International Journal of Research in Engineering, Science and Management
Volume-3, Issue-8, August-2020
journals.resaim.com/ijresm | ISSN (Online): 2581-5792 | RESAIM Publishing

Impact Load Analysis of Innovative Hollow Corrugated Members

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***Abstract*: As we know conventional building materials are very costly and having huge mass in nature this leads to invention of economical, light weighted hollow members. As the technologies developed day by day improvements on hollow members leads to the idea of providing corrugations on these hollow members so as to increase the load carrying capacity and durability of these members. In my project I'm put forwarding some innovative models like, internally stiffened diamond type model, externally stiffened corner type model, externally stiffened middle type model, internally and externally stiffened corner type mode, internally and externally stiffened middle type model. After modeling, primary analyzing is done by ANSYS software to achieve the maximum axial load withstanding model, then secondary analysis is done. Here I'm colliding a load to the member to get the impact characteristics of the member using ANSYS software.**

***Keywords*: Axial load, Hollow corrugated member, Impact load.**

1. Introduction

The extensive use of thin-walled steel structural systems in the building and construction industry is mostly indebted for their high strength to weight ratio attributes and remarkable fabrication versatility. Corrugated plates fallen in this category, also have a wide range of application in various engineering fields. They are lightweight, economical, and have much higher load carrying capacities than flat plates, which ensure their popularity and have attracted research interest since they were introduced. The corrugation shape provides continuous stiffening which permits the use of thinner plates. A corrugated plate can easily be bent in one direction, whereas it retains its rigidity in the other direction. Fabrication costs for elements with corrugated panels are normally lower than those with stiffened plates.

Any type of structure under static or dynamic conditions can be evaluated by using ANSYS. ANSYS is the leading design software in the present engineering society. The ANSYS stands for extended three-dimensional analysis of building systems. designing of reinforced concrete structure.

ANSYS is the better choice than STAAD pro and E-tab because of simplicity of software. Main advantage of this software is fast generation of models by the similar storey concept. Static analysis of structure means analysis of structure.

2. Innovative Hollow Corrugative Members

The study of hollow corrugated members starts in early 1990s but here I'm introducing some of the new models of hollow corrugated members with stifferners.

3. Analytical Study

Analytical study of hollow corrugated members is done with the help of ANSYS Workbench 16.1 Software. It is used to find the best cross section which suits for axial and impact load characteristics.

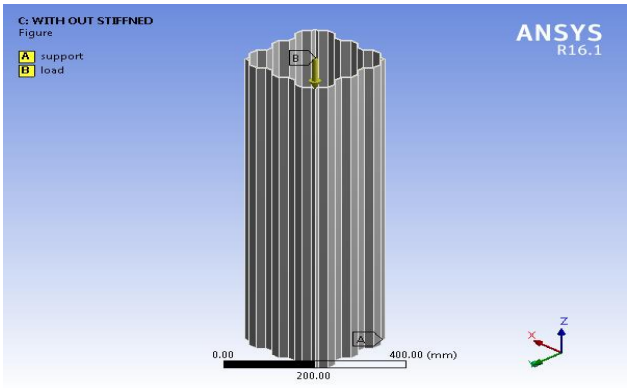

Fig. 1. Modal diagram of hollow corrugated member developed from ANSYS

Cross section of Hollow Corrugated Members is changed one after other and obtained the values of Total deformation, equivalent stress, strain, force reaction etc. under axial loading continues up to the failure of members. The comparison showing the graph of different cross section is as below.

The most viable cross section under axial loading up to failure of the model and impact loading up to failure of the model. The various models are

- Non stiffened H.C.M

- Internally stiffened H.C.M
- Externally stiffened H.C.M- corner type model
- Externally stiffened H.C.M- middle type model
- Internally and externally stiffened H.C.M - corner type model
- Internally and externally stiffened H.C.M - middle type model

These various models are analysed by Displacement control method in ANSYS software under axial load and impact load of 1000 Kg mass acting on 2.2 meters away from one side of hollow corrugated member coming with a 6.5 m/s velocity.

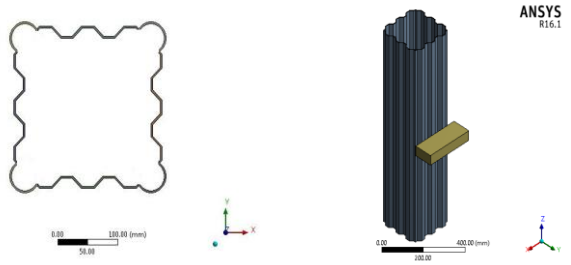

Fig. 2. Model and Impact Load diagram of Non stiffened H.C.M

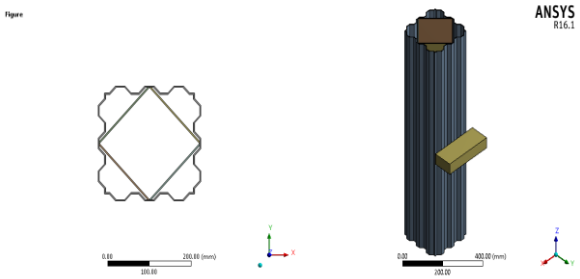

Fig. 3. Model and Impact Load diagram of Internally stiffened H.C.M – Diamond type

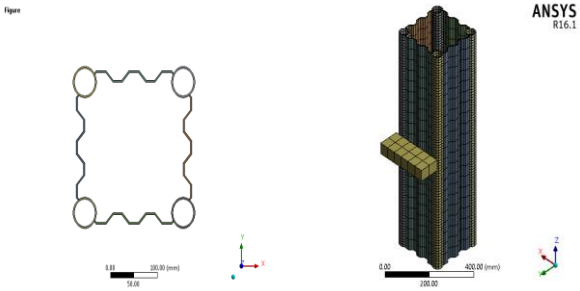

Fig. 4. Model and Impact Load diagram of Externally stiffened H.C.M - Corner type

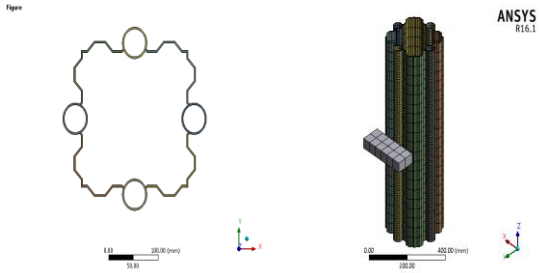

Fig. 5. Model and Impact Load diagram of Externally stiffened H.C.M - Middle type

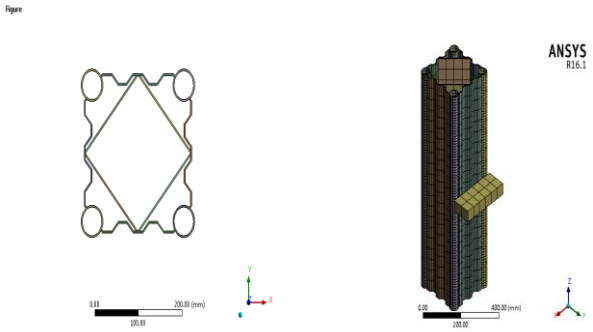

Fig. 6. Model and Impact Load diagram of Internally and Externally stiffened H.C.M -Corner type

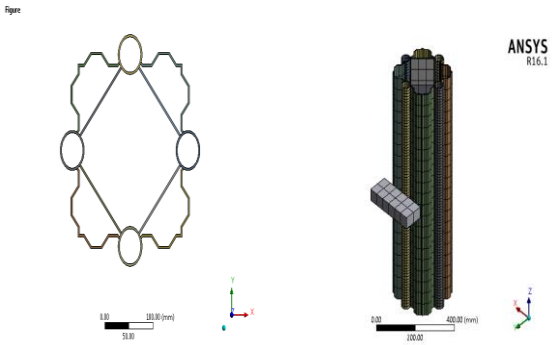

Fig. 7. Model and Impact Load diagram of Internally and Externally stiffened H.C.M – Middle type

After conducting the experiment in various models using software obtained the total deformations by both Axial Load and Impact Load analysis. The comparison study of various patterns can be expressed by the table and figures below.

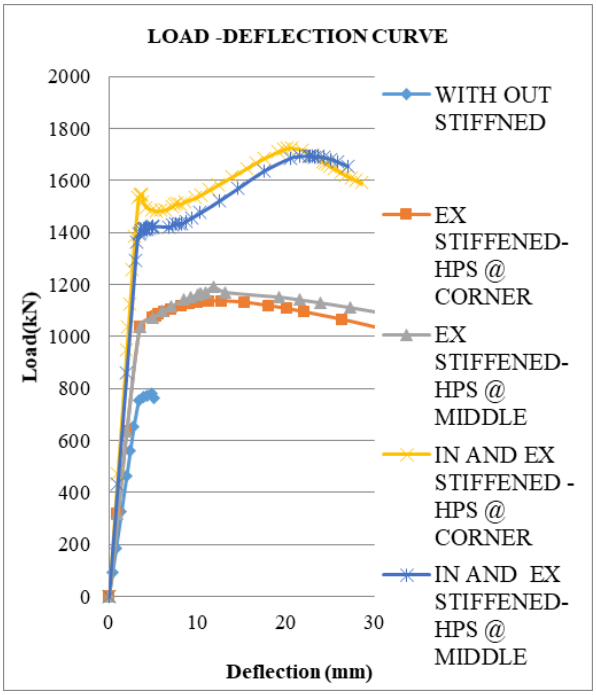

Fig. 8. Comparison Graph of Force V/S Deformation of various cross sections under Axial Loading

From the Fig. 8 it is clear that hollow corrugated member with internally and externally stiffened at corner and middle has less deformation compared to all other sections, under axial loading up to failure.

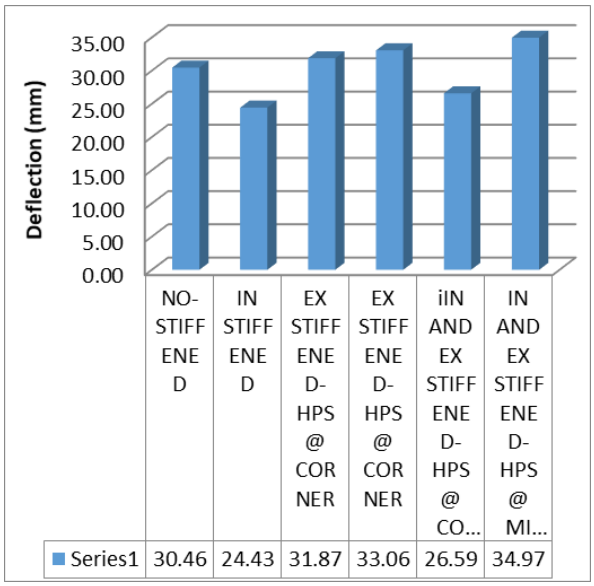

Fig. 9. Comparison chart of deformation of various models under impact loading

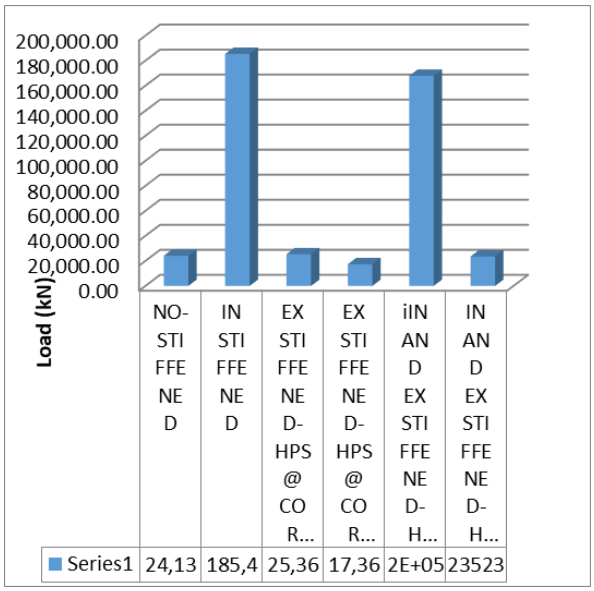

Fig. 10. Comparison chart of load for various models under Impact Loading up to failure

From Fig. 9, under Impact loading on all models it is clear that diamond type H.C.M and internally and externally stiffened corner type H.C.M has less deformation compared to other models.

From Fig. 10, under Impact loading on all models it is clear that diamond type H.C.M and internally and externally stiffened corner type H.C.M withstands maximum load

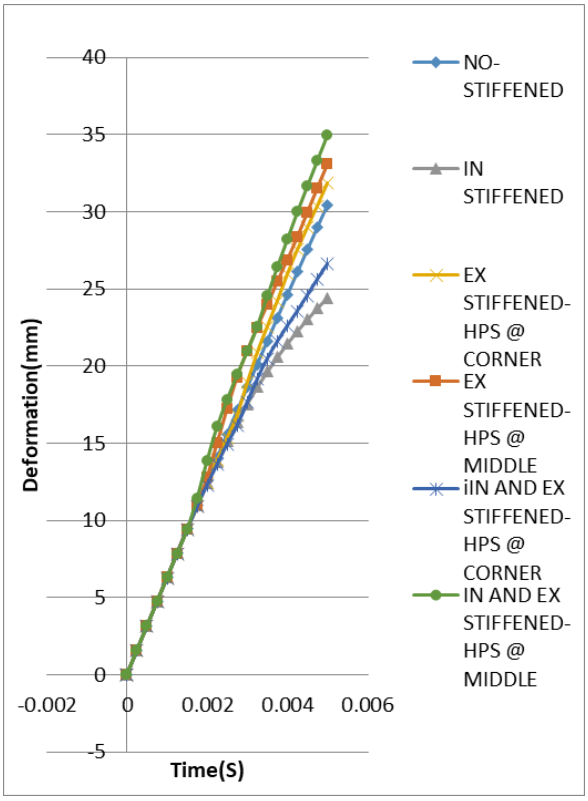

Fig. 11. Comparison graph of displacement of various cases

From Fig. 11, Impact load is provided in terms of velocity as I mention above, hence deformation is compared in terms of time. here at minimum time model like internally and externally stiffened H.C.M at corner and diamond stiffened H.C.M have lower deformation.

4. Conclusion

From the research conducted above it is clear that the most apt model for hollow corrugated member is internally and externally stiffened-corner type model and internally stiffened-diamond type model. Considering the present economic scenario it is better to adopt hollow corrugated members for construction than conventional construction members.

5. Future Scope

Further researches can be conducted in order to find other various shapes of hollow corrugated members with many useful performances in construction field comparing to the conventional hollow corrugated members.

Acknowledgement

The kind permission to publish this work is highly acknowledged. I thank all the authors of reviewed papers for their indirect support of knowledge. The support providing during the project work by Ms. Geethika G. Pillai, Assistant Professor, Indira Gandhi Institute of Engineering and Technology, Kothamangalam is gratefully acknowledged. I

also thank my mother and my family members for their patience and cooperation without which this paper may not have come out at an expected way.

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