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Short Communication

Comparative non-linear analysis of bamboo concrete column and steel reinforced concrete column under axial loading using ANSYS

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Abstract

Bamboo is basically a grass plant and has an ability to grow in different climatic areas. Within a month its growth is complete and gets mature within 3 years. When topography and climatic condition changes species of bamboo changes. It's mechanical property such as tensile and compression strength is good. This paper represents a comparative non-linear FEM analysis of bamboo reinforced concrete column and steel RC column of similar dimension.

Keywords: Comparative, non-linear, bamboo, reinforced.

Introduction

With the development of science and technology but still we have in a continuing phases for the improvement in RC structure around us. The structures in nature are of interest and it would be great lessons for human study, but only the most eco-friendly structural have survived. As we know that major countries have a high demand of steel RC concrete, but we are still incapable of producing steel that will meet future demand. So engineers have found an alternate for this problem and the solution is bamboo. Because from the investigation bamboo has a similar property likes steel and it is in future an ideal replacement of steel.

In the trials made by several authors, bamboo performs well. It achieves desired strength. It will make lightweight structure and easy for transport. It has the ability to grow in variety of areas and it is cheap. These factors make it as a good replacement as steel reinforcement[1].

Literature survey: Investigated or understand the non-linear behaviour/ mechanism of RC with SIFCON column with different percentages of SIFCON. From the results that having different slenderness ratios for particular columns, the required deflection was maximum in those column which have minimum slenderness ratio and it is minimum when maximum slenderness ratio so the buckling is observed in the slender column. Finally he concluded that load carrying capacity is maximum in case of column which has minimum slenderness ratio[2].

Presented FEM analysis of column. The author perform the analysis while considering various loading conditions such as reverse cyclic, buckling and monotonic loading condition and in order to predict maximum deformation or max. load it can withstand, and stress distribution[3].

Studied models of RC columns considering axial symmetric and eccentric loads. Nonlinear FEM analysis was used to analyse failure mechanism of RC columns. RC column subjected to the axial symmetric loading, are exactly same as modelled while considering the frequent use in the laboratory[4].

Provided an importance about the ductility and shear strength of the steel and also give the variation in shear strength and deformations with the different provision of transverse reinforcement[5].

Calculix and ANSYS software was used separately to predict the stress-strain behaviour of RC column. From the modelling point of view the author modelled concrete and steel part separately. An experiment was performed to validate the FEM model[6].

Reviewed and discussed about the performance of the composite column. It also emphases on the research activities done by various researchers on the composite column over the last ten years, which have impacted the use of composite column[7].

Focused area is beam-column joints, its behaviour and support conditions are of interest. Various authors analysed beam-column joints of RC frames with weak columns, poor anchorage of longitudinal beam bars and with inadequate transverse reinforcement. They come to final conclusion that the behaviour of exterior beam column joint is different than the corner beam column joint[8].

For the propagation of crack patterns in RC beams a FEM beam model is analysed using ANSYS software instead of doing numerical simulation and experimental tests. Using FEM model they studied from initial cracking to failure of the beam[9].

FEM analysis methodology

i. Phase-1: First we create the geometry or modelling of RCC column in ANSYS 15. ii. Phase-2: Assigning the material properties for the RC column as per design. iii. Phase-3: Assigning concrete material properties with various properties such as Young's modulus, Poisson ratio and density of concrete. iv. Phase-4: Generating element meshing as per geometry of the column. v. Phase-5: Applying boundary conditions such as fixed at one end for buckling analysis as per model specification. vi. Phase-6: Applied axial and eccentric load on the top of the column. vii. Phase-7: Meshing is created differently for concrete and steel. viii. Phase-8: Generation of solution for different parameters like total deformation, directional deformation etc.

Detail of RCC column: The reinforced column having cross section 300mm both side and height of 1500mm reinforced with 4-12mm bars with 6mm stirrups at 120mm spacing and concrete is of M 25 grade. Cover of 25mm is provided in all sides.

Material properties: The grade of reinforcement bar model was Fe415, Elastic modulus was 2×10^5 MPa and Poison ratio 0.3, whereas selected concrete grade was M25, with its elastic modulus was 25000 MPa and Poison's ratio of 0.15.

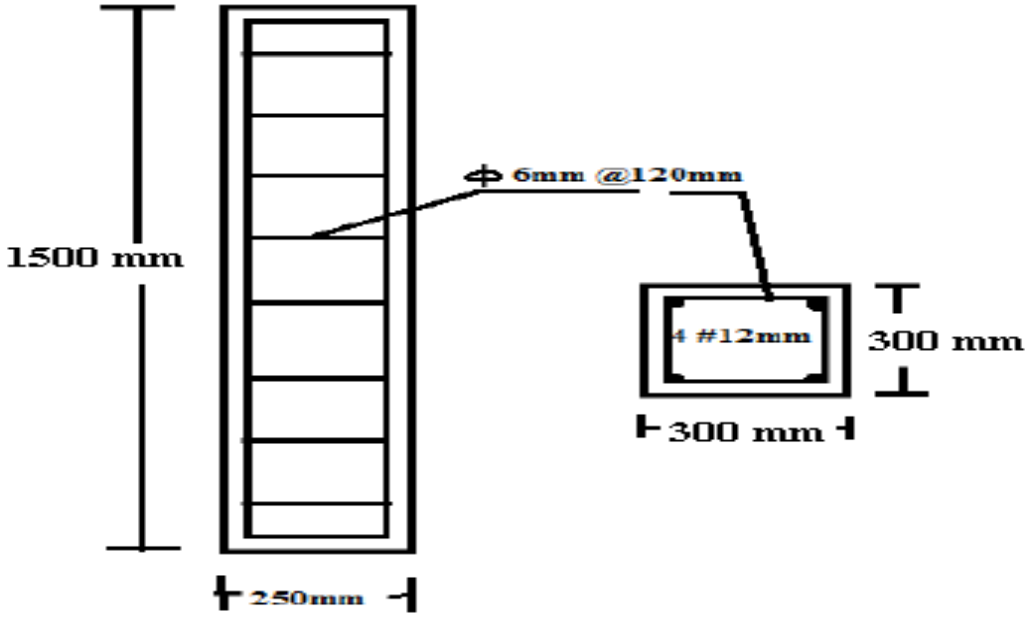


Figure-1: Details of RCC column.

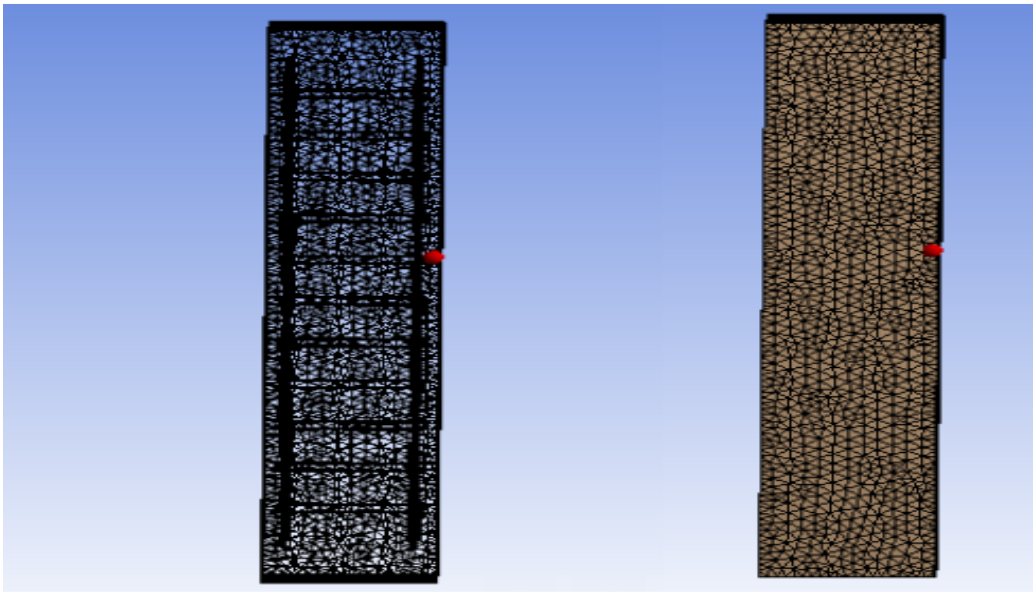


Figure-2: Mesh model of column.

Results and discussion

When we talk almost a displacement the first thing in our mind that displacement is a degree to which a structural element is displaced under an applied load. The body get disturbed or displaced in relation to angle or a distance. Simply the deflection is also analysed in relation of the slope of a body under applied load. The deviation of displacement according to the load is clearly observed in the below table and graph.

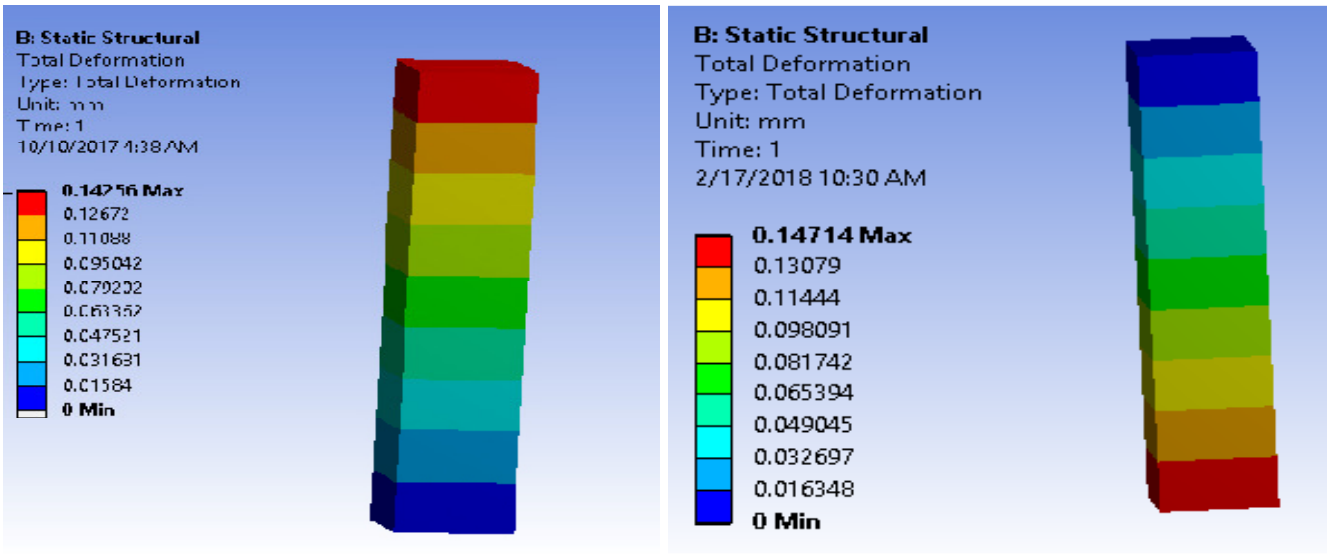
Table-1: Deformation for column model in non-linear analysis.

Load (KN)	Steel Column Deformation (mm)	Bamboo Column Deformation (mm)
25 x 10^3	0.14256	0.14714

Basically we analyse stress intensity because it is required according to different application to find out the peak stresses near the tip of a crack caused by an applied load or any residual stresses. This concept is beneficial or applicable to various materials whether it is homogeneous or linear elastic material and as it is useful for providing failure criteria for brittle materials. Figure-4 shows the peak stress near the supports. So it is clearly observed in Figure-4.

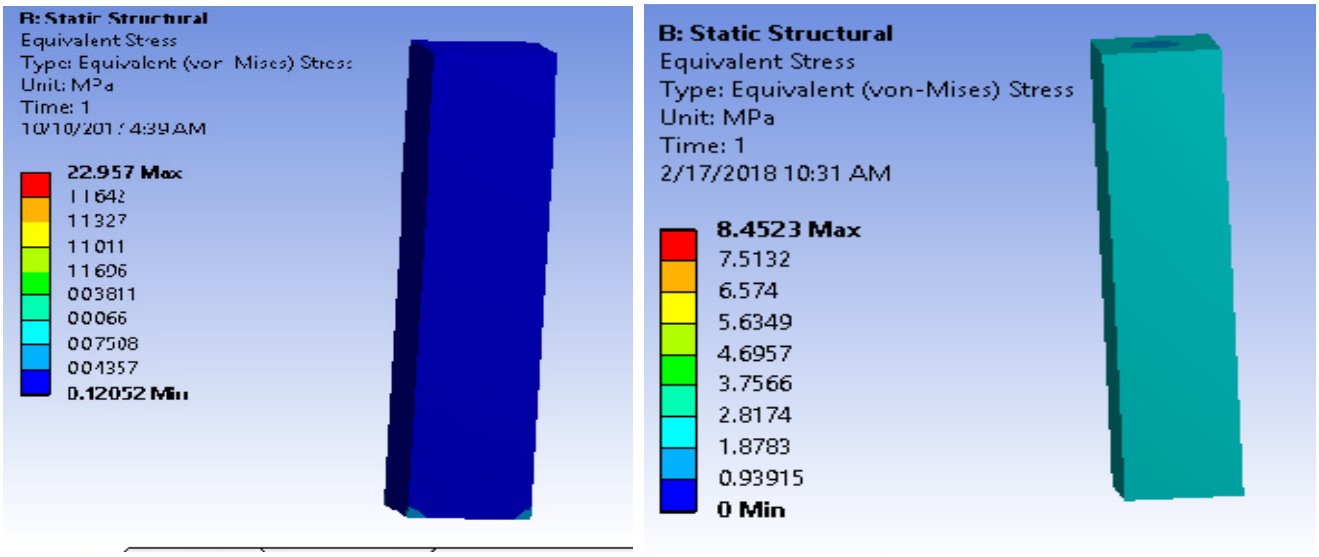
Table-2: Stress for column model in non-linear analysis.

Load (KN)	Steel Column	Bamboo Column
25 x 10^3	22.95 MPa	8..45 MPa



(a) (b)

Figure-3: Deformation for column model in non-linear analysis.



(a) (b)

Figure-4: Stress for column model in non-linear analysis.

Conclusion

From achieving desired strength we have to increase the dimension or we have to consider the specification of bamboo RC column when we compare it with steel reinforced column. This study suggest us that it can be utilized as reinforcement in structures having low rise and low cost structures because of the fact that it has good load carrying capacity as compared to steel RC column. However the bamboo RC column shows identical load- deformation and compression stress-strain curve as of steel RC column. Hence failure mechanism of bamboo reinforced column is same like that cracks along the length as in steel RC column.

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