

# Study on Strength of Hybrid Concrete Beam

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## ABSTRACT

The construction industry place a very important role in the economic development of a country. The main intention of these materials is to improve the quality of the materials used in the concrete. Hybrid concrete beam is one of the method of improving the quality of the materials. This hybrid beam consist beam consist of a special reinforcement called arch reinforcement other than concrete and main reinforcement.

*Keywords: Arch Reinforcement, Flexural strength, Hybrid Beam, Partial Beam.*

## 1. INTRODUCTION

The basic of all the construction work depends up on a term called Concrete. Concrete is the most consumed material in the world. It is made up of three basic ingredients that is cement, aggregates and water. And these materials get in to a liquid which can be turned into almost any shape and later on gets in to a hard rock. The materials used for concrete are easily available. It does not include any complicated system. The concrete structures can be formed in to any shapes, size and height. Depending up on the mixture of cement, aggregate and water we can get different grades of concrete mixtures. Concrete is strong in compression and weak in tension, in order to overcome this we are providing a material which can withstand the tensile forces called reinforcements. Steel is mainly used as the reinforcing material. With the use of steel in concrete we can obtain a material which is strong in compression and tension

### 1.1 Partial Beam

Beam is a horizontal structural member which takes the load from the super structure right angle to its axis. Beams while bending develop tension and compression zone which are divide by the neutral axis. As we know that concrete is good in compression and steel reinforcement is good in tension. Here we are going to reduce the amount of cement content in the tension zone that is we are going for two grades of concrete. A high grade concrete in the compression zone that is above neutral axis and low grade of concrete in the tension zone that is below the neutral axis. These types of beams are called as partial beams. The definition of partial beams says that using two different grade of concrete or creating a hollow or vacuum section in the tension zone of the beam, having flexural and shear strength similar to homogenous solid beam

### 1.2 Arch Reinforcement

Flexural test is done in order to find the tensile strength of the concrete. And it is a measure of calculating the bending of beams or slabs. As load is applied on the beam the beam start bending. In order to resist the bending nature of the beams we are introducing a special type of reinforcement called arch reinforcement. This special reinforcement tries to reduce the bending nature of beams and helps to carry more loads due to bending forces. This arch reinforcement can be applied in the longer span of the beam where the bending action is more visible. In this project the arch reinforcement is made with the help of PVC pipe with an infill of cement mortar in which the pipe is made to bend in to the shape of an arch.

## 2. METHODOLOGY

In this project we are casting 13 beams specimens of 6 varieties. The beam mould is of size 150mm \*150mm \*700mm. Table 2.1 represents the different type of beams and the type of concrete grades used in the work.

**Table 1: Types of beam with different grades of concrete**

Sl.No.	Type of Beam	Grade of Concrete	No. of specimens
1	Conventional	M25	3
2	Partial beam	M25 & M15	3
3	Conventional with single arch	M25	3
4	Partial beam with single arch	M25 & M15	3
5	Conventional with double arch	M25	3
6	Partial beam with double arch	M25 & M15	3

### 2.1 Bar Bending

The reinforcement are made with 10mm and 8mm dia. Bars, 10mm dia. bars as main reinforcement & 8mm dia. bars as

vertical reinforcement (Shear reinforcement @ 100 mm c/c). There are 2 bars at the top (Anchor bar) and 3 main bars at the bottom (Tension reinforcement).

**2.2 Materials**

The OPC cement is used of 53 grade with a fine aggregate confirming to IS standards, and coarse aggregate is used in different percentage i.e., 60% of 10mm down size and 40% of 20mm down.

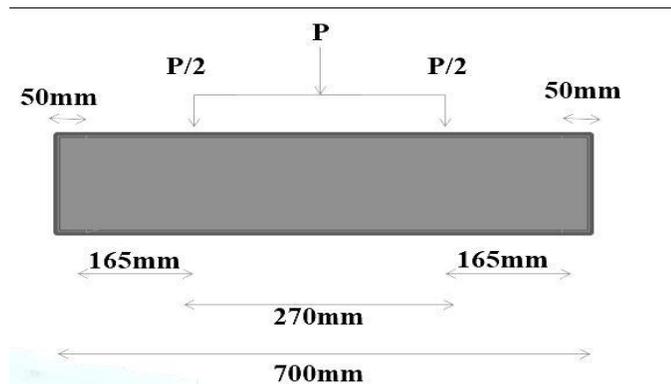
**2.3 Placing of Reinforcement and Testing**

The reinforcement is provided with 20 mm cover from all the sides. And clover Blocks are used for the providing cover. The arch reinforcement is made with a PVC pipe which has got an infill of 1:3 cement mortars and it is bent in to the shape of an arch. The arch reinforcement is supported with help of hook of the main reinforcement which is present at the bottom.



**Figure 1: Arch action in placing of reinforcement**

After placing the reinforcement inside the mould the concrete is filled inside the mould. After placing the concrete inside the mould tamping is done with the help of tamping rod. Tamping is done in order to remove the air voids inside. The specimen is cured for 28 days. The beam specimen is tested for the flexural strength. Two point loading is applied for the specimens. The point of application of load is at 1/3 distance from the ends. 50mm from the end is given for the support. Marking on the specimen is done as per the above requirements. Beams specimen is kept on the loading frame. Reading is noted with the help of proving ring.



**Figure 2: Two point loading**



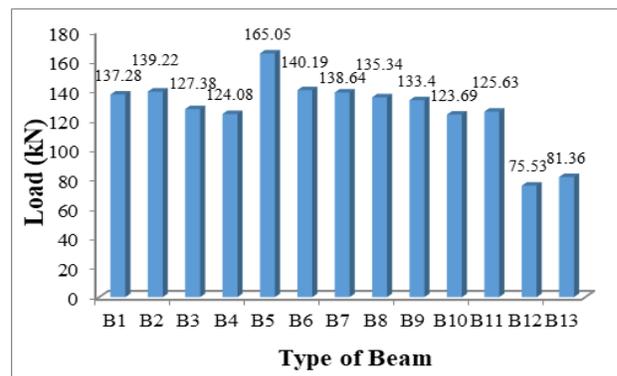
**Figure 3: Test Setup**



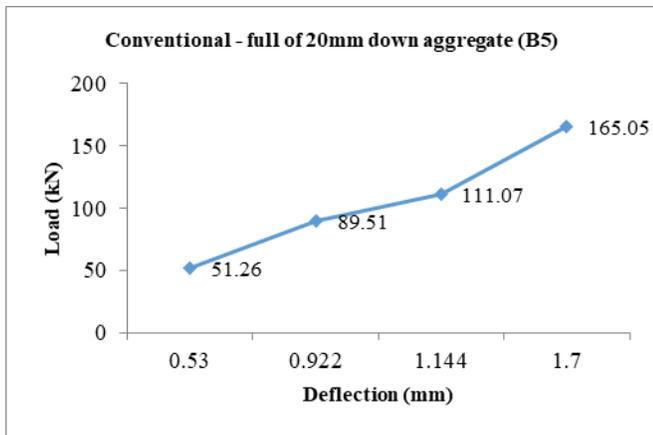
**Figure 4: Cracked beam**

**2.4 Proving Ring Reading Calculation**

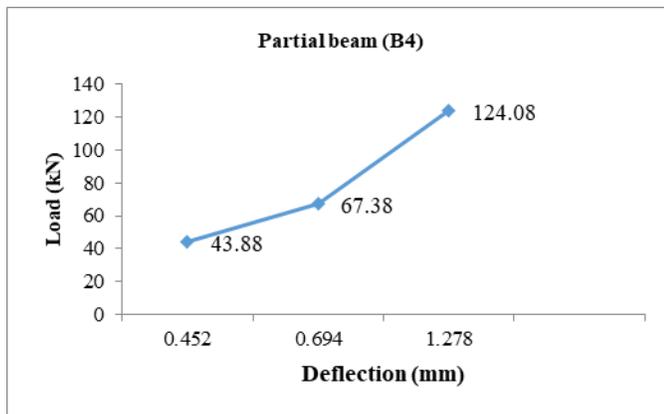
Proving ring consists of two scales one is main scale reading and the other one is small scale reading. In the main scale, there are 25 divisions and each division value is 0.2 mm. In the small scale reading there are 100 divisions and the value of each division is 0.002mm. When the load is applied if the needle of the small scale rotates one cycle the deflection value is taken as 0.2 mm which can be seen in the main scale. Least count of the small scale: 1 division = 0.002mm by using this values the deflection value of each specimens can be calculated. For each crack the divisions on the proving ring has to be noted down and the corresponding deflection has to be calculated. To calculate load, if the needle covers 103 division in the small scale then the load value is taken to be 20 kN. Corresponding values has to be noted down.



**Figure 5: Variation of strength for different type of beams**



**Figure 6: Deflection of conventional beam with 20mm down aggregate**



**Figure 7: Deflection variation of partial beam**

### 3. CONCLUSION

According to the test results, the conventional beam with single arch and the partial beam with single arch takes load which is almost near to that of the conventional beam. The load at which cracks developed in the conventional and partial beams having single arch reinforcements is almost near to that

of conventional beam. Since arch reinforcement helps to resist the deflection load, these arch reinforced beams mainly fails due to shear failure. By increasing the number of stirrups at the supports and minimizing at the centre the shear failure can be reduced and the beam will be capable to resist more loads.

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