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OPTIMISATION STUDY ON STEEL TIMBER COMPOSITE BEAM AND RCC BEAM

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Abstract **— Nowadays, construction of buildings through RCC material method is conventionally used. In this method, it is found to emit more amount of carbon dioxide and consume higher energy than wood construction method. Tensile strength of steel is good than that of timber, so the concept of steel-timber composite beam can overcome the problem of tension in beam and helps in strengthening of beam. Different types of timber are used during analysis for obtaining greater strength in bending. This paper shows modeling of composite beam using Catia V5 and analysis of composite beam using ANSYS software. Comparison of different types of timber in STC beam with RCC beam is shown in this paper. This steel-timber composite beam will be helpful in reducing cost, time and material quantity.**

Keywords **- timber, steel-timber composite beam, ANSYS.**

1. INTRODUCTION

Wood is considered as a natural and renewable material which has high strength to weight ratio and a good processing performance. It is one of the most environmentally friendly building materials in the world because of low-energy consumption and low carbon-dioxide emission. It is seen that laminated timber structure have high strength and may require less maintenance during its service compared to solid dawn timber structures. They are economical and light weighted too. Cold form steel members are easy in terms of fabrication and are a light weighted in terms of hot rolled steel members. Steel reacts in tension and wood excels better in compression. So the bending performance can be improved by combining steel and timber. In this steel timber composite beam, screws can be used as a connector to reduce the self-weight and increase the speed of construction. This could also help in reusing and recycling the building materials at the end of building service life.

2. METHODOLOGY

This paper shows the different properties of timber and the composition of timber with steel. Steel members are combined with timber members to gain the desired properties of beam. Models are designed in Catia software and analysis work has been done in ANSYS software. Comparison between different models has been carried out by varying different types of timber properties.

Validation of results for both steel timber composite beam and RCC beam will be carried out. In the literature surveys so far, the composite beams are validated with experimental values. In this paper, there would be analytical comparison between steel timber composite beam and RCC beam and it would also help in material costing and speedy construction.
Load bearing capacity and bending/deformation is obtained through analysis of beams.

3. MODELLING

A. Designing of steel timber composite beam in Catia.

The steel timber composite beam model is designed in Catia. It is designed in XZ plane and extended along Y plane.

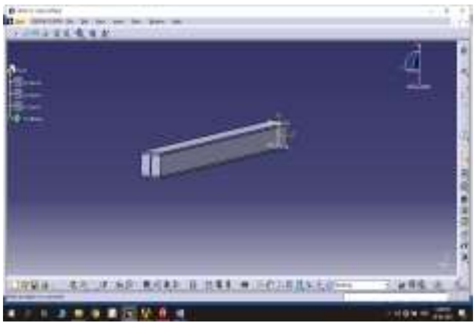

Fig 1: Steel Timber Composite Beam

In this beam, I section with parameters having height 250 mm, total length of flange 116mm and width of web 8mm is considered for further calculations.

Timber members are inserted between the flanges and connected with screws. This will help in easy and quick assemble and it is also behaving as a stronger connection between steel and timber.

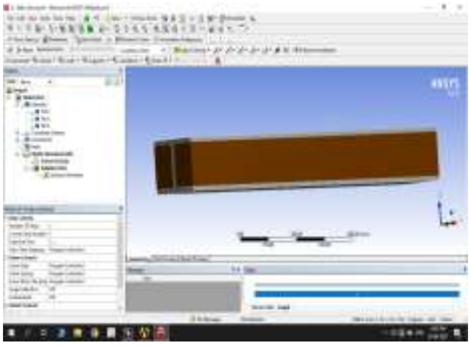

Fig 2: Steel timber composite beam

This beam, after the designing in Catia, it is exported to ANSYS software for analysis. It could be visible that the timber members are between flanges which would help the beam to resist compression and steel section would react to tension on the beam. Thus, combining both these materials will help to resist both tension and compression.

B. Designing of RCC beam.

Similarly, the RCC beam is designed in Catia software and exported back later to the ANSYS software for further analysis. It is designed having criteria of 125mm X 250mm breadth and depth respectively.

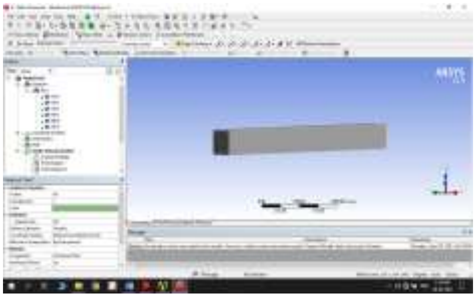

Fig 3: RCC Beam

On the basis of manual calculation of RCC beam, it is designed accordingly. Steel rods along with the box section of beam is extruded along y axis. Beam length is considered as 3m for this analysis.

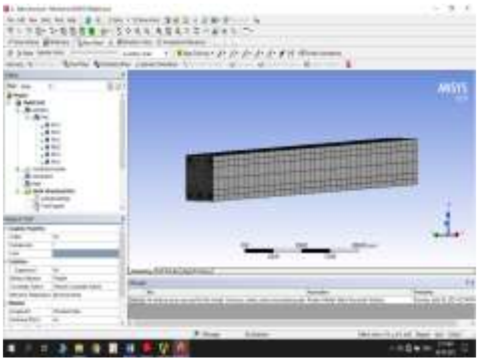

Fig 4: Meshing of RCC beam

Mesh is generated by carrying out the multiple node points. The reinforcement model is of steel which is taken as base model along with all steel reinforcement by assigning engineering properties of concrete and steel.

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3. RESULTS AND DISCUSSION

Analyzing the beams in ANSYS workbench, the following results are obtained.

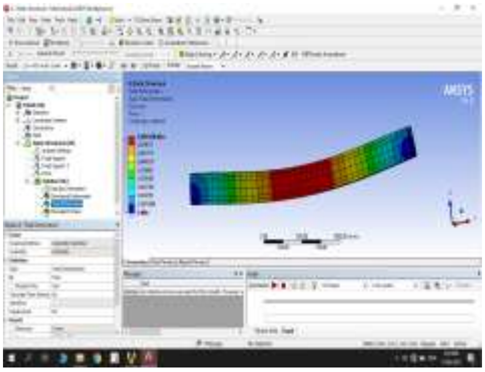


Fig 6: Analysis of RCC beam

RCC beam is analysed under uniformely distributed load of 50kN/m as considered. Due to this, deformation of 0.066mm is observed in the RCC beam and followed by maximum deformation at the centre of the beam. This beam is heavy in comparision with steel timber composite beam. It is time consuming as compared to STC beam and emits more CO2 gas.

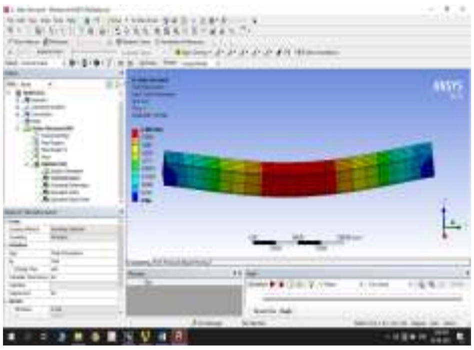
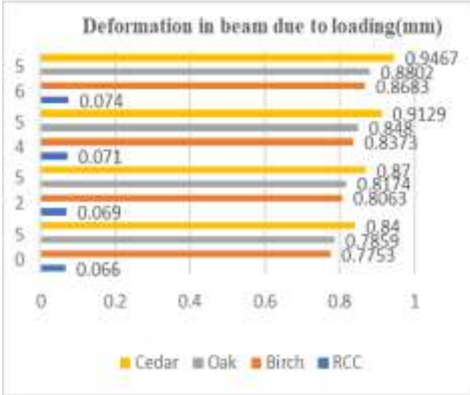


Fig 5: Analysis of Steel timber composite beam.

The Steel timber composite beam is analysed in Ansys software after importing it from Catia Software. Total load of 50kN/m was implied on the three types of timber beam and amount of deformation was compared with the RCC beam. Types of timber used in analysis are Birch, Oak and Cedar timber.



Graph 1: Comparison of deformation in RCC beam with different types of timber in STC beam.

The deformation was observed to be 0.84mm, 0.7859mm and 0.7753mm in Cedar, Oak and Birch timber respectively under given conditions. The deformation was observed maximum at the centre of the beam. The steel section present in this beam helps in resisting tension due to load and timber members present in beam helps in resisitng compression due to load. This way, it is more preferable material for composite beam.

Due to its light weighted property, it can resist lesser load as compared to RCC beam . But due to its easy assembleing property, it requires less energy to construct.

Load bearing capacity of RCC beam is more as compared to STC beam therefore, deformation in beam is observed more in STC beam than that of RCC beam.

4. CONCLUSION

- From the analytical results of steel timber composite beam and RCC beam, bending in RCC beam was seem to be less as compared to steel timber composite beam.
- Due to its easy to accessible property, steel timber composite beam is easy and fast to construct compared to RCC beam
- Load bearing capacity in beams is seen more in RCC beam than that of STC beam.
- Due to its light weight, the dead load of the whole structure decreases and that helps in resisting earthquake load in a better way.

- Comparing the results of all the beams, birch timber is the strongest of all having minimum deformation for steel timber composite beam.

5. References

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