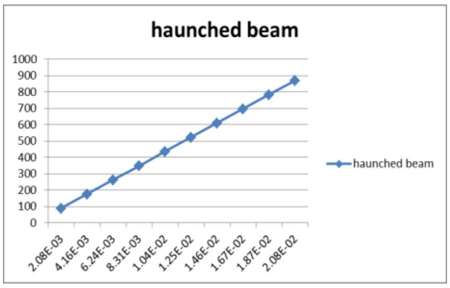

FIG-8: Load versus deflection for haunched beam

Tapered Beam

The following figure 9 represents the load versus deflection curve for tapered beam.

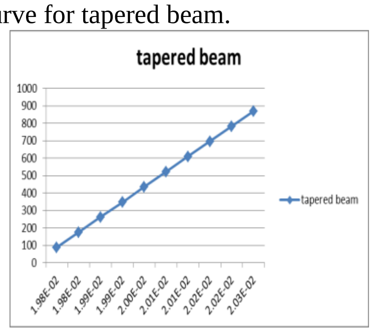

FIG-9: Load versus deflection for tapered beam

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Prismatic Beam

The following figure 10 represents the load versus deflection curve for prismatic beam

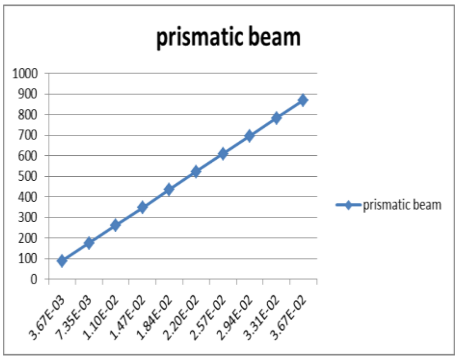

FIG-10: Load versus deflection for prismatic beam

B. Stress Versus Strain

Haunched Beam

The following figure 11 represents the stress versus strain curve for haunched beam.

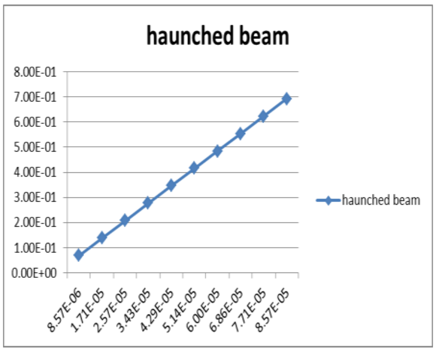

FIG-11: stress versus strain for haunched beam

Tapered Beam

The following figure 12 represents the stress versus strain curve for tapered beam.

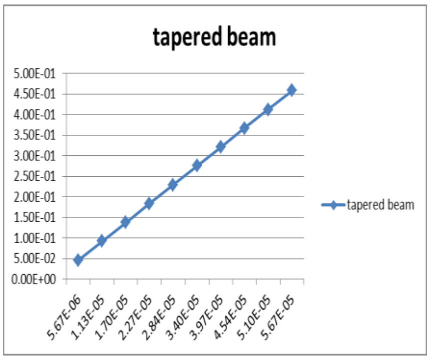

FIG-12: stress versus strain for tapered beam

Prismatic Beam

The following figure 13 represents the stress versus strain curve for prismatic beam.

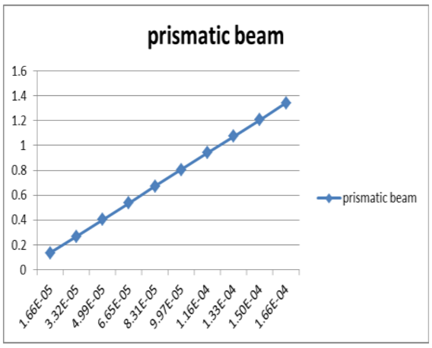

FIG-13: stress versus strain for prismatic beam

V.CONCLUSION

From this analytical study, the responses are discussed and following conclusions were made for steel beams.

1. Comparsion of steel haunched and tapered beam shows less deformation then tapered beam.
2. Compare with prismatic beam and tapered beam are moreover similar in response.

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