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Comparative Study of RCC and PSC Girder

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Abstract- *Girder is a horizontal member of structure which is basically a beam subjected to loading due to which shearing and straining forces acts on the lateral and axial cross section. The main difference between reinforced concrete girder and prestressed concrete girder is the fact that reinforced concrete combines concrete and steel bars by simply putting them together and letting them act together naturally. On the other hand, prestressed concrete combines high strength concrete with high strength steel which is achieved by tensioning the steel and holding it against the concrete, thus putting concrete into compression. This combination results in a better behavior of two materials. The Girder, when subjected to loading undergoes changes due to applied loads. This paper gives the comparative study of R.C.C.(Reinforced Cement Concrete) Girder and P.S.C.(Prestressed Concrete) Girder, which include the design and estimates of R.C.C. and P.S.C. Girder of various spans. The aim of this work is to study R.C.C .girder as well as P.S.C. girder and then compare the results. The idea is to succeed in a superior conclusion regarding the prevalence of the 2 techniques over each other. R.C.C members are commonly used for residential as well as commercial structures and are generally short span. In R.C.C. depth of girder increases with the increase in span due to deflection limitation. To surmise, R.C.C girder shall be suitable for small to medium span however the prevalence of prestressed concrete girder is undeniable for extended spans.*

Keywords- Girder, R.C.C., P.S.C., Span

I. INTRODUCTION

Concrete frame structures are quite common or perhaps the foremost common form of new construction in our country. From the name we can say that, this sort of structure consists of a frame or the whole structural members of concrete. To construct a frame we used Reinforced Cement Concrete commonly called RCC, this is often one of the development techniques that made construction very easy and brought a boom to the world of construction. In RCC structure cement concrete can take up immense compression but weak in bearing tension whereas steel is good in withstanding both tension and compression. No doubt, RCC framed structure is extremely easy to construct when the span length is from 3 m to 7.5 m but it's not suitable when the span is large and it becomes very cumbersome for giant span because when the span is increased the cross-sectional dimension of the member is additionally increased and it directly increases the self-weight of the member.

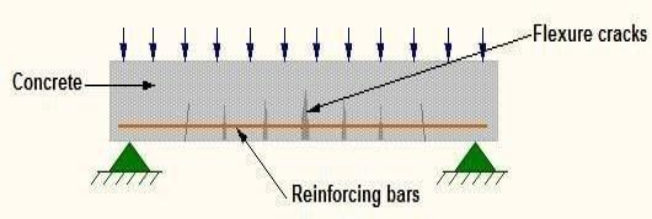

Fig -1: RCC Girder

Prestressed concrete is that the most up-to-date major type of construction introduced in the field of structural engineering because of its own advantage like, the scale or dimension of structural members are reduced, which can increase the clearances or reduce the structure heights. It also permits the design and construction of enormous spans (greater than 30 m) with shallow members, even when a heavy load is encountered.

High strength concrete is important in prestressed concrete, because the material offers high resistance in tension, shear, bond, and bearing. Within the zone of anchorages, the bearing stresses being higher, high –strength concrete is invariably preferred to attenuate costs. High –strength concrete is a smaller amount prone to shrinkage cracks, and contains a higher modulus of elasticity and smaller ultimate creep strain, leading to a smaller loss of prestress in steel. The use of high –strength concrete leads to a reduction in the cross-sectional dimensions of prestressed concrete structural members. With a reduced deadweight of the materials used, an extended span becomes technically and economically practicable. The aim of this work is to examine a girder of RCC as well as PSC variety and then compare the results. The motive is to reach a productive conclusion regarding the superiority of the two techniques over each other.

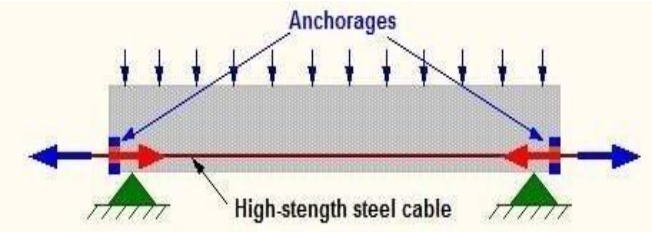

Fig -2: PSC Girder

II. METHODOLOGY

This study is conducted on the RCC moment resisting frame and PSC moment resisting frame with different spans. The plan of the building is given in figure.3.1. Building considered is a single storey building in which rectangular columns are provided. Height of story is 4.5m excluding the depth of foundation and all other concerned data is given in table 1.

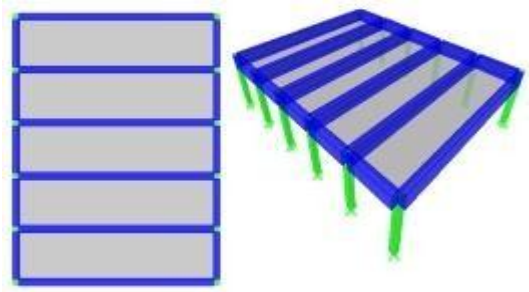

Fig -3: Typical Plan of building

Table -1: Details of specification for model

Plan dimensions	10x22.5 m
Total height of building	6 m
Height of slab	4.5 m
Depth of foundation	1.5 m
Size of girder(beam)	300x700 mm
Size of pier(columns)	500x500 mm
Thickness of slab	150 mm
Thickness of walls	230 mm
Floor finishes	1.5 kN/m^2
Live load at floor	4 kN/m^2
Grade of concrete	M35
Grade of steel	Fe500
Density of concrete	25 kN/m^2
Density of walls	20 kN/m^2

Table -2: Comparison of maximum shear force for different span

SHEAR FORCE		
Span(M)	Shear Force(kN)	%Increase
10	365	-
12	462	26.57
15	657	80.00
18	907	148.493

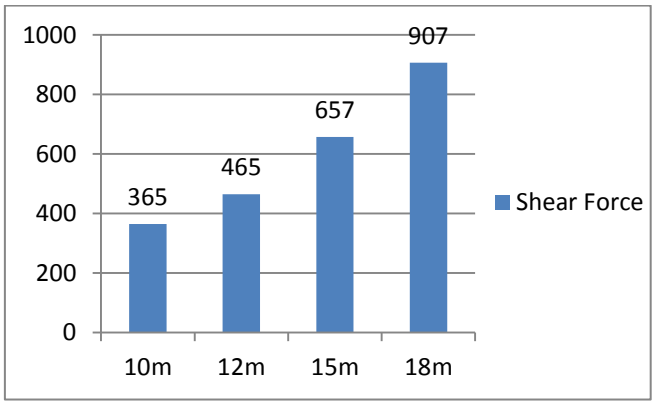

Chart -1: shear force at different spans

Table -3: Comparison of maximum bending moment for different span

BENDING MOMENT		
Span(M)	Bending Moment(kN.m)	%Increase
10	619	-
12	462	26.57
15	657	80.00
18	907	148.493

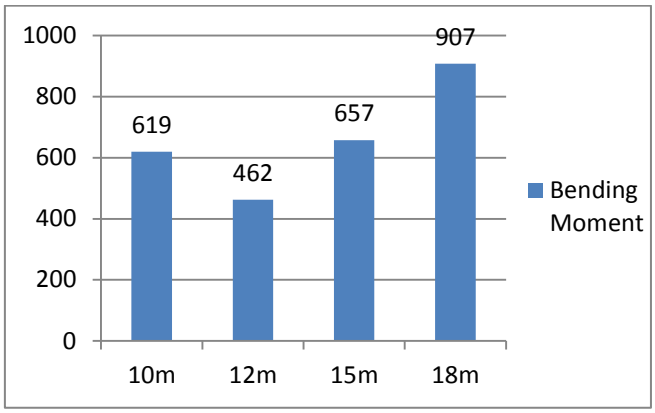

Chart -2: bending moment at different spans

III. ANALYSIS AND RESULT

Table 4 to Table 8 gives the result obtained for RCC Girder and PSC Girder structure with respect to different spans. The result contains the comparison of different elements of the RCC frame structure for different span lengths, comparison of different elements of PSC frame structure.

Each and every table is linked with a graph which is given below every table that represents the comparison among the two in graphical manner.

Table 4 is based on size of girder for RCC and PSC frame structure for different span.

Table 5 gives us difference in the reinforcement for RCC and PSC girder structure for different span.

Table 6 gives us difference in the concrete for RCC and PSC girder structure for different span.

Table 7 shows us the deflection of girder for RCC and PSC frame structure for different span.

Table 8 finally gives us the most important thing which is comparison of total cost of One RCC girder and One PSC girder for different span.

While calculating the cost of PSC Girder cost of accessories like spilt cones, bearing plates, sheathing duct and cost of prestressing are considered.

From spans 10 m to 18 m, PSC Girder is economical, as the span increases its economic efficiency also increases. The deflection of Girder also gets reduced in the case of PSC which satisfies the limit state of serviceability & durability. The result also shows the saving of concrete quantity and reinforcement but as there is a huge saving of material in prestressed concrete structure but on the other hand to execute the prestressed concrete work one requires skilled labor and accessories.

Currently in India Prestressed Concrete structure is more popular and is widely used in the construction of Bridges as well as in commercial building and industrial building. For small span Reinforced Cement Concrete structure is more suitable.

Table -4: Comparison of size of girder for RCC and PSC frame structure for different span

RCC GIRDER			PSC GIRDER		% Reduction
Span (M)	Width (mm)	Depth (mm)	Width (mm)	Depth (mm)	
10	300	750	300	600	25
12	350	900	350	650	38.46
15	450	1100	450	850	29.41
18	600	1350	600	1000	35

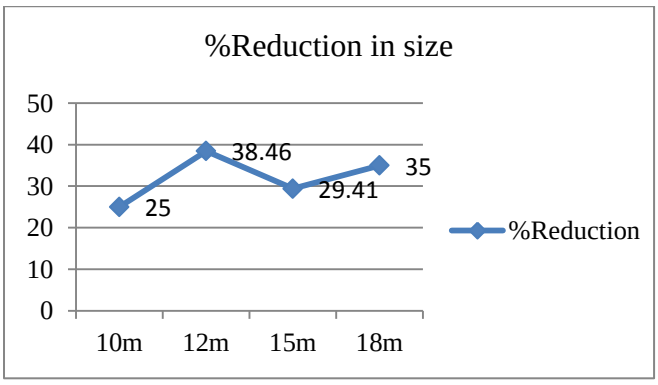

Chart -5: reduction in size for each span

Table -5: Comparison of reinforcement for RCC and PSC girder structure for different span

Span(M)	RCC	PSC	% Reduction
	Quantity(kg)	Quantity(kg)	
10	495	88.4	460
12	788	109.1	622
15	2028	203.2	898
18	2443	349.4	599

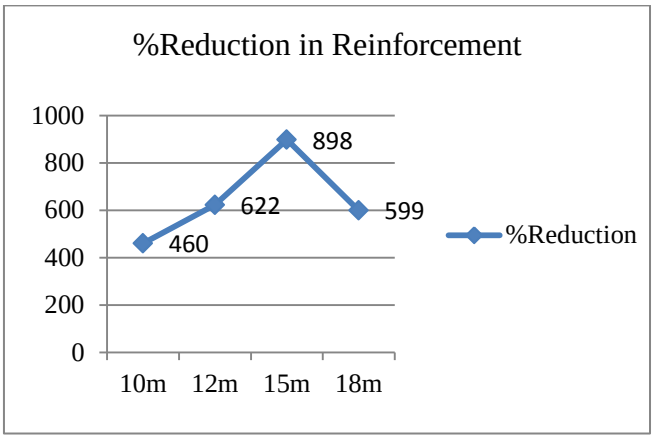

Chart -6: reduction in reinforcement at each span

Table 6- Comparison of quantity of concrete in girder for RCC and PSC frame structure for different span.

Span (M)	RCC	PSC	% Reduction
	Quantity (m^3)	Quantity (m^3)	
10	14	11	25
12	23	16	42
15	45	34	31
18	87	65	35

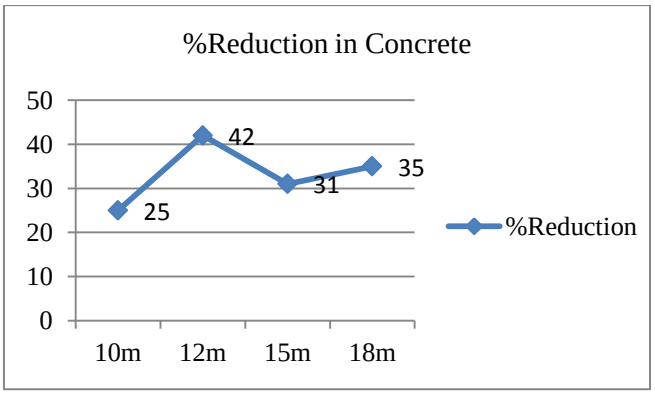

Chart -1: reduction in concrete quantity for each span

Table -7: Comparison of deflection of girder for RCC and PSC frame structure for different span

Span (M)	RCC	PSC	Allowable short term deflection (mm)	% Reduction
10	25.50	7.32	40	284
12	33.41	17.2	48	94
15	29.69	22.19	58	34
18	33.99	28.68	70	19

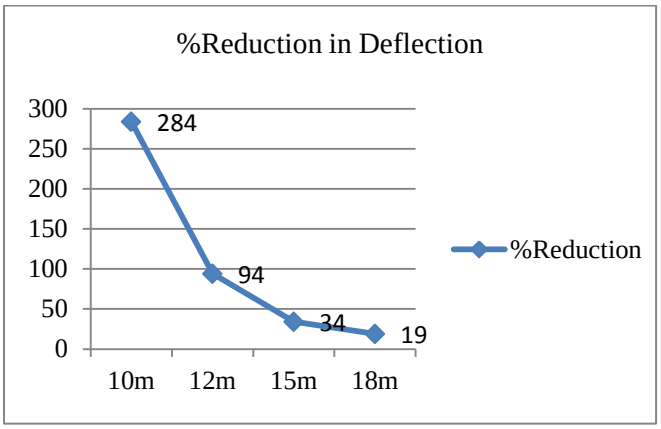

Chart -7: reduction in deflection at each span

Table 8- Comparison of total cost of One RCC girder and One PSC girder for different span.

Span(M)	RCC	PSC	% Reduction
	Cost	Cost	
10	41178.38	33182	24.09
12	66936.45	50714.21	31.98
15	156185.70	100543.50	55.34
18	223726.70	174879.60	27.93

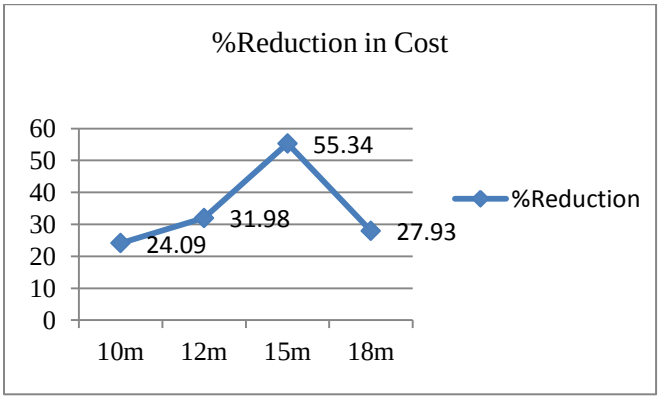

Chart -8: reduction in cost of girder at each span

IV. CONCLUSIONS

Based on the study conducted, it could be concluded that-

Reinforced concrete beams are generally heavy. They always need shear reinforcements besides the longitudinal reinforcement for flexure. Prestressed concrete beams are lighter. By providing the curved tendons and the pre-compression, a considerable part of the shear is resisted.

In reinforced concrete beams, high strength concrete is not needed. But in prestressed concrete beams, high strength concrete and high strength steel are necessary. Reinforced concrete beams being massive and heavy are more suitable in situations where the weight is more desired than strength. Prestressed concrete beams are very suitable for heavy loads and longer spans. They are slender and artistic treatments can be easily provided. Cracks do not occur under working loads. Even if a minute crack occurs when overloaded, such crack gets closed when the overload is removed. The deflections of the prestressed concrete beams are small.

Prestressed concrete sections are thinner and lighter than RCC sections, since high strength concrete and steel are used prestressed concrete.

V. REFERENCES

[1] IS 456-2000 Plain and Reinforced Concrete - Code of Practice.
[2] IS: 800:2007 – Code of Practice for general construction in Steel
[3] IS 1343-1980 Code of Practice for Prestressed Concrete (First Rivision)
[4] IRC 6-2010, "Standard Specifications and Code of Practice for Road Bridges", Section II, loads and stresses, The Indian Roads Congress, New Delhi, India, 2010
[5] Krishna Raju, 2013. "Prestressed Concrete", Fifth Edition, McGraw- Hill Education (India) Pvt. Ltd. New Delhi.
[6] Dr. B.C. Punamia, "R.C.C. Design (Reinforced Concrete Structure)", Laxmi Publisher, 2006.
[7] Vakas K.Rahman & Prof. A.R. Mundhada "Comparative study of R.C.C. and Prestressed Concrete Flat Slab"
[8] Rajamoori Arun Kumar & B. Vamsi Krishna "Design of Pre-stressed concrete T-beams", International Journal of Scientific Engineering and Research, Vol-2, Issue 8, August 2014
[9] Suchitra De & Shraddha Sharma "Economics of Continuous RCC and Prestressed Concrete beam and design in MS-Excel", International Journal of Innovations in Engineering and Technology, vol.7, Issue 2 August 2016.
[10] V.Kavitha, K.P.Nandhini, P.Prakash, Dr.N.Arunachalam "Economical Design of Prestressed Concrete Beams", International Journal of Innovative

Research in Science, Engineering and Technology, Vol.5, Issue3, March 2016.
[11] A.R. Mundhada & Mohmmad Shahezad "Economics of continuous R.C.C. Beams Vis à-vis Continuous Pre-Stressed Concrete Beams", International Journal of Scientific & Engineering Research, Volume 3, Issue 7, July 2012.