Comparative Study Of Flexural Behaviour Of Reinforced Concrete Beam And Prestressed Concrete Beam.

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ABSTRACT

The tow tensile strength of concrete is overcome either by reinforcing it or by prestressing. Both these methods have certain advantages and disadvantages, and one must be very careful with choosing one these two by taking into consideration the structural requirements and economics of the given problem. The common construction material for residential and commercial buildings and other allied structures is still reinforced concrete, though the prestressed concrete is better in structural behaviour, durability and economy. The aim of present work is to compare the economics and structural behaviour of the reinforced concrete and prestressed concrete beams and finding out the suitability of each. Results show that overall flexural behaviour of prestressed concrete beam is very good in all aspect compared to reinforced concrete beam.

Key words: RCC, PSC. Flexural strength, beam.

1.0 INTRODUCTION.

Concrete is established to be a universal building material because of its high compressive strength and it's adoptability to take any form and shape. The low tensile strength of concrete is offset by the use of steel reinforcement the resulting combination of the two being known as reinforced concrete, although the steel reinforcement provides the cracked concrete beam with flexural strength. It does not prevent cracking and loss of stiffness due to cracking, since in order to satisfy serviceability requirements, the increased strain capacity offered by high strength steel. Prestressed concrete is a particular form of concrete in which prestressing involves the application of initial compressive load on a structure to reduce or eliminate the internal tensile forces developed due to working loads and thereby control or eliminate cracking. The initial compressive load is imposed and sustained by highly tensioned steel reinforcement reacting on the concrete. The common construction material for residential and commercial buildings and other allied structures is still reinforced concrete, though the prestressed concrete is better in structural behaviour, durability and economy.

The production line efficiency employed in the fabrication of standardized precast prestressed units makes them one of the most economical building materials available in many types of structures. At the job site time and labour are saved thro' the rapid erection of precast units with an absolute minimum of forms and cast in site concrete. Also there are some additional benefits which can occur due to getting the job done under the roof in a short time.

2.0 MATERIALSSPECIFICATIONS.

In general reinforced concrete section is a combination of two materials concrete of the grade M20 and reinforcement and HYSD bars of Fe 415 grade

While for Prestressed concrete beam concrete is of M 30 and tendons are wires of 3.75 mm diameter having an ultimate tensile strength of 1475 N/mm^2

To achieve the required concrete grades viz. M20 for reinforced concrete members and M35 for prestressed concrete members, trial and error method of mix design was used. We achieved the grade M20 by a nominal mix of 1:2:4 with water-cement ration of 0.6. For achieving the grade of concrete M35 we required 1:1:2 mix, with water-cement ration of 0.45. such rich mix was necessary due to poor quality of vibration and poorly graded aggregates and hand mixing.

3.0 EXPERIMENTAL PROGRAM

In order to study structural behaviour of reinforced concrete and prestressed concrete flexure members, it is proposed to cast the beams of 2.5 m and 3.0 m spans of each type with the same cross-section of 100 mm width and 150mm overall depth. For reinforced concrete beam, it is proposed to have a concrete grade of M20 and H.Y.S.D. (Fe415) steel reinforcement, which are normally used in practice. The tensile reinforcement in the section is restricted so as to have under-reinforced section.

For prestressed concrete beam, it is proposed to use a concrete grade M35 and H.T.S. wires of 3.75 mm diameter with ultimate tensile strength of 1475 N/mm^2. The number of wires in the cross-section and the amount of prestressing given is so adjusted that of tensile force offered by tensile steel provide in reinforced concrete beam.

The prestressed concrete beams are cast by mould method. The required mould is designed and fabricated as part of this project work. The wires are tensioned using the hydraulic jack.

The cast beams are tested for the pure flexure condition.

The mould is designed to cast prestressed member/s of the cross-section 100mm wide and 300mm deep and max. 6.5m length. The location of prestressimg wires of 4mm diameter is as shown in fig.3.3. Maximum stress to which wires can be extended is 0.8 time the ultimate tensile strength, as per I. S. 1343.

In the mould of casting the precast, prestressed members, the prestressing force is sustained by the mould up to the time of transfer. The tensioning of wires cause the axial force to induce in the mould in addition to the moment due to eccentricities. Thus, the mould behaves as beam-column, with effective length of 6.5m

It is proposed have one fixed end plate and one movable end plate and each end. Fixed plate will be directly welded to channels, while the movable plate will be supported on four threaded rods and nuts at the corners of plate with the rods extending from the flanges of channels. The purpose of movable plate is to release the prestess gradually to the concrete at the time of transfer; also it can facilitate manual prestressing operation in the emergency case.

4.0 RESULTS AND DISCUSSION

The results have been interpreted in graphical form as shown in figures 2.0 to 4.0. In the experiments, the deflections and strains are measured at three point viz. under the loads and at the centre of the span.

As can be seem from the results tabulated and graphs of load v/s deflection that the deflection for first few loads was well matching with the theoretical values. Also the graph shows a linear pattern for these values. But afterwards the rate of increase in deflection increases with load and this may be because of the cracking of concrete. Thus it can be Conclude that the cracking moment is the one at which the linear pattern of graph ends. Also the cracking moment can be found from the strain reading, as the strain is directly proportional to the cracks. The comparative statement of cracking moment, ultimate deflection is as shown in table 1.0.

Table 1.0 Comparative Statement of results

Member Type	Cracking moment		Ultimate Moment		Ultimate Deflection (mm)
	Theoretical (KN-m)	Actual(KN-m)	Theoretical(KN-m)	Actual(KN-m)	
R.C.C.(3.0m span)	0	1.5	6.3	7.125	18.04
R.C.C.(2.5m span)	0	1.5625	6.3	6.875	17.5
P.S.C.(3.0 m span)	4.87	4.875	8.22	7.875	11.21
P.S.C.(2.5m span)	4.86	4.6875	8.22	7.5	10.52
Composite(3.0m span)	0	1.6875	0	6.94	15
Composite(2.5m span)	0	1.71875	0	6.25	14.5

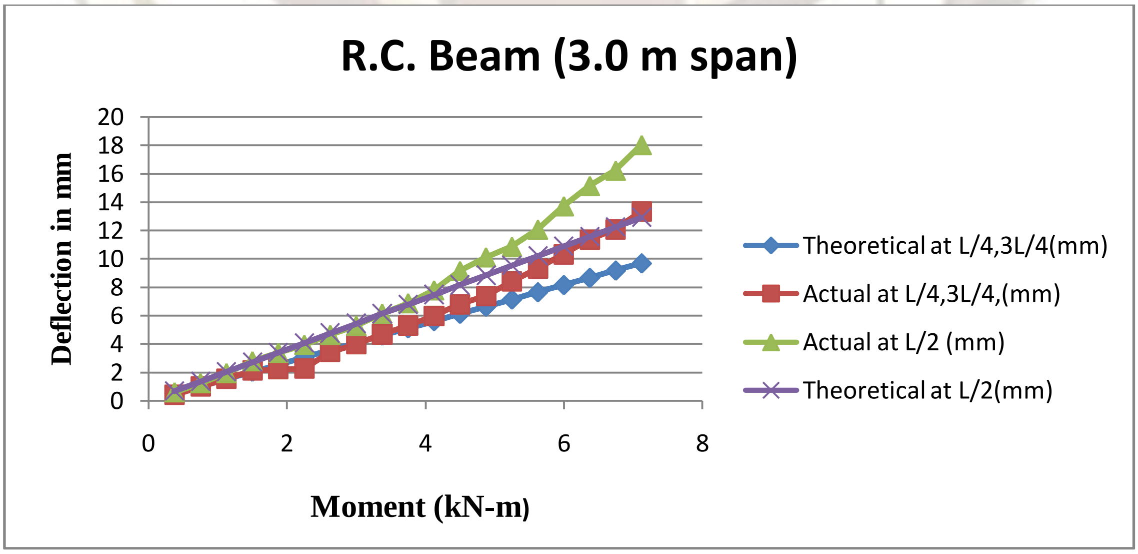

Fig.1.0 moment v/s deflection for RC beam 3.0M span

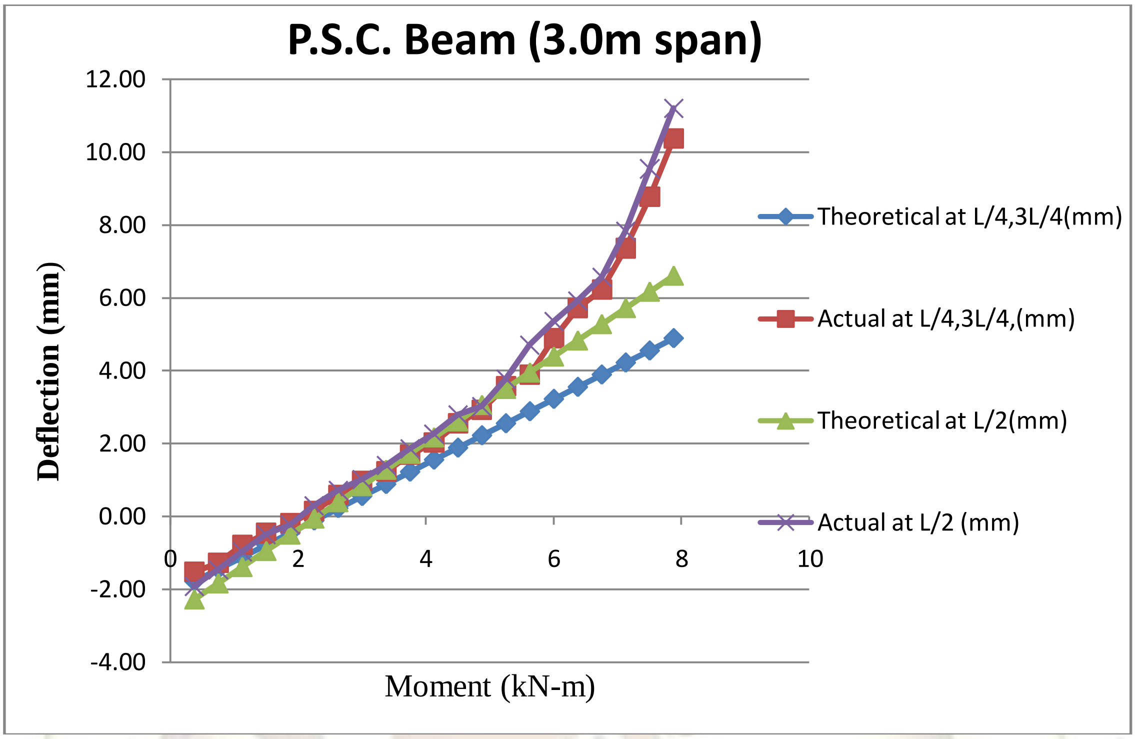

Fig.2.0 moment v/s deflection for PS beam 3.0M span

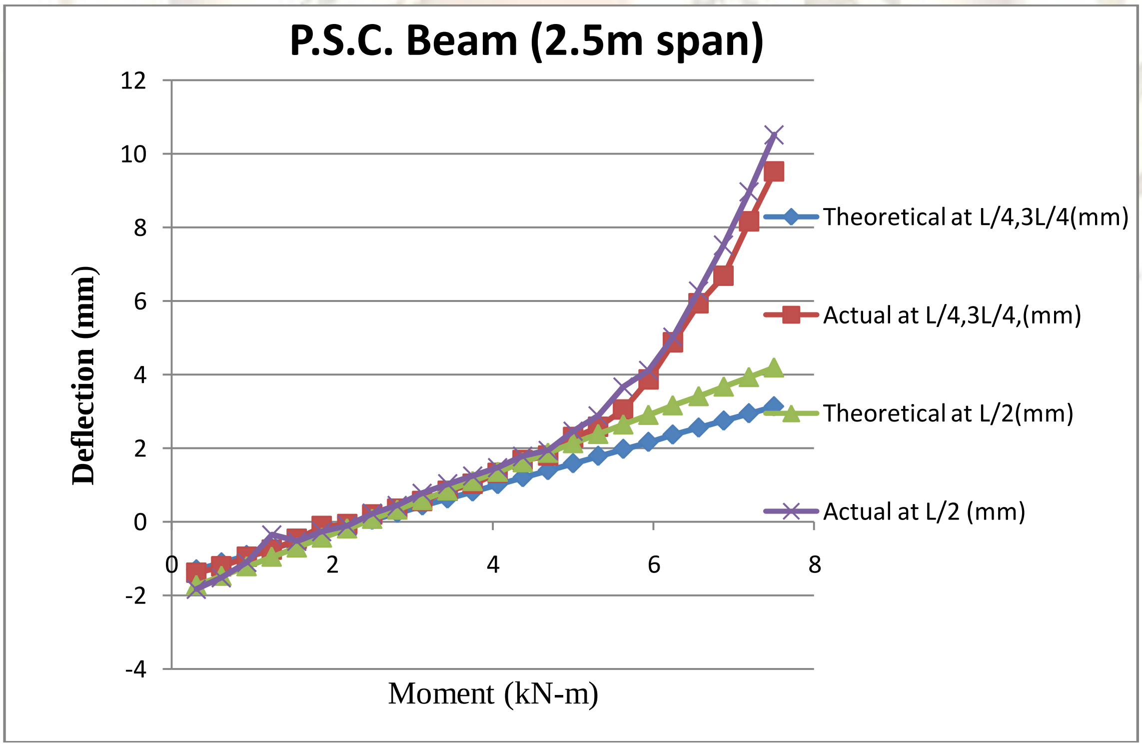

Fig.3.0 moment v/s deflection for PSC beam 2.0M span

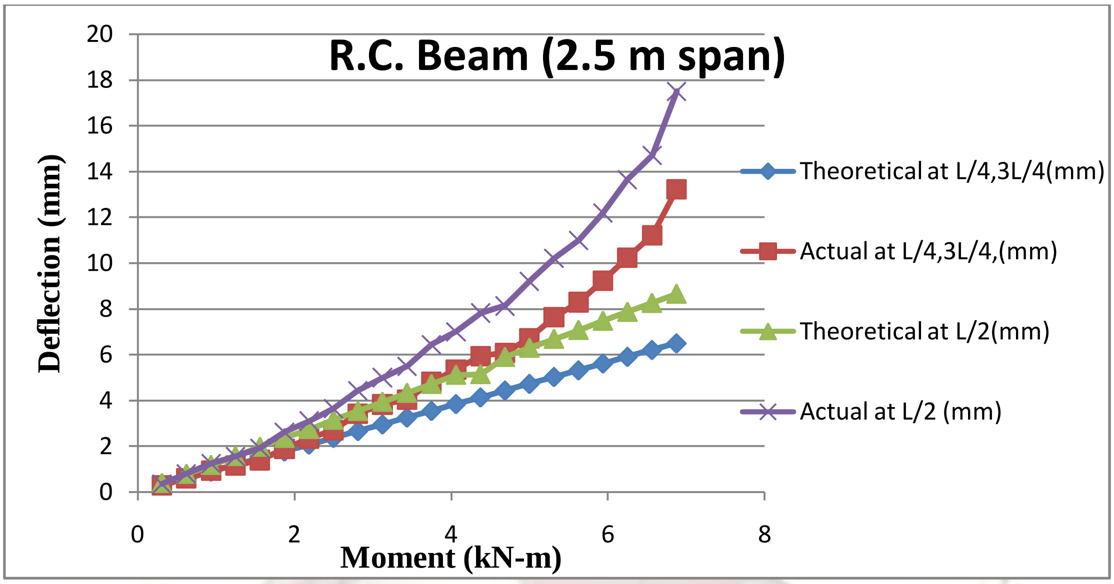

Fig.4.0 moment v/s deflection for RC beam 2.5M span

6.0 CONCLUSIONS

From the results obtained through the experimental program, following conclusions can be made.

1. The casting of precast prestressed beams is feasible with the designed mould.
2. The moment of resistance showed by the equivalent prestressed beam as compared to the R.C.C. beam was more by 12.4%
3. The moment causing cracking of the concrete in case of prestressed beam was 3 times more than for equivalent reinforced beam.
4. The ultimate deflection in case of prestressed beam was 60% less than the ultimate deflections in case of reinforced concrete beam.
5. The failure of reinforced concrete beam occurred nearly at the centre of the span whereas the failure in case of prestressed concrete beam was under the loads, showing that the failure governed by shearing in case of prestressed beam rather than flexure.(This may be because of straight cable profile).
6. The cracks seen in case of reinforced beam were more in numbers and less in width whereas for prestressed beam the cracks were less in numbers and more in width, probably because of stress concentration under the loads and bad patches of concrete due to poor vibration.
7. The transmission length in case of pretension prestressed beam is not a governing factor even for small of simply supported beam.
8. The material is used more effectively for prestressed beam than the reinforced beams because of improved service load behaviour.
9. The recovery of deflection after removal of the load was more in case of prestressed beam indicating more elastic behaviour. Thus prestressed beam are more suitable to take fatigue loads than reinforced beams.

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