Comparative Study on Crack Pattern of RCC and Brick & RCC Composite Beams

Piyush Kumar[1] Mr. R.D. Patel[2]
[1]P.G. Scholar [2]Associate Professor
[1,2]Department of Civil Engineering
[1,2]M.M.M.U.T. Gorakhpur, India

Abstract— This paper presents a study carried out on Crack Pattern and Failure modes of RCC and Brick & RCC Composite Beams. The main objective of this thesis is to study replacement of concrete by bricks. The concrete of tension zone has been replaced by Brick in order to reduce weight and cost of the reinforced concrete beams An experimental program is conducted on six simply supported concrete beams. All six beams cast in 2 different groups and every group having 3 beams. The first group of beams is of reinforced concrete beams and second group of beams are composite beams. The Crack Pattern of both groups of beam compare with each other. The comparative study result on Crack Pattern is taken with the help of load deflection reading by using dial gauge. The dial gauge are at position L/6, L/3, L/2, 2L/3 and 5L/6, where L is the length of beam.

Key words: RCC Beams, Brick Beams, Flexural Strength, Reinforced Masonry, Deflection

I. INTRODUCTION

Brick and RCC composite beams an attempt is being made to reduce cost of reinforced concrete beams, replacing concrete by brick near the neutral axis as well in tension zone. The behaviour of brick and RCC composite beams is same to that of reinforced concrete beams.

We know that concrete is fairly strong in compression but very weak in tension. So concrete of tension zone has been replacing by brick. Steel is very strong in tension. The steel bars are placed near the bottom of beams where they are most effective in resisting the tensile bending stresses. Thus, the tensile weakness of bricks overcome by the provision of steel bars in the tension zone. The bond between brick and concrete layers at the brick concrete interface should be good. It should be ensure that no slip occur between concrete and brick.

In this study partially utilized concrete of RCC beam have been replaced by bricks in order to reduce the weight of beams and also achieve economy, and by reducing concrete we have to save cement and by saving cement reduced the greenhouse gasses emissions. So it is environment friendly.

II. EXPERIMENTAL STUDY

Total six numbers of reinforced concrete beams were cast for the experimental study. All the six beams were cast in two different group of three beam in each group. The first group of beams is the control group in which three reinforced concrete beams were cast. The second group of beams is the composite beams in which three brick and reinforced concrete composite beams were cast. The Crack Pattern and failure modes of both groups of beam compare with each other.

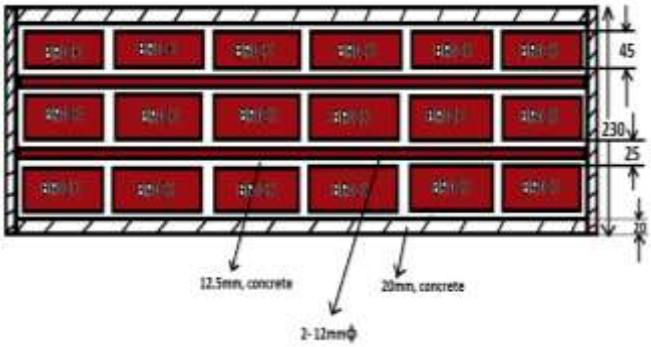


Fig. 1: Arrangement of Bricks & Longitudinal Bars in Tension zone of Beam

Fig. 2: Arrangement of Bricks with Reinforcement Cage

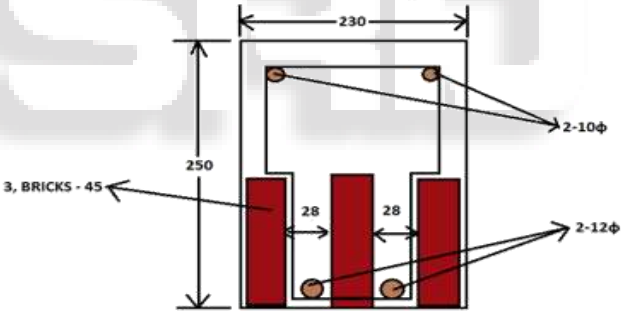


Fig. 3: Arrangement of Bricks & Reinforcement of Beam at a Section A-A

III. CASTING OF SPECIMEN

For conducting experiment , six reinforced concrete beam specimen of sizes as shown in the figure effective length leff = 2.4m , breadth of beam b =0.23m, depth of beam d = 0.25m. The mix proportion used is for water, cement, fine aggregate and course aggregate is taken. The mixing is done by hand mixing. The beam cured for 28 days. For each beam 2 cubes and 1 prism were casted to determine the compressive strength and flexural strength respectively for 28 days.

Fig. 4 Casting of Beam

IV. EXPERIMENTAL SET UP

The testing procedure for all the specimen is same. First the beams are cured for a period of 28 days then its surface is cleaned with the help of sand paper for cleared visibility of cracks. The two point loading arrangement was used for testing of beams. This has the advantage of substantial region of uniform bending, the two point loading system is provided is being showed in figure. The load is transfer through load cell on to the spreader I beam. The spreader I beam is installed on rollers seated on desired point of beam loading was done by hydraulic jack of capacity 100KN.

Fig. 5 1st group B-1A on Testing Frame..

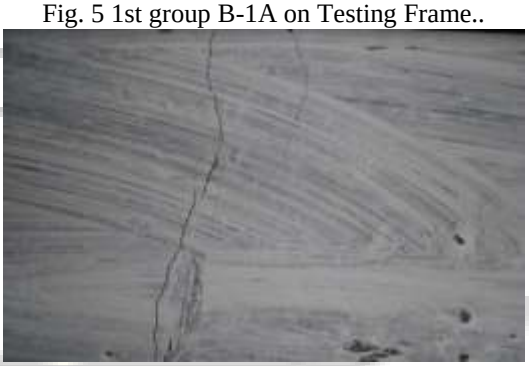


Fig. 6 Crack in Tension Zone Propagates in Upward Direction

Fig. 7 Crack Pattern

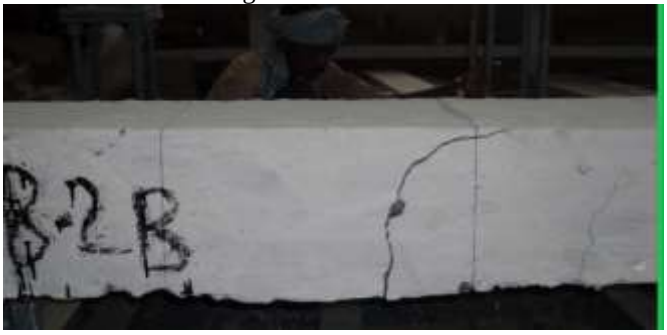


Fig. 8: Failure of 2nd group of beam at Ultimate Load

Fig. 9 Crack Pattern of 2nd group of beams

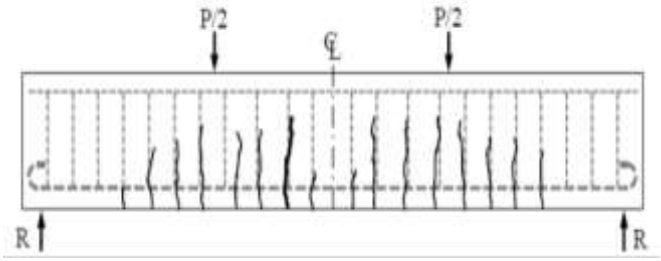


Fig. 10 Crack Pattern

V. EXPERIMENTAL RESULT

Failure modes have been observed in the experiment of rectangular RCC beams and composite beams. Load was applied at the L/3 and 2L/3 and at each increment of the load, deflection at L/6, L/3 , L/2 , 2L/3 and 5L/6 is taken with the help of dial gauges. The loading arrangement is same for all beams.

A. Study on crack pattern of group beam b-1

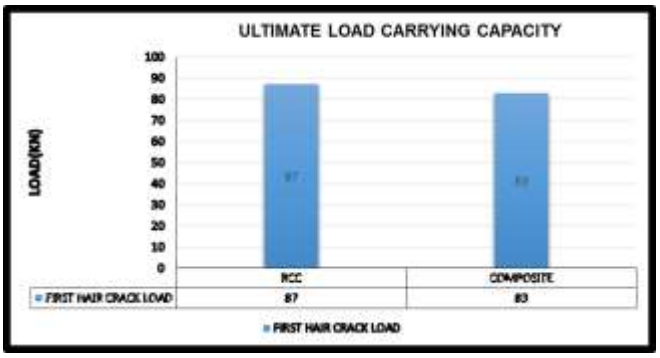
As the beams of group B-1 designed with the help of limit state designed philosophy and the designed load is for 47 KN. The control beam B-1, flexure test starts as the test progress the crack pattern are found under the application of loading.

As the load and deflection curve is being curved out of first group beam .All the dial gauges reading is being marked out in this curve. Load is being applied on control beam the first hair line crack is being observed at the load of 50 KN. The cracks which are being observed in the middle as well L/3 and 2L/3 are like at 80° - 90° and the one which are at L/6 and 5L/6 are at 40°-50°.

B. Study on Crack Pattern Of Group Beam B-2

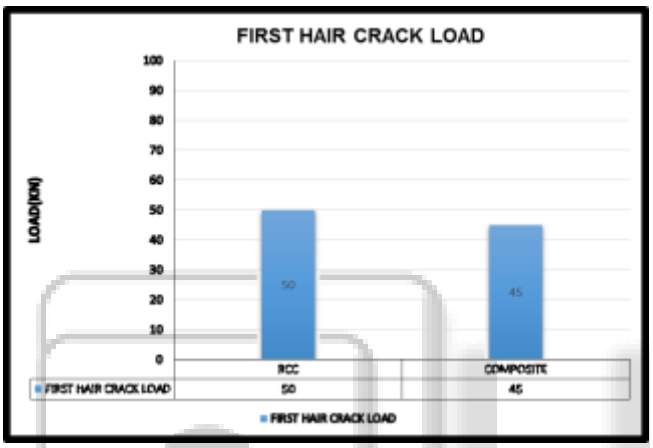
In group second B-2 as the load is being applied the first hair line crack is observed at 44kN. The most of the cracks are being seen between L/6 and 5L/6. The cracks generate from bottom and then propagate towards the compression zone where point load is being applied. Small cracks appear near L/6 and 5L/6 of beam. In case of beam B-2C cracks propagates in a zigzag manner and seen flexure area near L/6 and 5L/6. The cracks are propagated from bottom and joined around compression region. At end of beams the cracks are being seen and are at 30°to 40°. A large crack appear where point load is being applied.

C. Ultimate Load Carrying Capacity



By this study it has been observed that RCC group beams B-1 has greater load carrying capacity as compared with composite group beams B-2.

D. First Hair Crack Load



It has been observed that RCC group beams B-1 has more first hair crack strength as compared with composite group beams B-2.

VI. Conclusion

The most of the cracks are being seen at point L/3 and 2L/3 where load is also applied and small cracks appear near L/3 and 5L/6 of beams for both RCC and composite beams.

All the beams of composite shows large deflection and cracks with respect to the RCC beam.

Control beams shows a little bit more ultimate load as compare to composite beams. So group beam B-2 has desired strength as group B-1.

It has been observed that RCC group beams B-1 has more first hair crack strength as compared with composite group beams B-2.

Behaviour of composite beams is similar to that of reinforced concrete beams.

By reducing concrete we have to save cement and by saving cement reduced the greenhouse gases emissions. So it is environment friendly.

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