STRUCTURAL BEHAVIOUR OF COMPOSITE I-BEAMS WITH PLYWOOD AND GI SHEET

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ABSTRACT-Plywood is artificially processed natural material, is generally used for furniture, doors, Shuttering works. It has dimensional stability and equal strength properties in both planers directions as compared to wood. Considering strength properties of plywood, there is scope for its utilization in structural application. In developed countries like Brazil, Canada, Australia, plywood has been used for various structures like, roof beam systems, frames, floors etc. To improve the strength properties of plywood further, it can be used as composite material along with Galvanized Iron (GI) sheet. GI sheets as facing material will improve strength properties, durability against fire resistance, decay, moisture and insects attack. Such composite materials will be light weight, sufficiently strong, economical, easy to manufacture and therefore is proposed to be used as a structural member in light weight, temporary, semi-permanent or emergency structures. Design of simply supported beam having I-section, made from such composite plates will be done. The strength capacity performance and mode of failure of such beams will be observed by conducting experimental work.

KEYWORDS-Boiling Water Proof Plywood (BWP), Galvanized Iron Sheet (GI Sheet), I-section, Global buckling, Local buckling, flexural behavior.

I. INTRODUCTION

Plywood is often named as the first from the group of products which are known as engineered wood at the present. It was the first material that consists of disintegrated wood particles in order to create larger and solid composite units, firmer, and tougher than the sum of the values of their parts. Till now many experiments are carried out on various light weight materials like wood, wood plastic composite, laminated composite to enhance their structural use. Plywood is one light weight material but mostly used in furniture works. Its structural use is very limited. Looking to its dimensional stability, equal strength property and high strength to weight ratio it can have various structural applications. Galvanized iron or steel is a building material of sheets of hot dip galvanized mild steel, cold rolled to produce a linear corrugated pattern in them. Corrugation increases the bending strength of the sheets in the direction perpendicular to the corrugations. G.I. sheets are light, strong, corrosion resistant, and easily transported. Even though there are many composites with plywood, there is lack of work regarding the composite member of plywood and Galvanized iron sheets. The dimensional stability, equal strength property and high strength to weight ratio of plywood and bending strength of Galvanized iron sheets can be composed together to get a stronger material than the conventional wood.

Composite sections provides following advantages over the conventional material:

i. High strength to weight ratio
ii. Light weight & easy to transport.
iii. GI-Sheet has high resistance to corrosion.
iv. Economical
v. Any desired shape of any length can be produced.

Composite sections has following disadvantages over other conventional material.

i. Low fire resistant.
ii. Connection of composite section could behave different at the time of failure.
iii. Delaminating of the section takes places at higher loads.

II. MATERIALS & METHODOLOGY

A. Materials

I. Plywood

Various grades of plywood are available in the market viz. Moisture Resistant (MR), Boiling Water resistant(BWR) and Boiling Water Proof(BWP) which is also called as marine plywood. In present study for preparation of specimen Boiling Water Proof (BWP) which is also called as marine plywood is used. Marine plywood conforms to IS 710-1976. This plywood is available in various thicknesses. For experimental work the thickness of plywood used is 18mm.

II. GI Sheet

Various thicknesses of GI sheet available are 0.2 mm, 0.5mm, 0.7mm, 1mm, 1.2mm, 1.5mm, 1.8mm, 2.2mm. Considering tensile strenght of GI as 300MPa and that of plywood as 40 MPa, if tensile strenght of GI is equal to tensile strenght of plywood,

thickness of GI sheet required for 12mm, 15mm, 18mm, 25mm are 0.8mm, 1mm, 1.2mm, 1.67mm respecively. GI sheet of 0.7 mm was found to be appropriate and hence it is used to make the member composite with plywood.

III. Nails

There are two types of nails used in the experiment. The one which are used for making composite section of plywood and GI sheet and bind them together, another type nails are used to attach web to the flange, these nails are designed as per the loading on the sample and do have structrural importance hence observation and study of these nails is also done.

B. Specimen Preparation

Figure 1 Composite I-Beam

The sample of only plywood beam and composite beam are prepared for this study. Composite members are prepared using boiling water proof plywood of 18mm thickness along with covering of GI sheet of 0.7mm thickness i.e.22 gauge. The connection of two members are carried out by the nails and adhesives for proper bonding. The plywood beam and the composite I-Beam section were prepared as shown the fig (1) and tested.

C. Experimnental Procedure

The testing of beams for deflection and other study are generally done for 3-point loading as shown in fig (2) and also 4-point loading as shown in fig (3). The test carried out on sample in this study is 4-point loading test over the composite beams and the plywood beams. The test results are studied and compared to observe the change in structural properties.

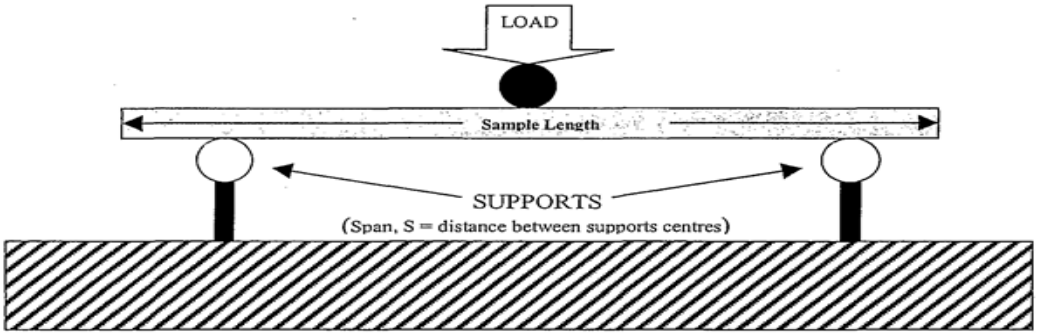

Figure 2 Three-Point Test Setup

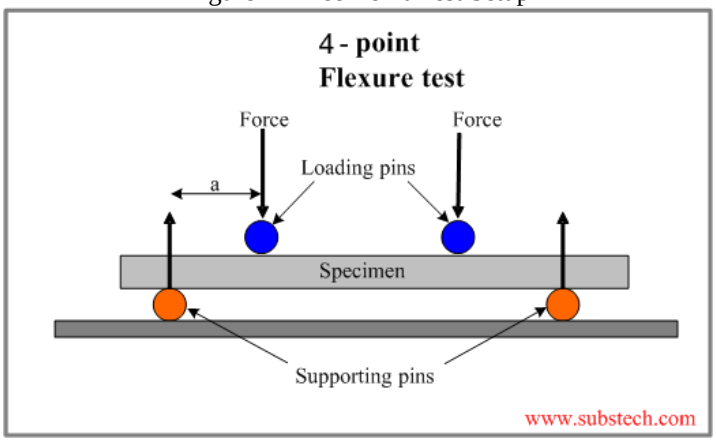

Figure 3 Four point loading

The pure bending results are obtained from the four point load test. The comparison of the test results of plywood beam and the composite beam is done and checked by the analytical values obtained from the design which are cross-checked with the experimental value to ensure the results obtained are safe.

III.RESULT AND DISCUSSION

A. Flexural Test Results

A 4-point load flexural test was performed on conventional plywood beam and also composite beam. The size of the beam taken was depth of beam as 200mm the flange width of 120mm and the thickness of web and flange as 18mm the dimensions were obtained from design of section as per IS and the tests were conducted over the section.

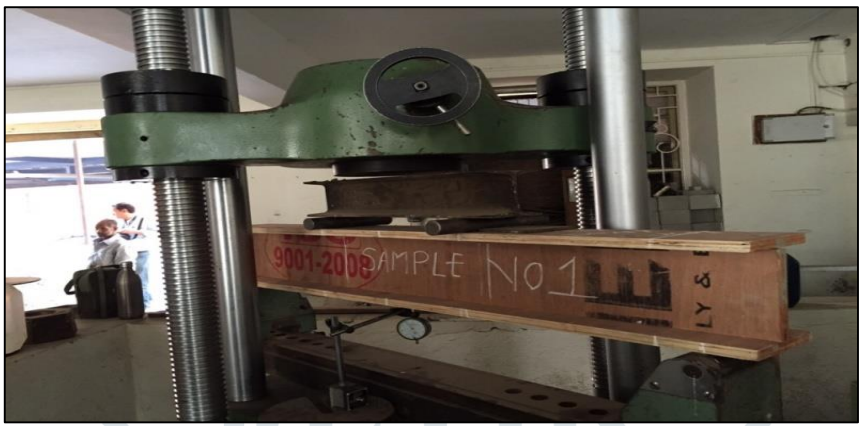

Figure 4 Four Point Load Test On Plywood Beam

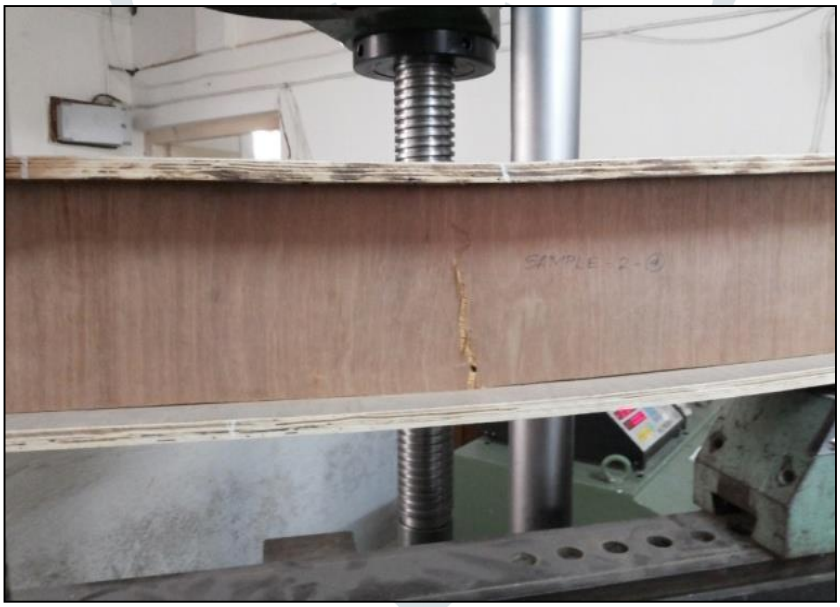

Figure 5 Vertical Crack Formation At Junction Of Web And Flange

Figure 6 Composite Beam Testing

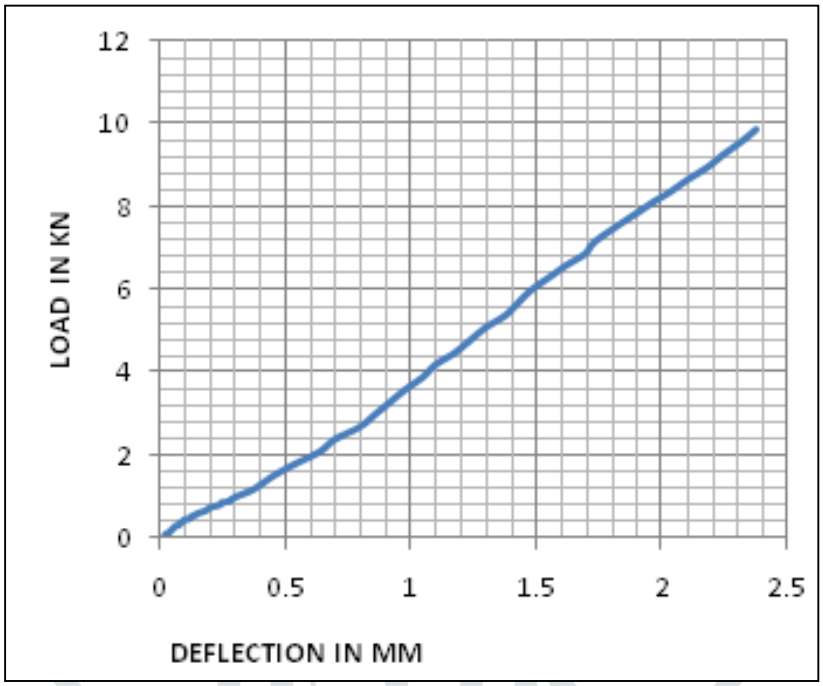

Figure 7 Graphical Representation Of Result Of Plywood Beam

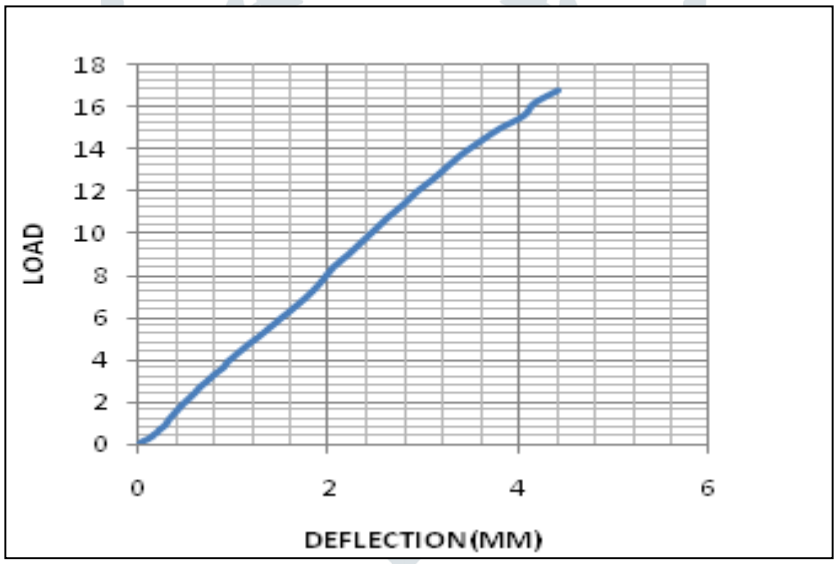

Figure 8 Graphical Representation Of Result Of Composite Beam

IV.CONCLUSION

From testing it was observed that the increase in load resisting capacity was increased by 80% after the application of GI sheet was made with plywood. The bending capacity also increased with the application of GI sheet over the section. The local failure i.e bearing failure, web buckling, delaminating of plywood fiber was converted to global failure i.e bending, lateral torsion buckling.

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