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Comparative Flexure Behavior Between Equivalent R.C and P.C Beams with Different Sections

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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 behavior, durability, ductility, deformability and economy. The aim of present work is to compare the flexure behavior of the reinforced concrete and prestressed concrete beams and finding out the suitability of each. Results show that overall flexural behavior of prestressed concrete beam is very good in all aspect compared to reinforced concrete beam.**

In this paper analyzed the RCC &PSC beams against the different parameters. We studied the analysis of prestressed concrete beams more effective as compared to equivalent reinforcement concrete beams in flexure. There is a very good understand all aspect of prestressed concrete beam better than as compared to reinforced concrete beam in flexural .

Keywords*— *RCC beams & PSC beams, Flexural strength, beams.

I. INTRODUCTION

The use of concrete has evolved over the years, starting with unreinforced concrete, to reinforcing concrete structures with mesh or bars as a form of passive reinforcement, to using a prestressing system in order to control the stresses and the squeeze the concrete makes the beam strong **[1,2]**. Prestressing could be considered a form of actively controlling a structure; however, after the tendons are tensioned they are normally never adjusted again. In fact they gradually lose force due to long term losses that are associated with prestressed concrete **[3,4,5]**. 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**[6,7,8]**. 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 behavior, durability and economy **[9,10]**.

II. MATERIAL SPECIFICATIONS

All concrete mixtures were designed for a 28- day's compressive strength of approximately (300,400and500 kg / cm ²). Coarse aggregate in the concrete mixture consisted of crushed basalt rock from mount ataqa in Egypt.

Content of concrete mixtures used for (1 m ³) shown in table (2.1).Maintaining the Integrity of the Specifications

All specimens (SR1, SR2, SRT, SP10and SPT) was mixed in concrete mixer station.

Table 1: Content of 1 m ³ of concrete.

1 m ³ of concrete	Cement (kg)	Sand (kg)	Aggregates (kg)	Water (kg)
M30	348	725	1125	182
M40	446	700	1055	167
M50	499	665	1095	191

All specimens (SR1, SR2, SRT, SP1, SP2, SP3, SP4, SP5, SP6, SP7, SP8, SP9, and SP10and SPT) was mixed in concrete mixer station.

III. EXPERIMENTAL PROGRAM

A total of five beams were constructed and tested to determine the advantages that can be gained through the use of prestressed concrete beams with different shapes versus reinforced concrete beams. These beams were separated into two groups shown in table (2). With each group investigating different parameter.

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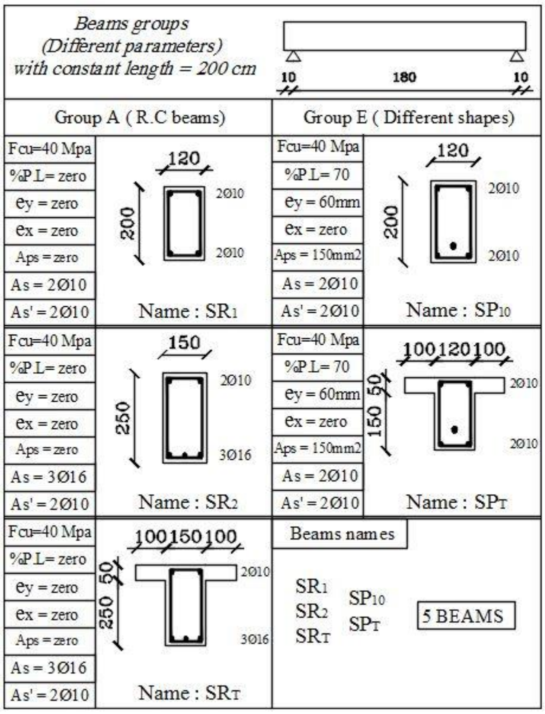
Table 2: Details of beams groups A&E.



The procedures used to test the beams is applying two loads at mid-span of the beams showing in Fig.1 and the strains within the beam at mid-span.

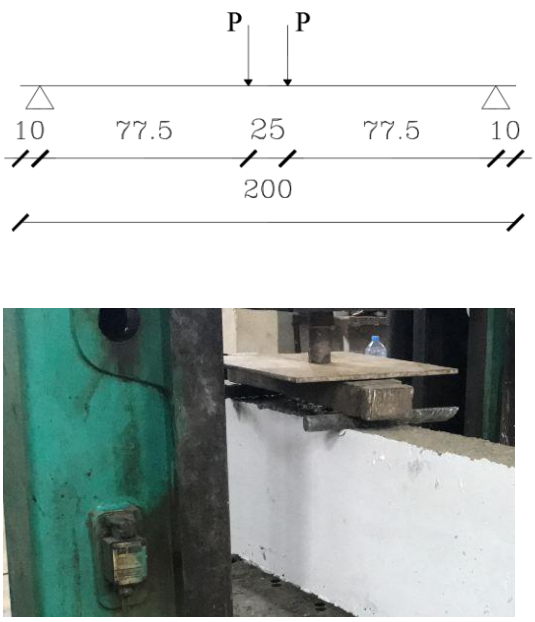


Fig. 1: Loads applying on beams.

IV. EXPERIMENTAL RESULT

In this part the structural behavior of newly constructed RC beams specimens is investigated by testing of five (5) R.C and P.C beams under vertical loads. The test results of the tested beams are presented in this part.

The tests results as observed by visual inspection during the test and as measured by instrumentation are presented in different forms such as load vertical deflection curves, load-strain curves for concrete, failure modes, and summary of major events The following gives a brief description of different test indicators as presented in this part.

Results from experiments performed on five beams, Specimens (SR1, SR2, SRT, SP10& SPT are discussed in this part. This section is focused on a specific specimen response, described using data collected from instrumentation and photographs taken throughout the test.

The load-deflection behavior of the test beams was studied with regard to the effects of variations in the prestressed and non-prestressed beams on the deflections before cracking, at service loads, and at ultimate strength. Mid span deflections obtained practically for all beams.

The load-deflection behavior was essentially linear until the cracking load was reached, after which the member's stiffness was reduced and the slope of the load-deflection curve decreased. At loads corresponding to those causing yielding of the steel, the slope decreased more rapidly. Small Increases in loads produced large deflections; and the ultimate load was reached soon after. The measured and computed load-deflection curves of the 5 test beams are shown 1n Fig.2 and Fig.3.

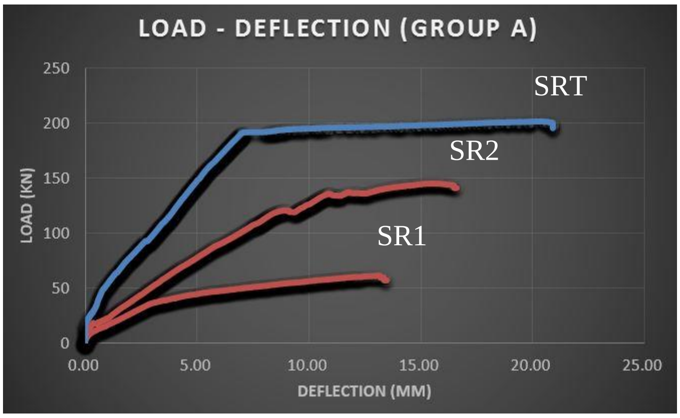


Fig. 2: Loads deflection curves of R.C beams.

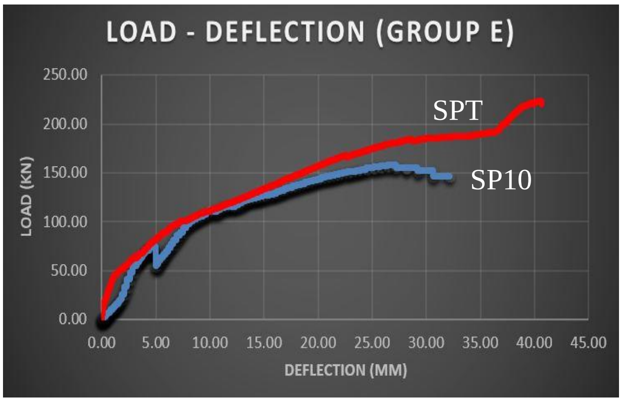


Fig. 3: Loads deflection curves of P.C beams.

The effects of the parameters in prestressed and non-prestressed beams are presented in this part for the R.C beams, and P.C beams.

The failure loads and maximum measured vertical deflections for all the tested beams are summarized in Table 3. Ductility for all beams are compared in Fig. 4.

Table 3: Cracking loads, Failure loads and deflections for all test beams.

Parameter	Groups	Specimens	Cracking load (kN)	Failure load (kN)	Maximum deflection (mm)
Different cross sec. of R.C beams	A	SR1	*10*	*58.67*	*14.55*
		SR2	*24*	*145.07*	*15.54*
		SRT	*95*	*200.34*	*20.7*
Different shapes of P.C beams	E	SP10	*38*	*157.9*	*27.17*
		SPT	*46*	*223.52*	*43.9*

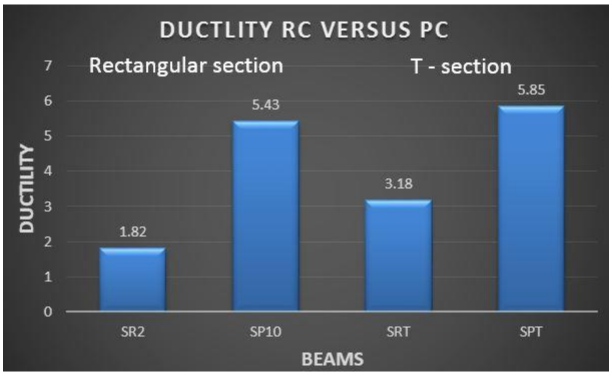


Fig. 4: Ductility of R.C beams versus P.C beams.

Previous research on the performance of buildings during severe earthquakes indicated that structural over strength plays a very important role in protecting buildings from collapse. The over strength factor (Ω) may be defined as the ratio of the actual to the design lateral strength calculated in Equation (4.1) and the results shown in table 4.

$$E.A.I = \frac{A_1 + A_2}{A_1} \quad \text{.................................} \quad (4.1)$$

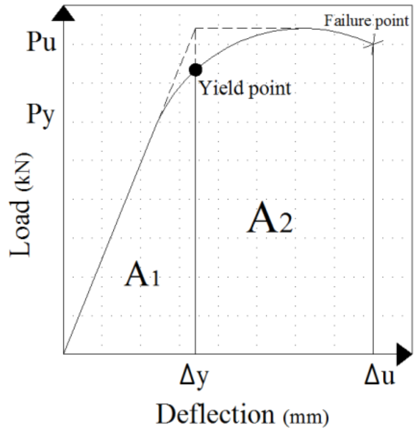


Fig. 5: Load-Vertical Deflection curve showing (A1& A2).

Table 4: Energy absorption index (Deformability) for all beams groups.

Groups	Specimens	*A1*	*A2*	*A1+A2*	**E.A.I**
A	SR1	***122.6***	***1159.2***	***1281.8***	***10.45***
	SR2	***1181.1***	***2379.7***	***3560.8***	***3.01***
	SRT	***1657.2***	***5824.9***	***7482.1***	***4.51***
E	SP10	***829.3***	***14019***	***14849***	***17.9***
	SPT	***2009.1***	***24821***	***26830.6***	***13.35***

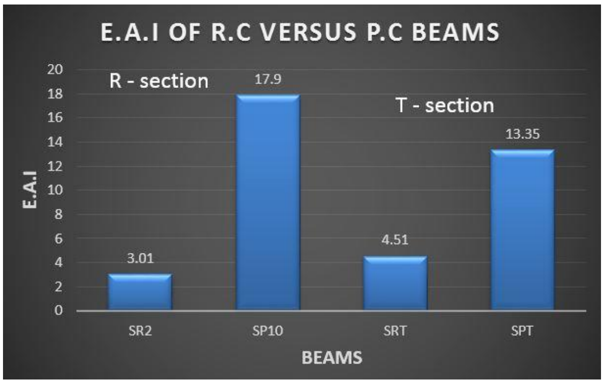


Fig. 6: E.A.I for R.C beams versus P.C beams.

V. CONCLUSIONS

Table 5: All parameters for beams groups A & E.

Groups	**Specimens**	**P_u (kN)**	**Ductility (µD)**	**E.A.I**	**Ki**	**Ks**	$\frac{K_s}{K_i}$
A	SR1	*58.67*	*5.82*	*10.45*	*33.33*	*15.2*	*0.45*
	SR2	*145.07*	*1.82*	*3.01*	*16*	*14.11*	*0.88*
	SRT	*200.34*	*3.18*	*4.51*	*39.58*	*30.76*	*0.77*
E	SP10	*157.9*	*5.43*	*17.9*	*19*	*14.4*	*0.75*
	SPT	*223.52*	*5.85*	*13.35*	*32.85*	*13.33*	*0.4*

From the discussion of Table 5, the following conclusions can be drawn:

- The failure load showed by the equivalent prestressed beam SP10 & SPT as compared to the R.C.C. beams SR2 & SRT was more by 8.84% & 11.57% respectively .
- The failure load showed by the equivalent prestressed beam SP10 as compared to the R.C.C. beams SR1 (same SP10 without prestressing) was more by 169.13%.
- Ductility showed by the equivalent prestressed beam SP10 & SPT as compared to the R.C.C. beams SR2 & SRT was more by 198.3% & 83.9% respectively .
- The energy absorption capacity showed by the equivalent prestressed beam SP10 & SPT as compared to the R.C.C. beams SR2 & SRT was more by 494.6% & 196% respectively.
- The initial elastic stiffness are almost the same for all beams.
- The secant stiffness of beams SR2 & SP10 are almost the same and for SRT compared to SPT is more by 130.7%.

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REFERENCES

[1] Brzev, S., & Pao, J. (2006). Reinforced Concrete Design A Practical Approach. Toronto: Pearson Prentice Hall.
[2] Hewson, N. R. (2003). Prestressed Concrete Bridges: Design and Construction. London: Thomas Telford Publishing.
[3] Lin, T. Y., & Burns, N. H. (1981). Design of Prestressed Concrete Structures. John Wiley & Sons, Inc.
[4] Collins, M. P., & Mitchell, D. (1987). Prestressed Concrete Basics. Ottawa, Ontario: Canadian Prestressed Concrete Institute.
[5] Youakim, S. A., Ghali, ?., Hida, S. E., & Karbhari, V. M. (2007, March-April). Prediction of Long-Term Prestress Losses. PCIJournal .
[6] J.Wolanski(2004) Flexural Behavior Of Reinforced And Prestressed Concrete Beams Using Finite Element Analysis M.Tech Thesis.
[7] M K Maroliya (Nov-Dec 2012), Research oncomparative study of flexural behaviour of reinforced concrete beam and prestressed concrete beam.
[8] A.R.Mundhada, Mohammad Shahezad (July-2012), Research on economics of continuous R.C.C. beams and continuous Pre-stressed concrete.
[9] Anupam Sharma and suresh singh kushwah “Comparative Analysis of Reinforcement and Pre-stressed Concrete Beam” International Journal of Current Engineering and Technology Volume 5, No 4, July 2015.
[10] Comparative Study on Design of RCC and PSC Beams Shaheenjaham, Akshata C Sureban, Megha Chappalagaon, Mudassar Sharif. (B.E Students) Department of Civil Engg, SECAB Institute of Engineering & Technology, Vijayapur, Karnataka, India. Prof. Sachin S Kulkarni (June 2016).