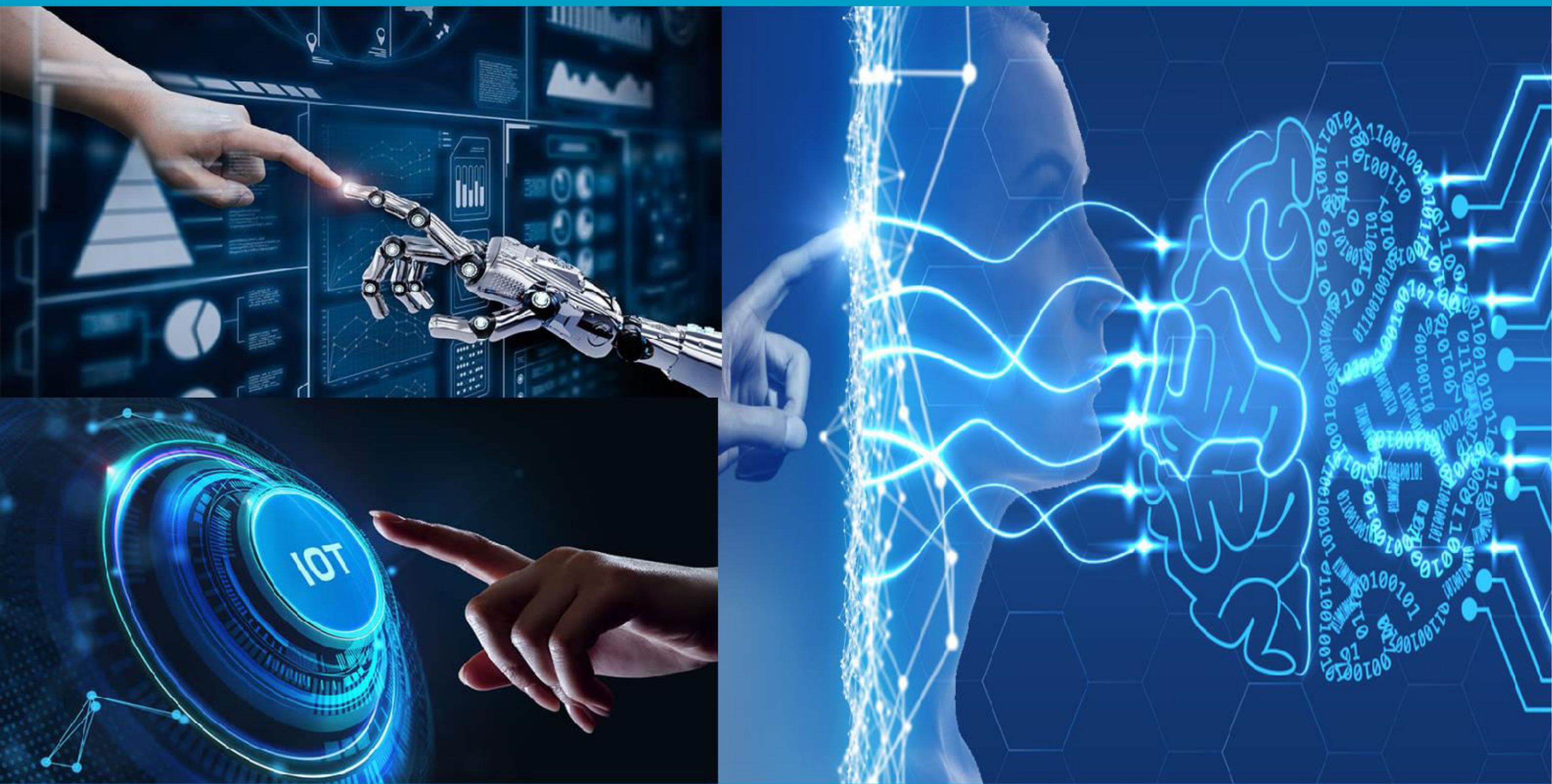
IJMRSETM

e-ISSN: 2395 - 7639



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

Volume 10, Issue 6, June 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.580

International Journal of Multidisciplinary Research in Science, Engineering, Technology & Management (IJMRSETM)

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580| A Monthly Double-Blind Peer Reviewed Journal |

| Volume 10, Issue 6, June 2023 |

Analytical and Experimental Techniques to Determine the Most Effective Method for Performance of CFS Composite Beams

Mukesh Kumar, Abhishek Sharma

Structural Engineering, CBS Group of Institutions, Jhajjar, India

A.P Civil Dept., CBS Group of Institutions, Jhajjar, India

ABSTRACT : As part of a new initiative to solve the instability caused by the use of thin-walled cold-formed steel, research and development are underway on FRP and other cutting-edge types of packaging material. The goal of this study is to learn more about the flexural behavior of screw-fastened, rectangular compression-flanged composite I-beams. Buckling in the compression flange lip is significantly affected by the suggested screw spacing for the Screw Fastened Rectangular Compression Flange CFS composite I-beam. Reducing the screw spacing brought the screws closer together, preventing the lip from buckling under the load. Unlike when packing material was used, which prevented lateral global buckling in the shear zone of specimen 2 (with a decreased screw spacing), packing material was not used in this experiment. Local web buckling and bearing failure were observed at the loading sites. This specimen-2 was discovered to be distorted in all four potential orientations inside the flexural zone. The data indicates that the component broke due to flange distortion and lateral buckling before the yield load was attained. The buckling in the side caused this to take place. This means that its potential is not being fully exploited. The weft material in specimen 3 (a fiberglass reinforced plastic) allowed the web to support heavier loads before giving. The severity of the beam's lateral global buckling was greatly mitigated by the use of FRP reinforcements at both the top and bottom of the compression flange. Specimen 4 showed the greatest improvement in load bearing, with a 156% increase compared to the previous specimen. The beam was rigid and could not be bent in any way. There was very nothing to signal that things were beginning to unravel on a global or even a regional scale. Power that would otherwise be lost owing to the brittle nature of cold-rolled fine-walled steel might be collected using the cold-formed and FRP composite components. Cold formed and FRP composite components provide this benefit.

KEYWORDS: CFS composite beams, fiberglass reinforced plastic, CFS buckling, PVC, Local Bending

I. INTRODUCTION

Cold-formed steel is a terrific option that has the potential to improve steel use, speed up the building process, and reduce waste. Multiple building materials, including hot rolled steel, have been used to evaluate CFS's superior strength-to-weight ratio. For instance, although hot-rolled steel is restricted in section, cold-formed steel might benefit from automated welding to provide a far wider range of useful sections. In comparison, hot-rolled steel has a much smaller usable cross section. Cold-formed light gauge steel has many applications, but it has the potential to buckle quickly and fail. As a result, there is a pressing need for the development of such a method to aid in preventing such early buckling in CFS by using adequate packing material with CFS, especially in critical zones of the section. To prevent or postpone buckling failure in CFS, this would let the segment to almost achieve its maximum load failure capability.

The issue of CFS buckling may be addressed with the use of cold-formed steel and carbon fiber polymer parts. These parts are easy on the pocketbook and easy on the body. To this time, only wood, hard cardboard, sand, and PVC have been utilized. The adoption of these novel materials has resulted in a slight improvement in the performance and buckling resistance of certain parts of the CFS. In order to fully take use of the strength of CFS, which is more than in cold form steel sections owing to its higher yield strength, a composite section made of carbon fibre polymer sheets and cold form steel is used. Man-made materials, such as carbon fiber polymer sheets, may have their characteristics altered to meet a wide range of needs. The I-section has been considered the gold standard of flexure sections since ancient times. Standard cold-formed steel's load-bearing capacity and structural efficiency have been vastly enhanced by the incorporation of wood planks securely fastened to lipped I-section flanges. We combine a rectangular tubular

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580| A Monthly Double-Blind Peer Reviewed Journal |

| Volume 10, Issue 6, June 2023 |

compression flange with a fiber-reinforced polymer to create a composite section for cold-formed sections, which is the core focus of our research. The potential for these segments to reduce buckling and improve structural performance is exciting.

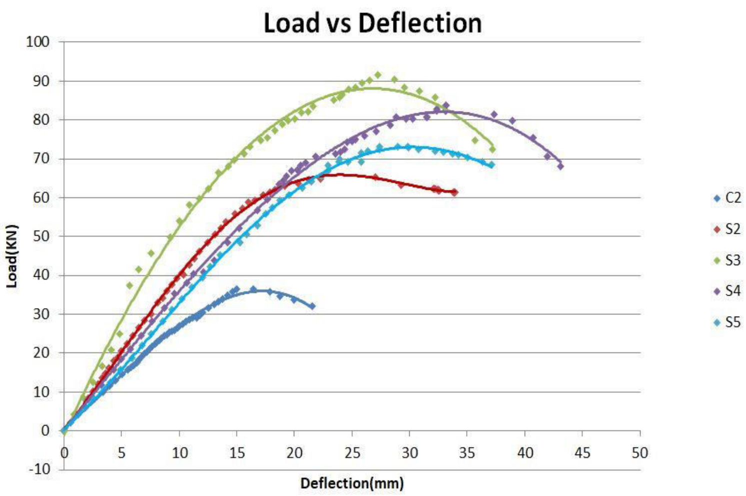
II. INTERPRETATION

The following table presents specimens together with information on their maximum load capacity as well as their weight. In addition to that, the table determines specific values that are desired.

Table 1: Specimen'sself-weight and maximum load

SPECIMEN	FINAL LOAD- (KN)	WEIGHT (kg)	STRENGTH/ WEIGHT (KN/KG)	% INCREASE IN ULTIMATE LOAD
C2	35.765	25.36	1.41	0
S2	65.313	34.56	2.65	87.94
S3	91.56	30.43	2.146	52.19
S4	83.793	32.674	2.568	82.1276
S5	73.23	28.64	2.56	81.56

The load-deflection patterns of specimens 2-6 are shown in comparison in Figure 1. Figure-2 depicts the specimen 2-6's ultimate load capacity in the form of a bar graph. Fig. 2 shows the increase in ultimate capacity as a percentage above that of the control beam. Each specimen's strength to weight ratio is shown in Figure 4.



.

Figure 1: load vs deflection curve of all specimens

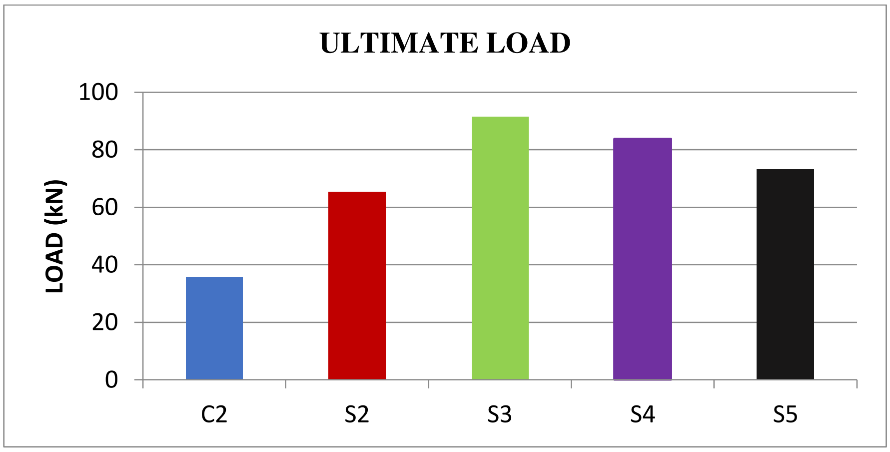


Figure 2: ultimate load bar chart

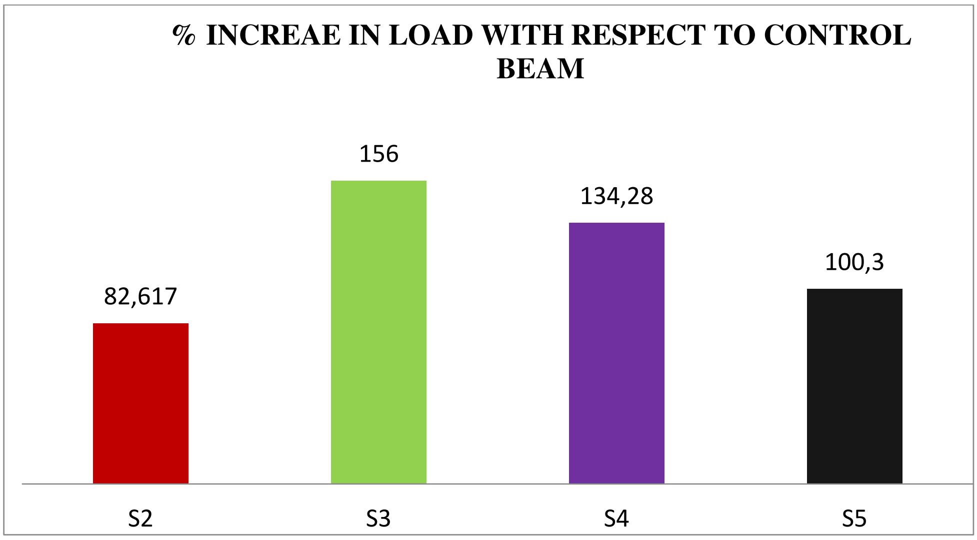


Figure 3: Percentage increase in ultimate load

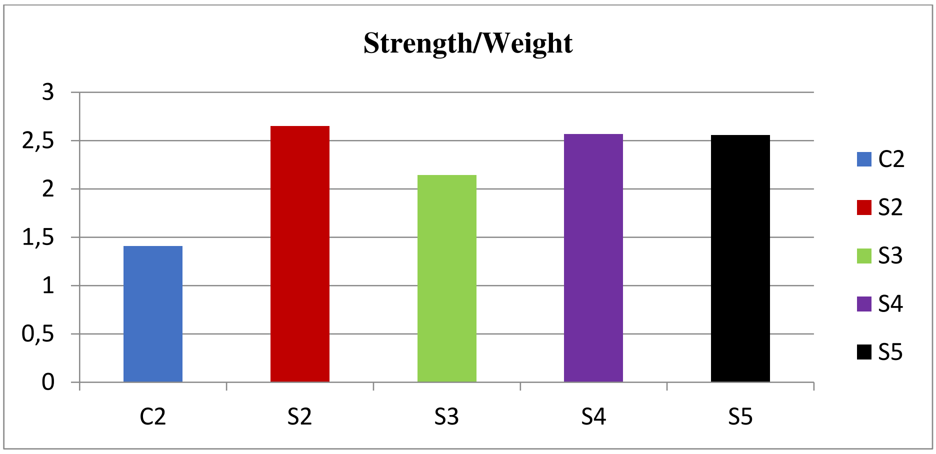


Figure 4: Strength/weight ratio

III. CONCLUSIONS

New initiatives are underway to create FRP and other cutting-edge packaging materials to address the instability posed by thin-walled cold-formed steel. This research looks at how composite I-beams with rectangular compression flanges and screws for fastening behave under flexure. When all the data is in, it's possible to draw the following conclusions:

- The degree of buckling in the compression flange lip is significantly affected by the proposed Screw Fastened Rectangular Compression Flange CFS composite I-beam screw spacing. The force applied to the lip did not cause it to collapse because the screws were spaced more closely together.
- Unlike when packing material was employed, lateral global buckling was seen in the shear zone of specimen 2 (with a decreased screw spacing). Local web buckling and bearing failure were found at the loading locations.
- This specimen-2 was found to be deformed along all four axes of the flexural zone.
- The evidence shows that the component broke due to flange distortion and lateral buckling before the yield stress was reached. This is preventing it from reaching its full potential.
- The use of fiberglass reinforced plastic (FRP) as the weft material in specimen 3 allowed the web to support greater loads before buckling. FRP reinforcements at the top and bottom of the compression flange mitigated the beam's lateral global buckling.
- A battery of tests revealed that FRP stops cold form steel from buckling before the steel can buckle, preventing costly repairs. Tests were conducted using specimen 3. As a result, the compression flange depth in specimen 4 was raised to 30 mm, and the thickness of the FRP web was increased from 10 mm to 20 mm.
- Specimen 4 showed no signs of a local web buckling. The flange was also protected so that it wouldn't become distorted.
- The specimen 4's final capacity was significantly increased by having it filled with FRP.

REFERENCES

1. Ayoub, A., & Chaallal, O. (2018). Experimental investigation of composite beams with cold-formed steel decks. Journal of Constructional Steel Research, 147, 182-193. doi:10.1016/j.jcsr.2018.03.014
2. Chen, S. L., & Peköz, T. (2017). Experimental behavior and design of composite cold-formed steel-concrete beams. Engineering Structures, 145, 1-13. doi:10.1016/j.engstruct.2017.04.014
3. Hu, X., & Peköz, T. (2019). Analytical study of composite cold-formed steel-concrete beams with shear connectors. Journal of Structural Engineering, 145(3), 04018225. doi:10.1061/(asce)st.1943-541x.0002182
4. Li, M., & Gao, Z. (2020). Experimental investigation on flexural behavior of cold-formed steel-concrete composite beams. Journal of Structural Engineering, 146(7), 04020093. doi:10.1061/(asce)st.1943-541x.0002702
5. Ma, W., & Uy, B. (2018). Experimental and analytical investigation of cold-formed steel beams with partial shear connection. Journal of Constructional Steel Research, 149, 39-54. doi:10.1016/j.jcsr.2018.05.012
6. Ma, W., Uy, B., & Tao, Z. (2019). Analytical study of cold-formed steel beams with different shear connection methods. Journal of Constructional Steel Research, 157, 307-323. doi:10.1016/j.jcsr.2019.01.036
7. Qu, Z., & Yu, W. (2019). Experimental and numerical study on cold-formed steel-concrete composite beams with various shear connectors. Journal of Constructional Steel Research, 161, 272-286. doi:10.1016/j.jcsr.2019.06.003
8. Tao, Z., Uy, B., & Oehlers, D. (2017). Behaviour of cold-formed steel-concrete composite beams with novel profiled steel sheeting. Journal of Constructional Steel Research, 132, 102-118. doi:10.1016/j.jcsr.2017.01.006
9. Uy, B., Tao, Z., & Oehlers, D. (2016). Experimental study of cold-formed steel-concrete composite beams with novel profiled steel sheeting. Journal of Constructional Steel Research, 126, 109-125. doi:10.1016/j.jcsr.2016.08.004
10. Yang, Y., & Chung, K. F. (2021). Performance evaluation of cold-formed steel beams with various types of shear connectors. Journal of Structural Engineering, 147(10), 04021123. doi:10.1061/(asce)st.1943-541x.0003180

INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 7.580

crossref

NISCAIR

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

+91 99405 72462 +91 63819 07438 ijmrsetm@gmail.com