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Flexural Behavior of RCC Beam Using Confined Reinforcement with Helical Stirrups

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Abstract: In the present condition the cost of construction goes on increasing due to usage of steel. In order to improve the tensile strength in concrete and reducing the usage of steel, a new type of reinforcement is essential for making an economical building. The main objective of our project is to reduce the usage of steel by providing helical stirrups in the reinforcement recommended as per IS 456:2000. By this method of reinforcement, we can achieve flexure in reinforced concrete beams which opposes conventional method of reducing the neutral axis depth of the beam. The under reinforced section of the beam can be achieved by this method of helical stirrups in the reinforcement. Steel is introduced in the tension zone to take the tensile stress, but as strength of concrete is ignored in tension zone with respect to compression zone. The objective of this research is to investigate the behavior of singly, doubly and confined reinforced beams. Ultimate load, deflection load, compressive stresses and tensile stresses were compared with the controlled plain reinforced helical stirrups beams. Single and double reinforced concrete beams were cast and tested for this purpose of investigation. The results obtained have indicated that enhanced the strength of concrete.

I. INTRODUCTION

General

Concrete is one of the materials of construction where the strength, workability, durability, impermeability, fire resistance and abrasion are required. The concrete is generally made by cementing materials, fine aggregate (sand), coarse aggregate and with appropriate water cement ratio. The natural and cheapest resource of fine aggregate is river sand. Dams, Buildings and other structures are constructed every year and hence these resources are erasing very fast. This study investigates to change the reinforcement types. In this study standard size beams for M 20 grade of concrete were used under flexure by applying two points load.

Need of the present study

The challenge before a construction engineer is that, with the available knowledge of concrete technology, can a structurally sound concrete can be developed using ecofriendly materials economically. To answer this, the present investigation has been focused on effective utilization manufactured sand in place of river sand in concrete. In this phase of study, the reinforcements were providing normal type and provide Tension zone, Tension zone cum Compression zone. Mostly tension zone are going to failure, this study going to provide prefer without reinforcement in compression zone what are all the defects to face and provide reinforcement some distance in compression zone.

II. METHODOLOGY

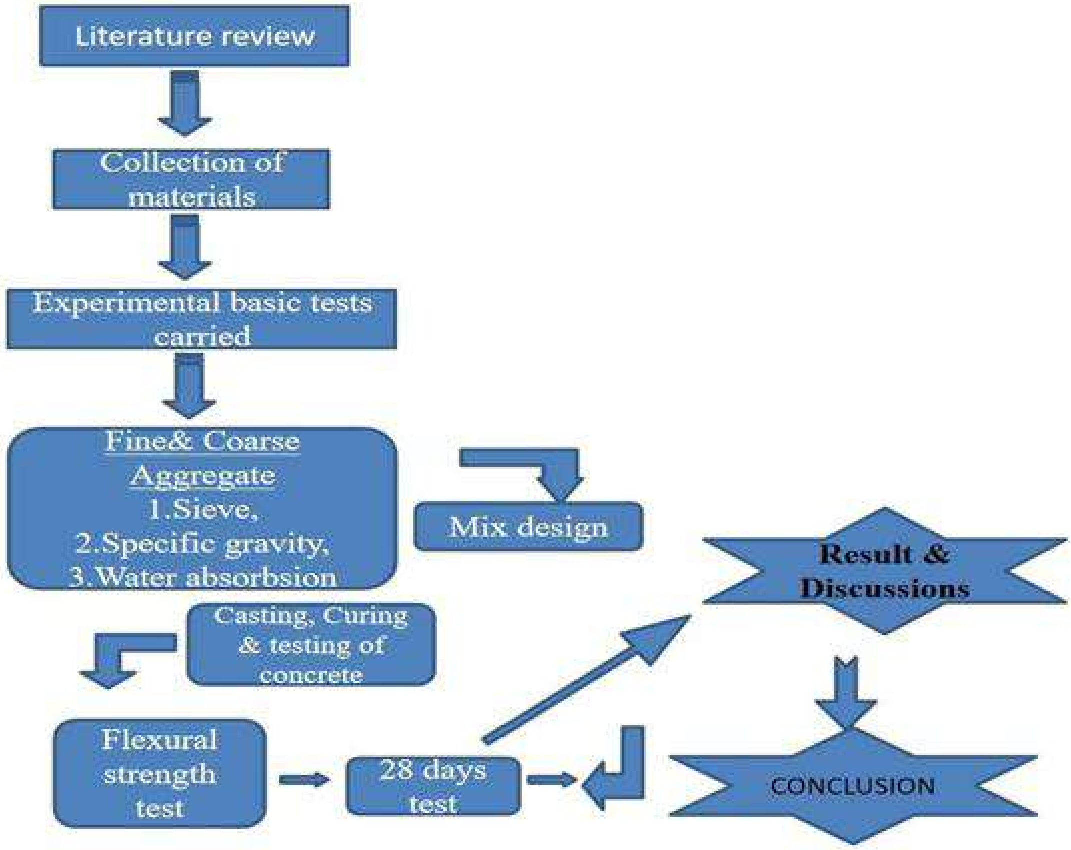


Fig.1 Methodology Flow Chart

III. LITERATURE REVIEW

1. An Experimental Study On The Flexural Behavior Of Frp Rc Beams And A Comparison Of The Ultimate Moment Capacity With Aci, Journal of Civil Engineering and Construction Technology, Vol. 1(2), pp. 27-42, December 2010, Iman Chitsazan, Mohsen Kobraei, Mohd Zamin Jumaat, Payam Shafigh.

In this journal use fiber reinforced polymer bars are typically quite different from those of steel bars and they depend mainly on both matrix and fibers type, as well as on their volume fraction; although generally, FRP bars have lower weight, lower modulus of elasticity, but higher strength than steel. In the other hand, FRP has disadvantages, for instance: no yielding before brittle rupture and low transverse strength. In this research, we have investigated flexural behavior in reinforced concrete beams with glass fiber- reinforced polymer (GFRP) and have analyzed the different kinds of failure, ultimate moment capacity, deflection, load of first crack, how to create and expand cracks, tensile and compressive strains created on beam and position of neutral axis (NA) during loading for different ratios. Using high strength concrete instead of normal concrete and increasing the effective depth over the breadth on flexural behavior of concrete beams with GFRP had been studied. As such an increase in concrete strength does not have any effect on deflections. When the diameter of the bar is constant, a reduction of beams' dimension caused a significant increase in the deflection of beams.

2. Flexural Strength Of Fibrous Ultra High Performance Reinforced Concrete Beams, APRN journal of engineering and applied science, Vol. 8, No. 3, MARCH 2013, Wasan, Khalil and Tayfur.Y.R.

In this journal the flexural behavior of ultra high performance conventionally reinforced concrete beams containing hooked and crimped steel fibers with different volume fractions (0.5%, 0.75% and 1%) in full and partial depths of beams cross sections is studied in this investigation. The load deflection relationship, resilience, toughness, indices, first crack load, ultimate load and concrete strains were investigated. The experimental results show that the addition of steel fibers slightly enhances the load-deflection relationship and ultimate load for beam specimens. The type of steel fibers (crimped and hooked) has a little effect on load- deflection behavior, ultimate moment capacity, cracking pattern, while in resilience and toughness, beam specimens with hooked steel fiber showed slightly better behavior than those with crimped steel fibers. The resilience of full depth fiber reinforced specimens containing hooked steel fibers with volume fractions 0.75% and 1% is considerably improved, the percentage increase relative to the reference beam is about 36% and 35% respectively.

3. Flexural Behavior of Steel Fiber Reinforced High-Strength Concrete Beams, Research Journal of Applied Sciences, Engineering and Technology 6(1): 1-6, 2013.

In this journal using steel fiber to increase flexural behavior 4 different beam heights were used Results reveal that the bearing capacity and the measured deflection of the steel fiber reinforced high-strength beams are much larger and the breaking of the compression zone is not too serious compared with the reinforced concrete beam.

A considerable increase for the ultimate flexural capacity of the beams was observed by increasing the steel fiber volume dosage. Besides, the longitudinal reinforcement ratio has great effect on the ultimate flexural capacity of steel fiber reinforced high-strength concrete beams and the ultimate flexural capacity is increasing gradually with the increase of the longitudinal reinforcement ratio. Compared with the reinforced concrete beam, the bearing capacity and the measured deflection of the steel fiber reinforced high- strength beam are much larger and the breaking of the compression zone is not too serious, which reflects the improvement of reinforcing and toughening of steel fibers. A considerable increase for the ultimate flexural capacity of the steel fiber reinforced high-strength concrete beams was observed by increasing the steel fiber volume dosage. The longitudinal reinforcement ratio has great effect on the ultimate flexural capacity of steel fiber reinforced high-strength concrete beams. The ultimate flexural capacity is increasing gradually with the increase of the longitudinal reinforcement ratio.

4. An experimental study on flexural strength enhancement of concrete by means of small steel fibers, A. Namdar et alii, Frattura ed Integrità Strutturale, 26 (2013), Abdoullah Namdar, Ideris Bin Zakaria, Azimah Bt Hazeli, Sayed Javid Azimi, Abdul Syukor Bin Abd. Razak.

In this journal to analyse the flexural strength without using reinforcement to increase the strength Cost effective improvement of the mechanical performances of structural materials is an important goal in construction industry. To improve the flexural strength of plain concrete so as to reduce construction costs, the addition of fibers to the concrete mixture can be adopted. The addition of small steel fibers with different lengths and proportion have experimentally been analyzed in terms of concrete flexural strength enhancement. The shear crack, flexural crack and intermediate shear-flexural crack have been studied. The research outcomes indicate that this method is one of the easiest, cost effective technique and less time consumer for enhancement of flexural strength of concrete beam. In steel-concrete mixture design, different proportion and length of steel fibers have been used. Increase quantity of fiber, improves flexural strength of beam. To improve flexural strength of thin cross section concrete the proposed method is well suitable.

5. Flexural behaviour and size effects of full scale Reinforced Lightweight Concrete Beam, journal of Marine and Technology, Vol. 19, No. 2, pp. 132-140(2011), Chung- Hao Wu, Yu-Cheng Kan, Chung-Ho Huang, Tsong Yen, and Li-Huai Chen.

In this journal indicated that the reinforced lightweight aggregate concrete (LWAC) beams had a similar load capacity and failure mode as those of normal weight concrete (NWC) beams, but demonstrated larger ultimate deflections and curvature ductility. The curvature ductility of both types of concrete beam decreased as the reinforcement ratio increased. On the other hand, an increase of the beam dimension lead to increases of the load and deflection at the yielding strength and ultimate strength, but reduced the ultimate deflection ratio for both types of concrete beams. The LWAC beams with similar cross-sections and concrete strengths can exhibit load capacity equivalent to that of the NWC beams, but demonstrate larger ultimate deflections than those of NWC beams. The variation pattern of curvature ductility of LWAC beams, same as that of NC beams, decreases with an in- crease of the reinforcement ratio, indicating that the LWAC beams exhibit similar flexural behavior as that of NWC beams. The loads and deflections corresponding to the yielding strength and ultimate strength of the LWAC and NWC beams increase as the specimen size increases.

6. Behavior of Fiber Reinforced Concrete Beams with spliced Tension steel Reinforcement, Vol. 3 – March 2012, Mohamed A. Safan , Department of civil Engineering, Faculty of Engineering.

In this journal I studied about to describe the flexural and bond behaviour of simply supported concrete beams with tension reinforcement spliced at mid-span. The parameters included in the study were the type of the concrete, the splice length and the configuration of the hooked splice. The test results in terms of cracking and ultimate loads, cracking patterns, ductility, and failure modes are reported. The results demonstrated the consequences due to short splices and the improvement in the structural behaviour due to the use of hooks and the confinement provided by the steel and polypropylene fibers. A splice length that was 36 percent longer than that allowed by the ACI 318-08 code detailed equation for the development length (Eq. 12.1) was not adequate for developing full bond strength and yielded brittle modes of splitting bond failures in plain concrete. The above splice length was more detrimental concerning the mode of failure and the small number of cracks at failure, while the ultimate load was reduced by only 7.0 percent. Compared to counterpart plain concrete beams, the use of polypropylene fibers increased the ultimate loads by 19 percent and 4 percent when 45-degree and 90-degree end hooks were used, respectively. The corresponding ratios were 27 percent and 8 percent when steel fibers were used.

7. Flexural Behaviour of Sand coated Glass-Fibre Reinforced Polymer (GFRP) Bars in Concrete, 29th Conference on OUR WORLD IN CONCRETE & STRUCTURES: 25 - 26 August 2004, R.V. Balendran*, City University of Hong Kong, SAR China, W.E. Tang, City University of Hong Kong, SAR China H.Y., Leung, City University of Hong Kong, SAR China, A.Ndeem, City University of Hong Kong, SAR China.

This paper presents the results of an experimental study of flexural behaviour of sand coated' G FRP bars in concrete, Previous studies on the general properties of GFRP bar, and its flexural behaviour with concrete are briefly reviewed. Tension test results indicated that the ultimate tensile strength and elastic modulus of GFRP bar was about 2.5 times and 25 % that of mild steel bar respectively. Results of the beam tests indicated that the ultimate strength of sand coated GFRP reinforced specimens was 1.4 -2 times greater than that of the mild steel reinforced specimens but exhibited a higher deflection. The ultimate tensile strength of GFRP bars was about 2.5 times that of MS bar, but their elastic modulus was only one-fourth that of MS bars. Once the first crack occurred, beams reinforced with the GFRP bars in general tended to deflect more rapidly and non-linearly with the load than in the case of MS reinforced beams.

It should be noted that the ultimate strength of sand coated GFRP reinforced specimens were 1.4 -2 times greater than that of the mild steel reinforced specimens but exhibited a higher deflection to failure. It should be noted that the ultimate strength of sand coated GFRP reinforced specimens were 1.4 -2 times greater than that of the mild steel reinforced specimens but exhibited a higher deflection to failure.

IV.MATERIAL

Cement

The Ordinary Portland cement (OPC) of 53 grades is used for the production of concrete. Standard consistency, specific gravity and fineness as percentage retained on 90 microns sieve were found. The IS 12269- 1987 code is referred for Identifying the properties of 53 grade ordinary Portland cement.

Manufacturing of Ordinary Portland cement

The raw materials required for manufacture of Portland cement are calcareous materials, such as limestone or chalk and argillaceous materials such as shale or clay. Cement factories are established where these raw materials are available in plenty. Cement factories have come up in many regions in India, eliminating the inconvenience of long distance transportation of raw and finished materials. The process of manufacturing of cement consist of grinding the raw materials, mixing them intimately in certain proportion depending upon their purity and composition and burning them in a kiln at a temperature of about 1300 to 1500°c, at which temperature, the material sinters and partially fuses to form nodular shaped clinker. The clinker is cooled and ground to fine powder with addition of about 3-55gypsum. The product formed by using this procedure is Portland cement. There are two processes known as "wet" and "dry" process depending upon whether the mixing and grinding of raw materials is done in wet or dry condition.

Chemical composition of ordinary Portland cement

The raw materials used for manufacture of cement consist mainly of lime, silica, alumina and iron oxide. These oxides interact one with another in the kiln at high temperature to form more complex compounds. The relative proportions of these oxide compositions are responsible for influencing the various properties of cement, in addition to rate cooling and fineness of grinding. The table shows the approximate oxide composition limits of ordinary Portland cement.

Table 4: Approximate oxide composition limits of ordinary Portland cement

S.No	Oxides	Percentage
1	CaO	60-67
2	Sio2	17-25
3	Al2O3	3-8
4	Fe2O3	5-6
5	MgO	1-4
6	Alkalies(K2O,Na2O)	4-1.3
7	So3	1-3.3

SAMPLING OF CEMENT

Samples shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling. When it is not possible to tests the samples within one week, the samples shall be packed and stored in air-tight containers till such time that they are tested

FINENESS TEST OF CEMENT

The fineness of cement had an important bearing on the rate of hydration and hence on the rate of gain of strength and the rate of evaluation of heat. Finer cement offers a greater surface area for hydration and hence faster the development of strength. About 100 grams of cement is taken on a standard IS Sieve NO.9(90 microns). Break down the air – set lumps in the sample with fingers. The sample is continuously sieved giving circular and vertical motion for a period of 15 minutes. This weight of the residue left on the sieve not exceeds 10 percent.

STANDARD CONSISTENCY TEST

For finding out the initial setting time, final setting time and soundness test of the cement, and strength a parameter known as standard consistency has to be used. The following procedure is adopted to find standard consistency of cement. About 500 grams of cement is taken and paste is prepared with water (say 24% of water by weight of the cement) as first trial. The paste is prepared in standard manner and filled in to the vicatmould within 3-5 minutes. After completely filling the mould, shake the mould to expelled air. A standard plunger, 10mm diameter, 50mm long is attached and quickly released and allowing it to sink in to the paste in the test block and quickly released and allowing it to sink in to the paste by its own weight.

INITIAL SETTING TIME TEST OF ORDINARY PORTLAND CEMENT

The vicat apparatus is used for setting time test. The following procedure is adopted. Take 500 grams of cement sample and gauge it with 085P. The paste is gauged and vicatmould in specified manner within 3-n minutes. Start the stop watch the moment water is added to the cement. Lower the needle gently and bring it in contact with the surface of the test block and quickly release. After some time the paste start to losing plasticity, the needle may penetrate only to a depth of 33-35mm from top. The period elapsing between the time when water id added to the cement and the time at which the needle penetrate the test block to depth equal to 33-355mm from the top is taken as initial setting time.

FINAL SETTING TIME OF ORDINARY PORTLAND CEMENT

Replace the needle of the vicat apparatus by a circular attachment. The cement shall be considered as finally set when, upon, lowering the attachment gently cover the surface of the test block, the center needle makes an impression.

while the circular cutting edge of the attachment fails to do so. In other words the paste has attained such hardness that the centre needle does not pierce through the paste more than 0.5mm.

AGGREGATE

Aggregate are the important constituents in concrete. They give body to the concrete, reduce shrinkage effect and economy. Almost all natural aggregate materials orginate from bed rocks. The granite group, the quality of aggregate may vary to very great extent owing to changes in the texture and structure of the mai parent rock from place to place.

(i) Coarse aggregate
(ii) Fine aggregate

The size of aggregate bigger than 4.75mm is consider as coarse aggregate and aggregate whose size less than 4.75mm is considered as fine aggregate.

SHAPE OF THE AGGREGATE

The shape of the aggregate an important characteristic since it affects the workability of concrete. From the standard point of economy in cement required for given water / cement ratio rounded aggregates are preferable to angular aggregates. Flat particles in concrete will aggregates will have particularly objectionable influence on the workability; cement required strength and durability. In general, excessively flaky aggregates make very poor concrete. The angular aggregate exhibit a better interlocking effect in concrete, which property makes it superior in concrete used for roads and pavements. The total surface area of rough textured angular aggregates is more than smooth rounded aggregate for the given volume. By having greater surface area, the angular aggregate may show higher bond strength than rounded aggregate.

SIEVE ANALYSIS OF AGGREGATE

This is the name given to the operation of dividing the sample of aggregate into various fractions each consisting of the same size. The sieve analysis is conducted to determine the particle size distribution in a sample of aggregate which we call gradation. The aggregate used for making concrete are normally 80mm, 40mm, 20mm, 10mm, 4.75mm, 2.36mm, 1.18mm, 600 micron, 300micron and 150micron. Grading pattern of sample of C.A or F.A is assessed by sieving a sample successively through the entire sieves mounted one over the other in order of size, with larger sieve on the top. The materials retained on each sieve after shaking, represents the fraction of aggregate. Sieve can be done either mechanically or manually.

GRADING OF AGGREGATE

One of the most important factors for producing workable concrete is good gradation of aggregate. A sample of the well graded aggregate containing minimum voids is requiring minimum paste to fill up thevoids in the aggregate. Minimum paste will mean less quantity and less quantity and less quantity of water which will further mean increased economy, higher strength, lower shrinkage and greater durability.

FIG. 2: MATERIALS

COARSE AGGREGATE

The nominal maximum size of the coarse aggregate is of 20mm. the sieve analysis of the coarse aggregate is presented in table 6. The sieve analysis revealed that the coarse aggregate falls in the Zone I as per IS 383-1972. The specific gravity and fineness modulus of the coarse aggregate was 2.87 and 2.87 respectively.

Table 5: Sieve Analysis of Course Aggregate

Sieve Size (mm)	Wt. Retained (gms)	% of Wt. Retained	Cumulative % Retained	Cumulative % Passing	I.S. Limit
25 mm	20	0.67	0.67	99.33	
20 mm	415	13.83	14.5	85.5	85-100
16 mm	1503	50.1	64.6	34.5	
12.5 mm	929	30.96	95.56	4.44	
10 mm	109	3.63	99.19	0.81	0-20
4.75	24	0.8	99.99	0.01	

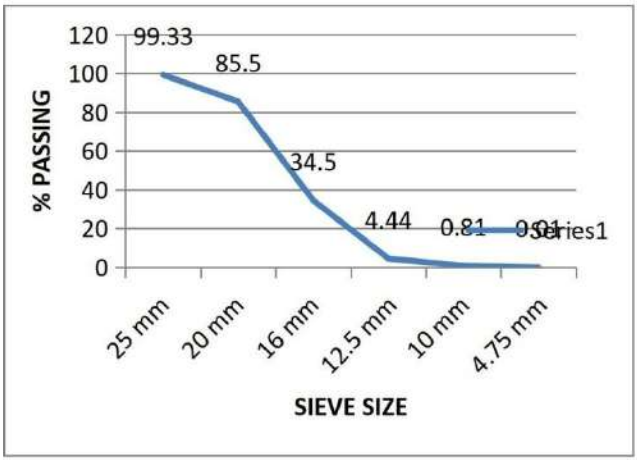


FIG. 3: SIEVE ANALYSIS (COARSE AGGREGATE)

SPECIFIC GRAVITY OF 20 MM AGGREGATE

Wt. of Empty Pycnometer : 667gms
Wt. of Pycnometer + Full water: 1567gms- A Wt. of Pycnometer + Appx half water: 1044gms- B
Wt. of Pycnometer + Appx half water + sample: 1459gms- C
Wt. of sample: 415gms- D
Wt. of Pycnometer + Full water + sample: 1824gms- E
Calculation: F= (D+A)-E = (415+1567) – 1824 =158 Sp. Gravity = D/F = 415/158 = 2.62650

WATER

Water is an important ingredient of concrete as it actively participates in the chemical reaction with the cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very careful. Portable water is used for concreting and curing purpose.

Table 6: THE PERMISSIBLE LIMITS OF SOLIDS PRESENTS IN THE WATER AS PER IS 456-2000

S.No	Materials	Permissible limits
1	Organic	200mg/l
2	Inorganic	3000mg/l
3	Sulphates	400mg/l
4	Chlorides	2000mg/l
5	Suspended matter	2000mg/l

Algae in mixing water may cause a marked reduction in strength in concrete either by combining with cement to reduce the bond or by causing large amount of air entrainment in concrete. Algae which are present on the water surface the aggregate have the same effect as in that of mixing.

FINE AGGREGATE

Fine aggregate used for the study should be properly graded to give the minimum voids ratio and shall be free from deleterious materials like clay, silt content and chloride contamination. River sand is normally preferred over crushed sand since in the former particle shape is fully water worn by attrition which helps in reduction of water content of mix and also lesser resistance to pumping.

Table 7: Properties of Fine Aggregate

Fineness modulus	2.31
Specific gravity	2.65

V. MIX DESIGN

The concrete mix for the manufactured sand is done as per IS 10262-2009. The detailed concrete mix design concrete designing is done. Summary of quantity of materials adopted for different parameters of M20 Grade concrete.

Mix design for a concrete of M 20 Grade

A-1. Design Stipulation

a. Grade designation = M 20
b. Type of cement = OPC 53 grade confirming to IS 8112
c. Max nominal size of aggregate = 20 mm
d. Minimum cement content = 320 kg/m^3
e. Maximum water cement ratio = 0.45
f. Workability = 100 (slump)
g. Exposure condition = Severe (for rcc)
h. Method of concrete placing = Hand
i. Degree of supervision = Very Goo
j. Type of aggregate = Crushed angular aggregate
k. Maximum cement content = 450 kg/m^3

A-2. Test data for materials

a. Cement used = OPC 53 Grade
b. Specific gravity of cement = 3.15
c. Coarse aggregate = 2.70
d. Fine aggregate = 2.65
Water absorption
e. Coarse aggregate = 0.50%
f. Fine aggregate = 1.0%
g. Free surface moisture
Coarse aggregate = nil
Fine aggregate = nil
d. Sieve analysis
Coarse aggregate = Zone - grade III
Fine aggregate = Zone – single graded 20 mm
e. Chemical admixture = Super plasticizer confirming to IS 9103

A-3. Target strength for mix proportioning

f^{l} ck = fck + 1.65s
= 20 + 1.65x4
Target strength f^{l} ck = 26.60 N/mm^2 A-4. Selection of water cement ratio
From table 5 of IS 456-2000, maximum water cement ratio = 0.50
Based on experience adopt water cement ratio
e. Mass of coarse aggregate= e x volume of C.agg x specific gravity of C.agg x 1000
= 0.812 x 0.65 x 2.70 x 1000
= 1425.06 kg
f. Mass of fine aggregate = e x volume of F.agg x specific gravity of F.agg x 1000
= 0.812 x 0.35 x 2.65 x 1000
= 753.13 kg

6.1.2 Normal concrete M20 Grade / cum

A-5. Selection of water content

From table 2 maximum water content =186 lit (for 25 to 50 mm slump)
Estimated water content for 100 mm slump (add 6% for every 50 mm slump)
= 186+ (6/100)186
= 197 litre A-6. Calculation of cement content
Cement content = 197/0.50
= 394 kg
From table 5 of IS 456-2000, minimum cement content for severe condition
= 320 kg
= 394 > 320 kg hence O.K

Proportion of volume of coarse aggregate and fine aggregate content. From table 3 volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (zone III) for water cement ratio of 0.45 = 0.64 For water content ratio of 0.45(+ 0.01 for every 0.05 reduction in water cement)
0.45 = 0.64+ (0.01)1 = 0.65
Volume of coarse aggregate = 0.65
Volume of fine aggregate = (1-0.65) = 0.35

Mix calculations

a. volume of concrete =1 cum
b. volume of cement = mass of cement x 1
Specific gravity of cement 1000
197 x 13.15/1000
= 0.063 cum
c. volume of water = mass of water x 1
Specific gravity of water 1000*394 x 1
3.15 1000
= 0.125 cum
d. volume of all in aggregate={ a-(b+c)}
= 1-(0.063+0.125) = 0.812 cum
Cement = 394 Kg/cum Course aggregate = 1425.06 Kg/cum Fine aggregate = 753.13 Kg/cum
Water = 197 liter Water cement ratio = 0.50/cu

VII. EXPERIMENTAL PROGRAMME

The test program consisted of reinforced concrete beams that were designed, constructed and tested in flexure to achieve the research objectives. Three of the beams were tested as control beams. The beam dimensions were 2000 mm × 150 mm × 200 mm and the beams were designed as under reinforced in accordance with IS 456-2000 with nominal bending moment. The shear failure was prevented by using spiral stirrups Φ12@150mm, Φ10@150mm and Φ8@150mm stirrups nominal diameter deformed steel bars were used for the longitudinal reinforcement.

BATCHING OF CONCRETE

There are two methods of batching volume batching and weigh batching. The volume batching is not a method for proportioning the materials because of the difficulty it offers to measure granular material in terms of volume. The amount of solid granular material is indefinite quantity. Weigh batching is the correct method of measuring the materials.

MIXING PROCESS OF CONCRETE

Thorough mixing of the materials is essential for the production of uniform concrete. The mixing should ensure that becomes homogeneous, uniform in color and consistency. Concrete grade M20 is proportioned by adopting IS method of designing. The mixing is done manually. The object of mixing is to coat the surface of all aggregates particles with cement paste, and to blend all ingredients of concrete into a uniform mass. The mixing action of concrete involves two operations.

(i) A general blending of different particle sizes of the ingredients to be uniformly distributed throughout the concrete mass, and

(ii) A vigorous rubbing action of cement paste on to the surface of the inert aggregate particles.

The aggregate is spread in a uniform layer on a hard, clean and non-porous base, cement is then spread over the aggregate and the dry materials are mixed by turning over from one end of the heap to another and cutting with a shovel until the mix appears uniform.

SLUMP CONE TEST

Slump cone test is the most commonly used method of measuring consistency of concrete which can be employed either in the laboratory or site of work the workability and quality of concrete can be obtained by observing the manner in which concrete slumps. The apparatus for conducting the slump test essentially consists of a metallic mould in the form of a frustum of a cone having the internal dimension as under. The mould for the specimen is in the form of the frustum of a cone of bottom diameter 20cm, top diameter 10cm and height 30cm. The internal surface of the mould is thoroughly cleaned, and placed on a smooth, horizontal rigid and nonabsorbent surface, the mould being firmly held in place when it is being filled. The mould is filled with fresh concrete in four layers, each approximately one quarter of the height of the mould. Each layer shall be uniformly distributed over the cross section of the mould and for the second and subsequent layer shall penetrate into the underlying layer. After the top layer has been rodded, the concrete is struck off level with a trowel so that mould is exactly filled. The mould is removed from the concrete by raising it slowly in a vertical direction. The concrete subsides and the slump is measured immediately by determining the difference between the height of the mould and the highest point of the specimen being tested. Any slump specimen whom collapses or shears off laterally gives incorrect result and if this occurs the test is repeated with another sample. If in the repeat test also, the specimen shears the slump is measured and the fact that the specimen sheared is recorded

FIG. 4: SLUMP CONE TEST

CASTING OF REINFORCED CONCRETE BEAM

The optimum mix proportion obtained from the cube test result is used for mixing. For casting of beam specimens, steel moulds of internal dimensions 2000mm x 150mm x 200mm were used. For easy removal of mould oil was smeared on the inner sides of the mould. 2 No of 12mm and 2 No of 10 mm diameter TMT bars were used as longitudinal reinforcement out of which 2 No of 10 mm diameter bars at top and 12 mm of diameter bars at bottom and 8 mm diameter of two legged stirrups at a spacing of 0.75 d was used at a full and half the depth alternatively.

The reinforcement after fabrication was placed in the mould and plain cement concrete was placed layer after layer up to the bottom of the confining hoops and carefully compacted by poking rods, uniformly to avoid honeycombing, the specimens were removed after 24 hours and cured in water tanks and dried in air one day before testing.

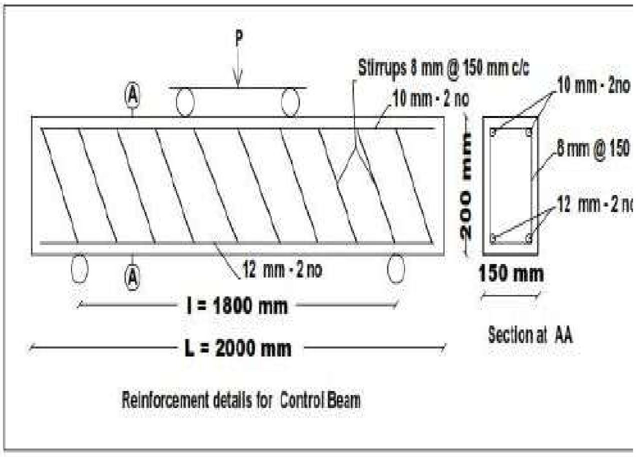


FIG. 5: CASTING OF BEAM

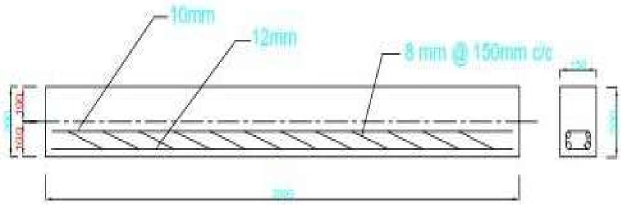


FIG. 6: SINGLY REINFORCEMENT DETAILS

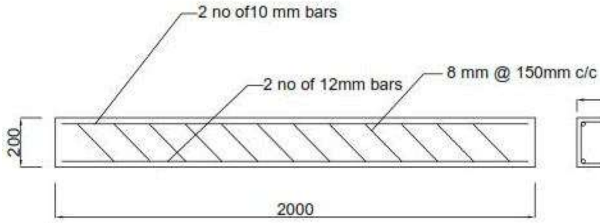


FIG. 7: DOUBLY REINFORCEMENT DETAILS

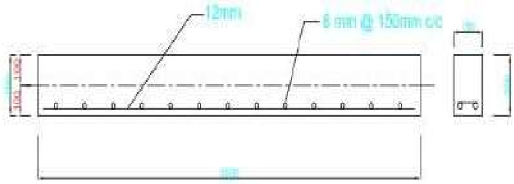


FIG. 8: CONFINEMENT ZONE REINFORCEMENT DETAILS

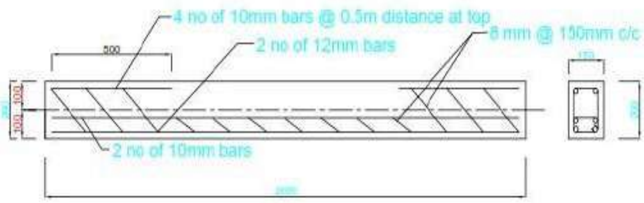


FIG. 9: DOUBLY REINFORCMENT WITH CONFINEMENT ZONE REINFORCEMENT DETAILS

7.5 FLEXURAL TEST

The beam were tested under static loading for simply supported condition with middle third loading. A Rolled Steel Joist was used to split the single concentrated load into two point loads a suitable capacity providing ring has been calibrated and used for the measurement of load. Dial gauges with a least count 0.01mm per division have been used for measuring deformation of the beam. Deflection was recorded during experiment.

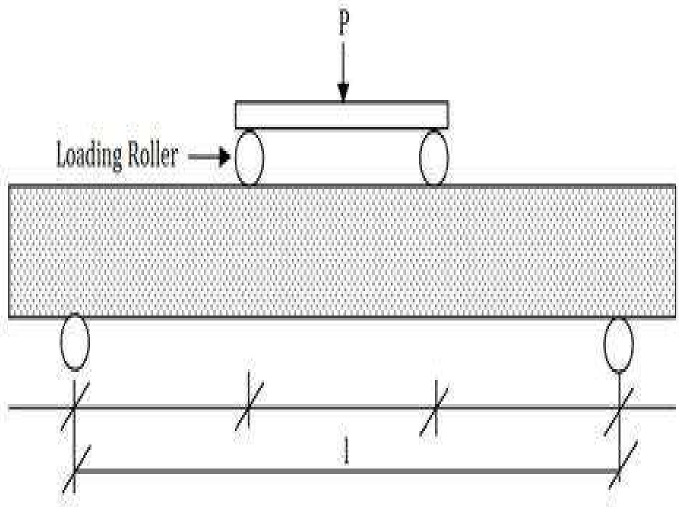
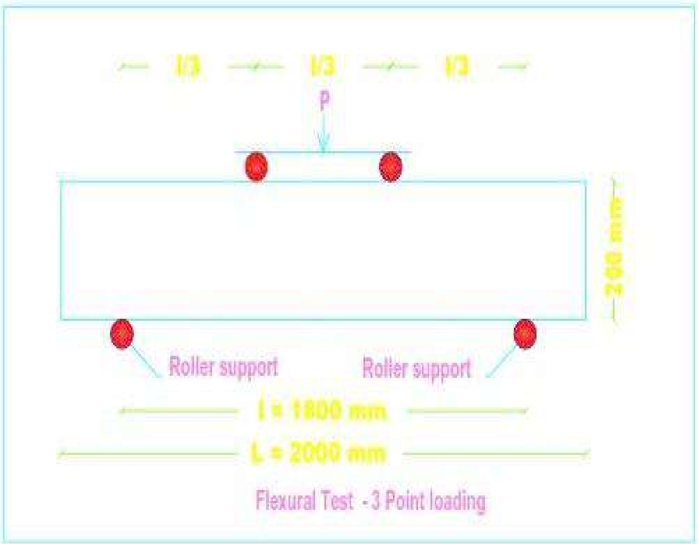


FIG. 10: FLEXTURAL TEST DETAILS



100 ton capacity reaction frame mounted over strong floor was used to test the beams. The beams were simply supported over an effectively span of 1.3 meter. Two point loads were applied gradually and in increments. The test was continued until the load dropped about 80% of ultimate load. All the beams were tested till it reaches their full flexural capacity. The behavior of the beam was keenly observed from the beginning to till collapse. The dial gauges was used to record the vertical deflection at the bottom of the beam. The deflection is measured under the two point loads as well as the mid span.

FIG. 11: LOADING FRAME

VIII. CONCLUSION

The beams in which the reinforcements were placed in confinement zone showed typical structural behavior in flexure. The overall flexural behavior of Partial beam used in this study closely resembles that of equivalent beam made with Normal beam. The reinforcement provided at tension side has shown sufficient contribution, though heory does not permit to account the same for diameter less than 12mm. All type of beams have shown flexural failure, no shear cracks were seen. Crack patterns and developing system, failure mode and the sustainability leads to select the Partial Beams as safer and serviceable than the Normal beams. From the overall study, it can be concluded that Partial beam is more efficient and economical than normal RCC beam. This is considered as best strengthening RCC beam among all the process. It is concluded that, Partial beams can be used in building construction works to achieve economy as well as reduction in Reinforcement rings to construction works.

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