

# International Journal of Innovative Research in Science, Engineering and Technology

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## Experimental Investigation on Steel Concrete Composite Beam

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**ABSTRACT:** In this study, test on rcc beam with replacement of rebar were carried out to investigation the actual behavior and the load bearing capacity of such beams. Hollow tubes were chosen for the experimental procedure. The concrete motor filled was found to significantly improve the capacity by preventing local inward buckling in rebar. Several tests were conducted on different specimens and the impact of each material was studied on the structural behavior of these members under deflection for comparison purpose between the loads and the lateral displacements. The results showed that using hollow tubes with mortar filling instead of normal rcc will reduce the weight of beam. At the same time, a high load bearing capacity is achieved

**KEYWORDS:** Circular hollow tubes, motor filled, deflection, local inward buckling, strengthening.

### I. INTRODUCTION

The reinforcement in concrete plays a vital role in increasing its self – weight. In order to reduce that weight the reinforcement is replaced by hollow steel pipe filled with cement mortar. The hollow steel pipe is taken of required dimension according to the structure. The replaced composite reinforcement is used in normal conventional concrete of M20 grade and tested for its strength.

Concrete is the world's most used man-made construction material today. It is relatively cheap and easy to form when cast in India. The most common reinforcing material for Reinforced Concrete (RC) used until now and is still used today is steel. Using steel as reinforcement has numerous advantages; it is strong in tension and has a high modulus of elasticity. The thermal expansion is similar to concrete and it works well with concrete under loading. The production process for steel is very stable and thus the material properties are also very stable, then steel is easy to form and work with. But using steel as reinforcement has also some disadvantages; it can corrode with time and has low fire resistance. The price of steel has also been rising over the last few years. The main challenge for civil & structural engineers is to provide sustainable, environmental friendly and financially feasible structures to the society. The reinforcement in concrete plays a vital role in increasing its self – weight. In order to reduce that weight the reinforcement is replaced by hollow steel pipe filled with cement mortar. The hollow steel pipe is taken of required dimension according to the structure. The replaced composite reinforcement is used in normal conventional concrete of M20 grade and tested for its strength.

Reinforced concrete (RC) is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility. The reinforcement is usually, though not necessarily, steel reinforcing bars (rebar) and is usually embedded passively in the concrete before the concrete sets. Rebar also known as reinforcing steel, reinforcement steel, is a steel bar or mesh of steel wires used as a tension device in reinforced concrete and reinforced masonry structures to strengthen and hold the concrete. It is also employed to confer resistance to concentrated loads by providing enough localized resistance and stiffness for a load to spread through a wider area.

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## II. MATERIALS USED

The following specimens are used for tensile test by applying load for studying the behaviour of beam to determine bending load and deformation for various specimen given2 below:

1. Stainless Hollow tube - 2 specimens with different diameter
2. Mild steel Hollow tube - 2specimens with different diameter
3. Galvanized iron Hollow tube - 2 specimens with different diameter

Fig 1



Fig 2



## III. EXPERIMENTAL INVESTIGATION

### 3.1 SPECIMEN PREPARATION

The 1.6m span beam specimen is moulded. As per the design procedure 12mm & 16mm sample rebar and replacement hollow sections are filled with concrete mortar is taken. The concrete motor filled was found to significantly improve the capacity by preventing local inward buckling in rebar. Several tests were conducted on different specimens and the impact of each material was studied on the structural behaviour of these members under deflection for comparison purpose between the loads and the lateral displacements

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### 3.2 INSTRUMENTATION

All tests were conducted in universal testing machine of capacity 900kN. The experimental set up is shown in fig 5. The specimen were placed, centred and levelled. Linear voltage displacement transducers (LVDT) were used to observe the lateral deformation. The load was applied slowly and the specimen was tested to failure by applying the two point load in small increment at regular interval. The failure modes, lateral deformation and failure load were recorded up to its ultimate load.



Fig 3: Experimental setup

### IV. RESULT AND DISCUSSION

#### 4.1 FAILURE MODES

For every specimen initial cracks are obtained at the critical load. This get varied for each sample specimen. The following graph shows the total deflection in the beam form uniformly increasing loads.



Fig 4 initial crack

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### 4.2 Deflection graph for control beam of 12mm rebar

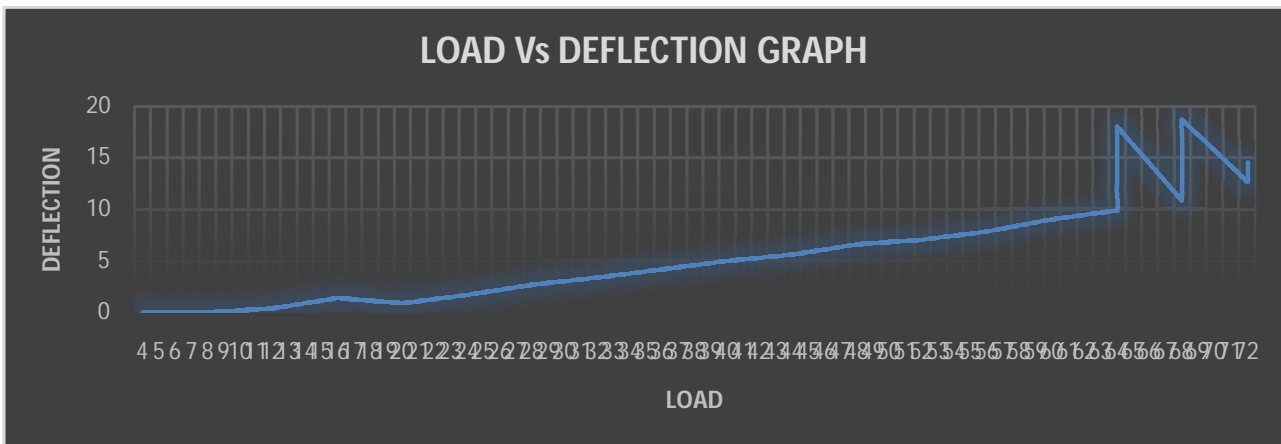


Fig 5

This is the graph of load Vs deflection for control beam of rebar 12mm. This graph shows that the load carrying capacity of M20 grade of control beam is 72kN. And this load is considered as critical load for normal rebar of size 12mm.

### 4.3 Deflection graph for control beam of 16mm rebar

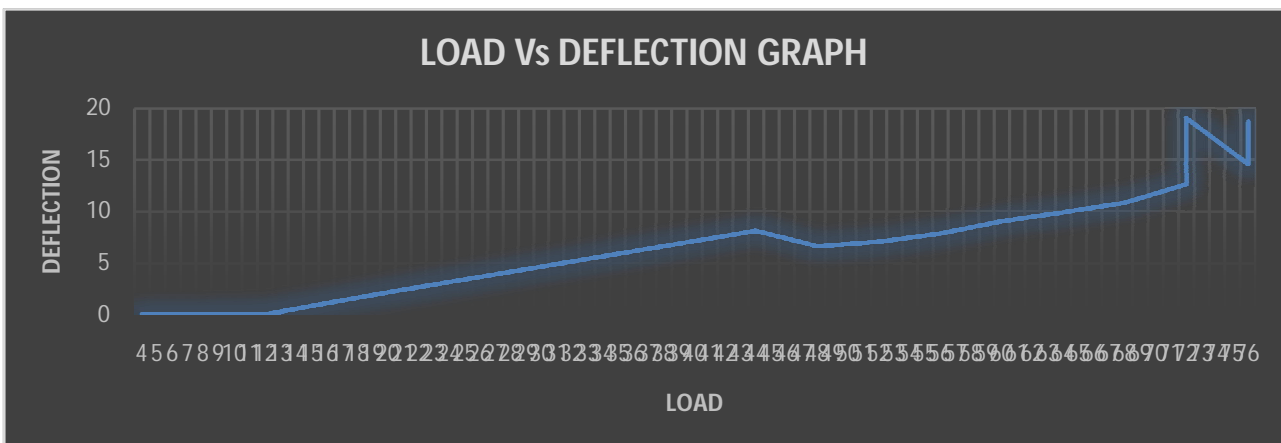


Fig 6

This is the graph of load Vs deflection for control beam of rebar 16mm. This graph shows that the load carrying capacity of M20 grade of control beam is 76kN. And this load is considered as critical load for normal rebar of size 16mm.

### 4.4 Deflection graph for beam of 12mm stainless steel bar

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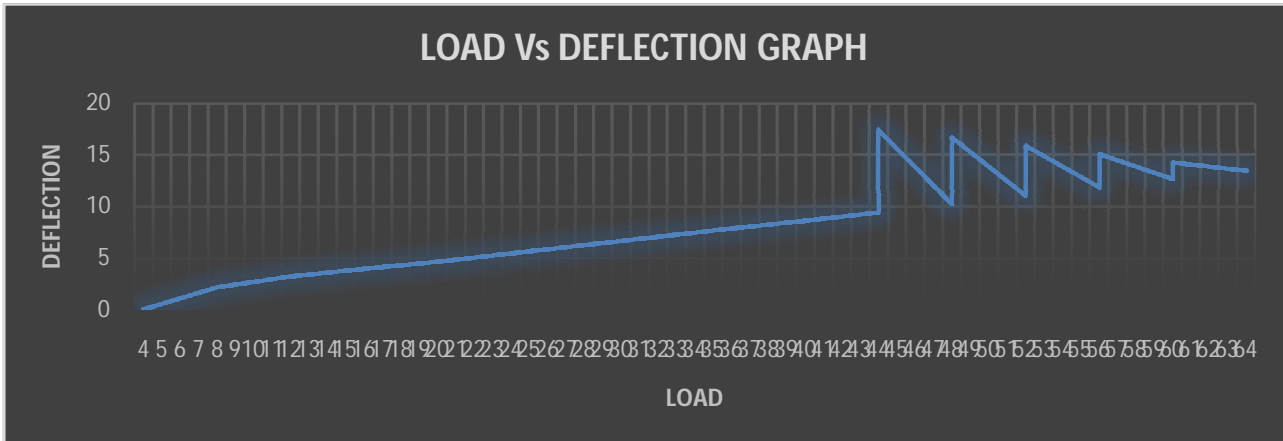


Fig 7

This is the graph of load Vs deflection for beam of SS12mm pipe. This graph shows that the load carrying capacity of M20 grade of this beam is 52kN. And this load is considered as critical load for normal rebar of size 12mm.

#### 4.5 Deflection graph for beam of 16mm stainless steel bar

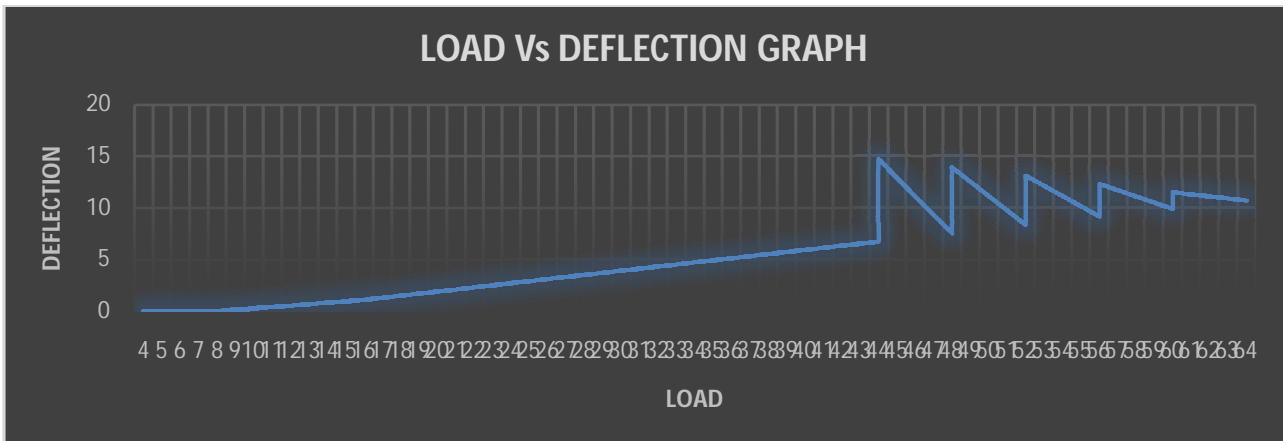


Fig 8

This is the graph of load Vs deflection for beam of SS16mm pipe. This graph shows that the load carrying capacity of M20 grade of this beam is 56kN. And this load is considered as critical load for normal rebar of size 12mm.

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### 4.6 Deflection graph for beam of 12mm mild steel bar

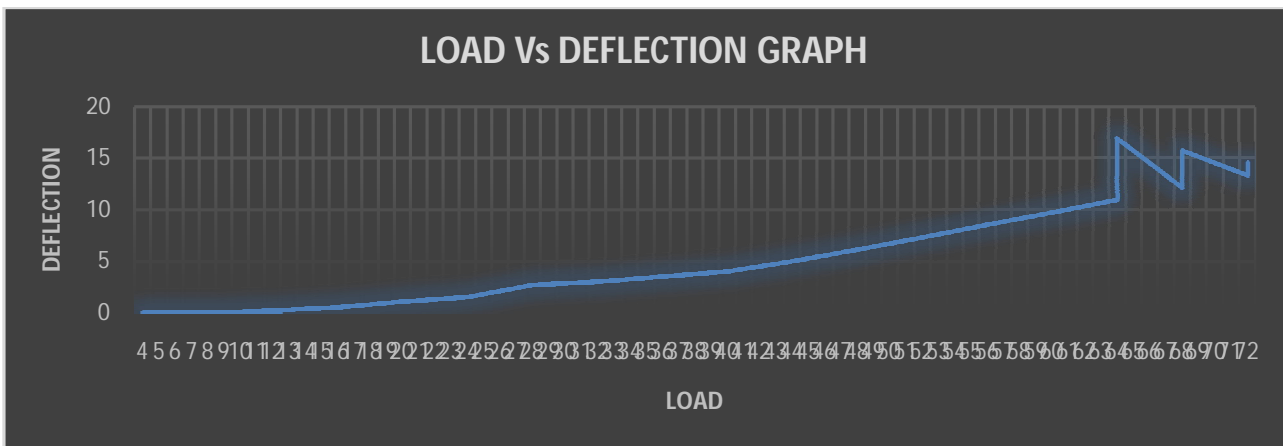


Fig 9

This is the graph of load Vs deflection for beam of MS12mm pipe. This graph shows that the load carrying capacity of M20 grade of this beam is 74kN. And this load is considered as critical load for normal rebar of size 12mm.

### 4.7 Deflection graph for beam of 16mm mild steel bar

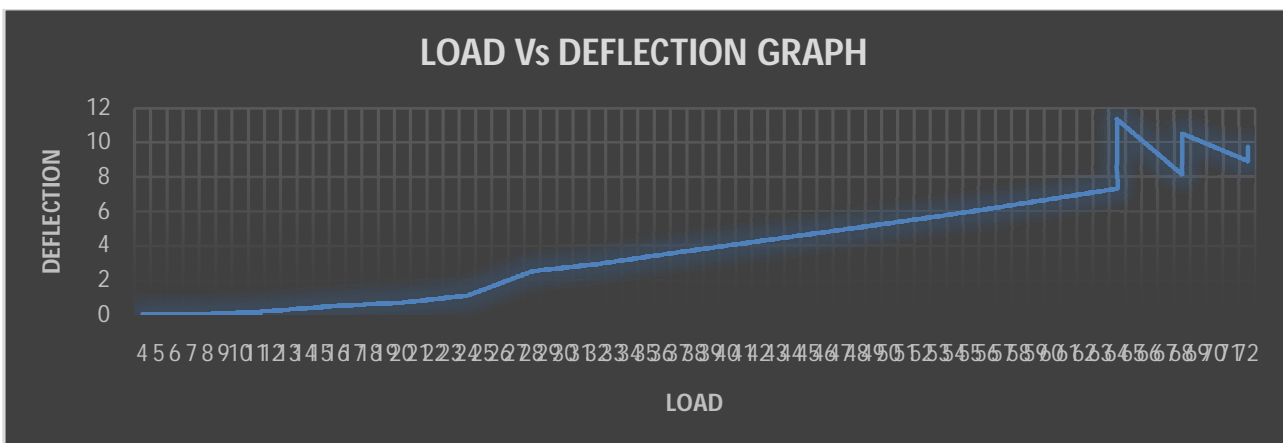


Fig 10

This is the graph of load Vs deflection for beam of MS16mm pipe. This graph shows that the load carrying capacity of M20 grade of this beam is 80kN. And this load is considered as critical load for normal rebar of size 16mm.

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## 4.8 Deflection graph for beam of 12mm galvanized iron bar

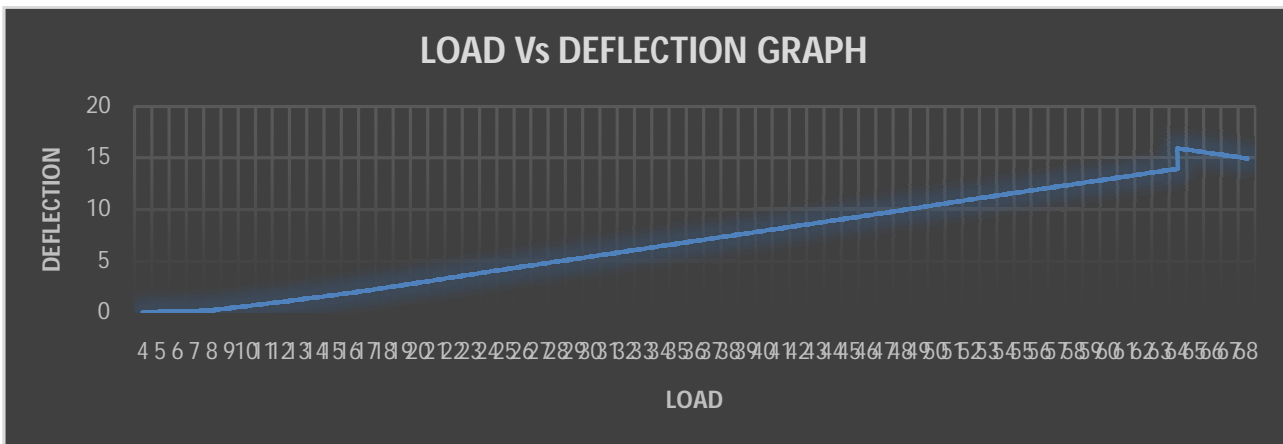


Fig 11

This is the graph of load Vs deflection for beam of GI 12mm pipe. This graph shows that the load carrying capacity of M20 grade of control beam is 72kN. And this load is considered as critical load for normal rebar of size 12mm.

## 4.9 Deflection graph for beam of 16mm galvanized iron bar

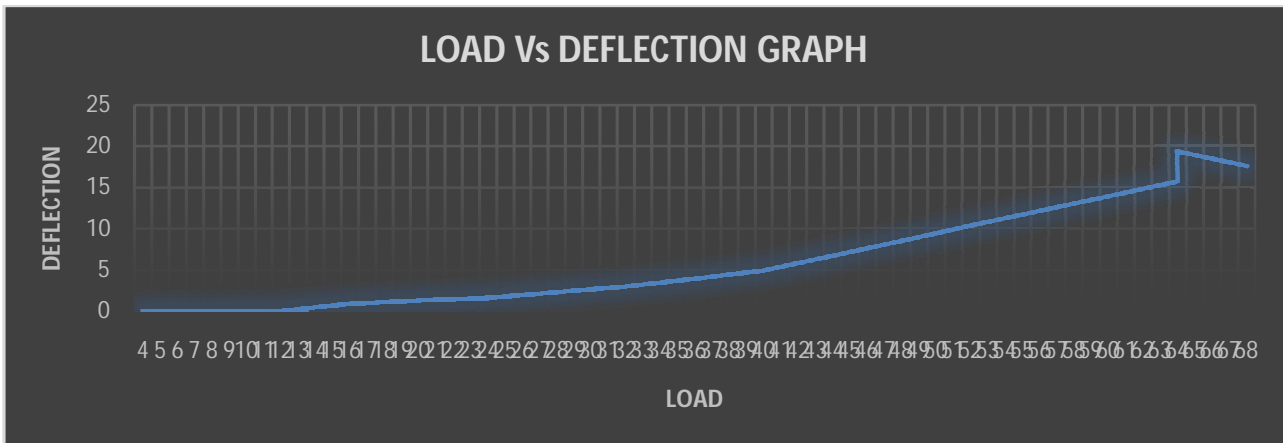


Fig 12

This is the graph of load Vs deflection for beam of GI 16mm pipe. This graph shows that the load carrying capacity of M20 grade of control beam is 74kN. And this load is considered as critical load for normal rebar of size 16mm.

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## V. CONCLUSION

The performance was observed and discussed in terms of failure modes, load Vs deflect and load carrying capacity. Based on the test report on the filled hollow tube beam, the following conclusions can be made:

1. Experiments were carried out for four different cases of Hollow pipes such as stainless steel, mild steel, galvanized iron compared with normal rebar beams in order to know the behavior and bending load of beam and tests were conducted under Monotonic loading.
2. Major conclusion from this study are: Load carrying capacity of beam with hollow mortar filled tubes are economical for construction techniques.
3. And also found that the mild steel has carried the maximum critical load when compared to other specimens.

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