

# RETROFITTING OF HOT-ROLLED STEEL CHANNELS USING CFS SECTIONS SUBJECTED TO IMPACT LOADING

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**Abstract** - Errors in load calculations, excess capacity due to excise diversions, illegal increase in the number of floors in a building and material deterioration can lead to structure failure. Studies have been carried on retrofitting of structural steel beams has mainly focused only the adoption of Carbon Fiber Reinforced Polymer (CFRP). CFRP laminates have very low compressive strength under flexural loading. The part of a modern cross-section above the neutral axis is subjected to compressive stress and fails. In such situations, the use of CFRP laminates may not be efficient; therefore, we need to use alternative materials. Cold formed steel (CFS) has shown satisfactory performance in light and fast structures. The main objective of the project is to carry out performance impact load studies, performance studies of various material properties used for retrofitting. The result obtained that the flat plate CFS section is a more impact resistant structure than the corrugated plate CFS section. By using different materials in retrofitting steel has high force value. The maximum force value is about 484.27 N and corresponding stress value is 639.88 MPa.

**Keywords:** Aluminium, corrugated sheet, retrofitting, steel.

## 1. INTRODUCTION

### 1.1 General Background

Numerical analyzes were performed to study the impact load resistance of the HRS section optimization with CFS sections of different sizes. Failure of a structure occurs when it completely or partially loses its ability to support the load acting on it. Given the prevailing design deficiencies as well as poor performance due to poor construction practices, there is a need for appropriate retrofit measures to ensure structural safety.

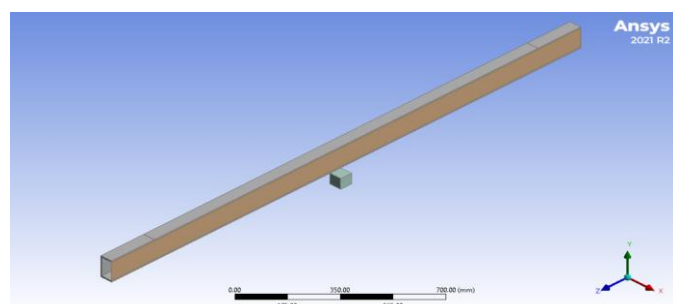


Fig -1: Geometry of plane sheet CFS section

## 2. OBJECTIVES

The main objectives are,

1. To study the impact load confrontation of retrofitting HRS section with different shaped CFS section.
2. To evaluate the Performance of different material properties used for retrofitting

### 2.1 To study the impact load resistance of retrofitting HRS section with different shaped CFS section.

HRS sections into closed sections (box type) by conveniently connecting CFS sections near the flange tips of the HRS channels and retrofitting the HRS channel beams. Modeling was done using ANSYS software. Here plane sheet CFS sections and corrugated sheet CFS sections are made.

Table-1: Material properties

Material	Fy (MPa)	Fu (MPa)	E (GPa)
HRS	325.7	447.6	197.2
CFS	421.3	542.1	202.4

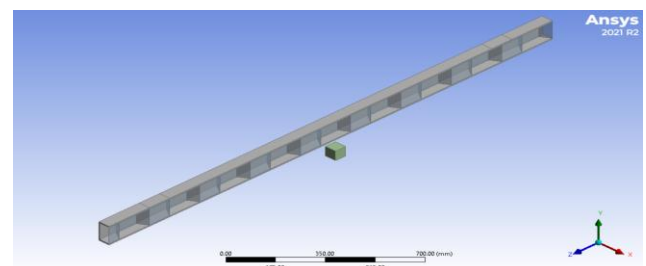


Fig -2: Geometry of corrugated CFS sections

Assembly was done according to the requirements of traditional classes. The boundary condition was set in such a way that a perpendicular load was applied at the midpoint of the CFS sections. In addition, large deformations and out-of-plane dislocations are considered in the modeling.

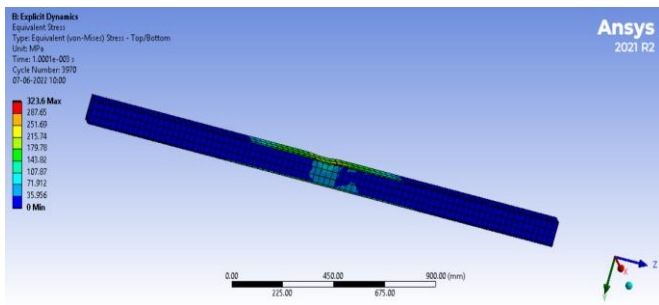


Fig -3: Equivalent stress of plane sheet CFS section

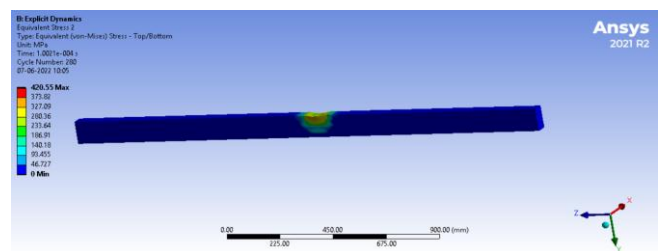


Fig -4: Equivalent stress of corrugated CFS section

Table-2: Result obtained

TYPE OF SECTION	EQUIVALENT STRESS (MPa)
plane sheet CFS section	323.6
corrugated sheet CFS section	420.55

2.2 To evaluate the performance of different material properties used for retrofitting

The material properties such as young's modulus is about 71000MPa, Poisson's ratio is 0.33, Bulk modulus is 69608 MPa, and compressive yield strength is 280 MPa.

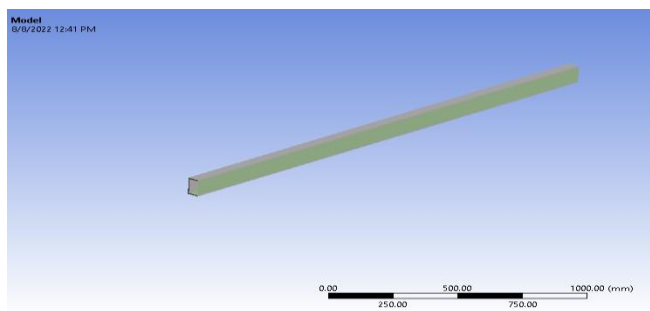


Fig -5: Geometry of retrofitting using aluminum

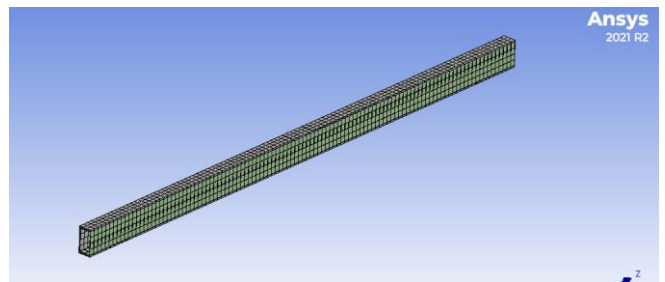


Fig -6: Mesh generated in retrofitting using aluminum

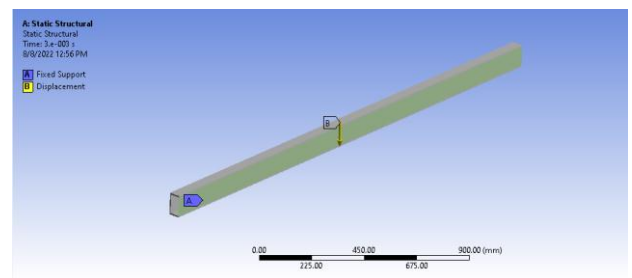


Fig -7: Boundary conditions in retrofitting using aluminum

The load was applied on the center portion. Here a displacement of 30 mm was applied.

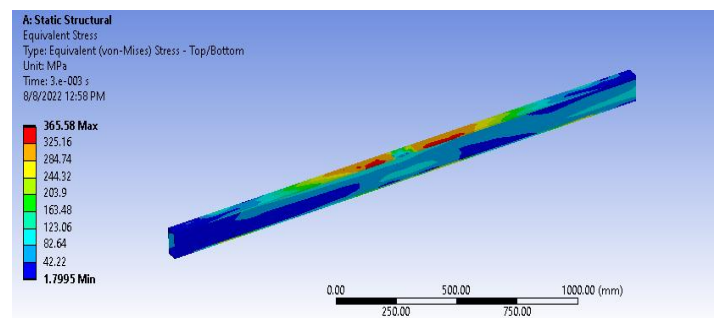


Fig -8: Equivalent stress obtained from aluminum retrofitting

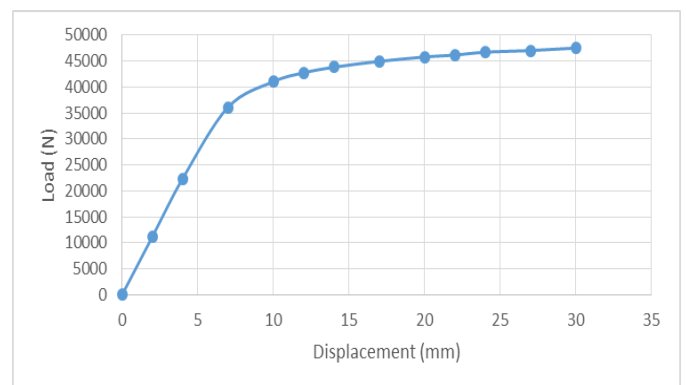


Chart-1: Load displacement graph

Retrofitting using steel

The material properties such as young’s modulus is about  $2e+05$  MPa, Poisson’s ratio is 0.33, Shear modulus 76923 MPa, and compressive yield strength is 250 MPa.

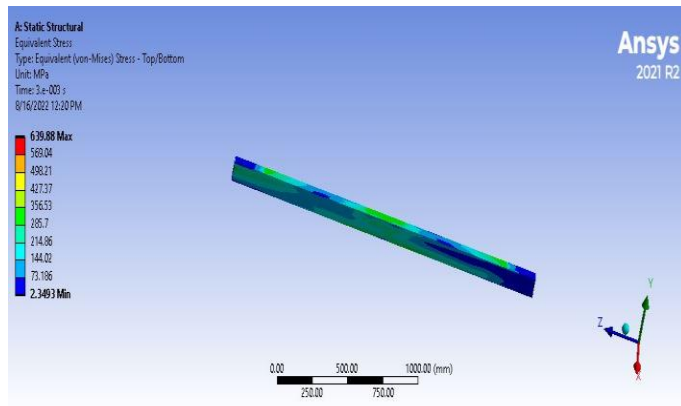


Fig - 9: Equivalent stress obtained from steel retrofitting

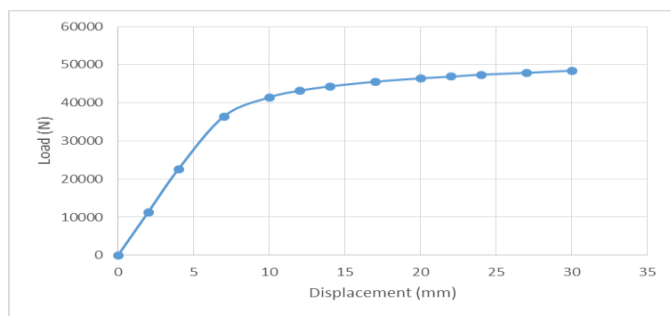


Chart- 2: Load displacement graph

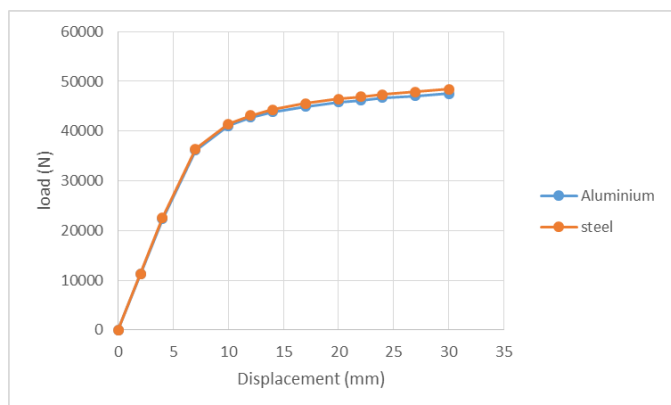


Chart- 3: Combination graph of aluminum and steel

Table-3: Result obtained

TYPE OF SECTION	EQUIVALENT STRESS (MPa)
Section with aluminum	365.58
Section with steel	639.88

3. CONCLUSIONS

The result obtained that the flat plate CFS section is a more impact resistant structure than the corrugated plate CFS section. A plain sheet CFS section is a more impact resistant structure than a corrugated sheet CFS section. By using different materials in retrofitting steel has high force value. The maximum force value is about 484.27 N and corresponding stress value is 639.88 MPa.

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