DISCUSSION ON FLEXURAL BEHAVIOUR OF LATEX MODIFIED SILICA FUME BASED RC BEAM

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ABSTRACT
The purpose of current study is to clarify the mechanical properties of the silica fume based latex modified concrete. The silica fume based latex modified concrete. The silica fume based latex concrete were prepared with latex content of 5%, 10% and 15% by weight of binder. The silica fume was used constant 8% volume of cement concrete specimen were casted and tested for mechanical properties. From the test results the optimized latex content is identified as 10% by weight binder. The beam was casted and tested for the optimized latex modified concrete shows the better behavior than the control and modified concrete.
Key words: LMC, Silica fume, Mechanical properties, Flexure, Replacement.

1. INTRODUCTION

For year civil engineers have been making good concrete with more and more improvement in its properties with development of super plasticizers and other admixture it is possible to achieve strength and durability of concrete. Further increase the strength addition of some material like, latex latex solid content, etc. Hence improve the mechanical, physical and chemical properties of concrete and suitable latex formations greatly improve the fundamental strength of concrete. The use of latex modified concrete could be attributed to the increase the tensile strength of the latex modified concrete compared to that of the conventional concrete.
Latex modified concrete was made using 5%, 10% and 15% of polymer admixture of the cement mass; in overall performance of LMC specimens under the laboratory test improve with addition of Styrene Butadiene Rubber latex (SBR) up to 5-10% only. Such improve is not observed with addition of 15% latex (SBR) content. When using the beyond the 5% of latex solid content showed extremely poor strength. The use of latex increases the scaling resistance of concrete. This improvement is in direct relationship with quantity of latex already insures a significant improvement.

The type of curing is remould at 24hours form the time of casting, and 27day wet curing as per ASTM C192 in our research this type of curing is achieved corporation of Silica fume is concrete is made to differently in different countries, probably in confusing to the reader. These materials are quoted mineral admixtures, siliceous admixtures, cement replacement materials, supplementary cementing materials, mineral admixture, and sometimes merely additions. There are strong economics, technical and ecological arguments for use of mineral admixture (Silica fume) as part of replacement of cement.
Silica fume reacts with some of the portlandite (CH) resulting from the hydration of the silicate in Portland cement to produce additional C-S-H. Such a pozzolanic effect of SF reduces the relatively high concentration of CH crystals at the transition zone with aggregate and in the bulk cement paste thus reducing porosity and permeability.
The cement replace level of 25% with Silica fume in concrete mixes is found to be the optimum level to obtain compressive strength at later ages, such ages could be considered for design. Comparison of result test for durability related properties properties with the results obtained by some of the previous investigation shows that the performance of the silica fume based HPC mixes having very good result. The slight reduction in the workability of the silica fume based mixes. The above research are based on only latex modified concrete and otherwise

silica fume replacement – based concrete done in separately and having more idea about in behaviour of latex modified concrete as well as the replacement of silica fume in concrete.

2. REVIEW OF LITERATURE

2.1 B.k.prasad, (2008) - In this paper result of an experimental investigation carried on cylindrical specimen of latex modified concrete (LMC) under cyclic compressive loading are present. The LMC was made using 5, 10, and 15 percent of polymer admixture of the cement mass. With increase of latex, water cement ratio was decrease to have same consistency for all the mixes. The parameters considered for the study are latex dispersion, water cement ratio and the concrete strength. Based on the experimental investigation subjected to slow cycle fatigue compressive loading conclude that in all LMC specimen at lower value in axial strain of 15% latex compared to 5%, 10% latex content. The overall performance of LMC under slow cycle fatigue loading improves with addition of latex up to 10% of only. Such improvement is not observed with addition of 15% latex.

2.2 J.M. Gao, C.X. Qian, B. Wang, K. Morino(2011) This paper discussed the flexural and the compressive strength of polyacryclic ester (PAE) emulsion and silica fume (SF)- modified mortar. The chloride ion permeability in cement mortar and the interfacial micro hardness between aggregates and matrix measured. The chemical reactions between polymer and cement-hydrated product were investigated by the infrared spectral technology. The results show that the decrease of porosity and increase of density of cement mortars can be achieved by the pozzolanic effect of SF, the water reducing and filling effect of polymer. Lower porosity and higher density can give

cement mortars such properties as higher flexural and compressive strength, higher micro hardness value in interfacial zone and lower effective diffusion coefficient of chloride ions in matrix.

2.3 Joao adriano rossignolo(2015) The paper deals with the effect of silica fume and Styrene-Butadiene latex (SBR) on the micro structure of the interfacial transition zone (ITZ) between Portland cement paste and aggregate (basalt). Scanning electron microscope (SEM) equipped with energy dispersive X-ray analysis system (EDX) was used to determine the ITZ thickness. In the plain concrete a marked ITZ around the aggregate particles (55μm) determine the ITZ thickness. In the plain concretes with silica fume or latex SBR the ITZ was less pronounced (35-40 μm). However, better results were observed in concretes with silica fume and latex SBR (20-25 μm).

3. STYRENE-BUTADIENE RUBBER (SBR),

A general-purpose synthetic rubber, produced from a copolymer of styrene and butadiene. Exceeding all other synthetic rubbers in consumption, SBR is used in great quantities in automobile and truck tires, generally as an abrasion-resistant replacement for natural rubber (produced from polyisoprene).

In the 1970's Styrne Butadine Rubber was the world's most important rubber styrene butadiene rubber was first prepared about 1930 by scientists at the German chemical company of IG farben. But the early products showed no properties meriting production of the 10 polymers started in Germany as buna S. The term 'Buna' arose from the fact that the early polymers of butadiene were made by sodium catalyzed polymerization of butadiene

SBR is a mixture of approximately 75 percent butadiene (CH_2=CH-CH=CH_2) and 25 percent styrene (CH_2=CHC_6H_5). In most cases these two compounds are copolymerized (their single-unit molecules linked to form long, multiple-unit molecules) in an emulsion process, in which a soap like surface-acting agent disperses, or emulsifies, the materials in a water solution. Other materials in the solution include free-radical initiators, which begin the polymerization process, and stabilizers, which prevent deterioration of the final product. Upon polymerization, the styrene and butadiene repeating units are arranged in a random manner along the polymer chain. The polymer chains are cross-linked in the vulcanization process.

3.1 Preparation and composition of SBR

Styrene-Butadiene rubber also known as GR-s rubber and Buna S rubber is made by copolymerizing 75 parts of Butadiene to 25 parts of styrene in soap water at 50℃. It can be vulcanized to soft semi hard and hard rubber. By using styrene as a monomer with Butadiene properties such as strength elongation and process ability are considerable improved as the amount of styrene is increase in the amount of styrene. Generally 25% styrene is added in SBR rubber.

3.2 Properties of SBR rubber

- It possesses high abrasion resistance and high load bearing capacity.
- These rubbers do not break down readily and are not as thermoplastic as natural rubber.
- Such rubbers do not will mix or calendar easily.
- It gets readily oxidized.
- It swells in oils and solvents.
- It has greater weather ability compared to natured rubber.

4. METHODOLOGY

- Optimization of Latex content by studying mechanical properties like, Compressive strength test, Flexural strength, E-for concrete of latex modified concrete and Silica fume based latex modified concrete.
- Flexural strength evaluation of beams.
  - Control beam
  - Control + latex
  - Control + latex + Silica fume
- Result will be analyzed with reference to the behaviour of control beams.

Table: 1 List of casting specimen:

Specimen	Size	Test conducted with specimen
Cube	150mm×150mm×150mm	Compression Tension
Cylinder	150mm dia and 300mm	E for concrete
Prism	500mm length,100mm depth, 100mm width	Flexure test

5. EXPERIMENTAL TEST RESULT AND DISCUSSION:

5.1 COMPRESSIVE STRENGTH TEST:

The bottom of the concrete cube is placed on the platform of the compression testing machine. The load is applied gradually till the concrete cube gets failed. The corresponding reading is noted which gives the compressive strength of that cube. Similarly the compression strength values of all cubes are found. For each mix cubes of size 100mm were cast to determine the compressive strength using a 200T capacity Compression Testing Machine (CTM). Tests were carried out an different ages on 28days, 56days and 91days respectively. Tests were conducted as per IS 516-1959

Table: 2 Compressive strength results for 28days and 56days :

No.of mix	Specimens	Compressive strength N/mm^2	
		28days	56days
1	CONVENTIONAL	34.44	40.44
2	LATEX5%	32.00	34.20
3	LATEX10%	35.33	37.66
4	LATEX15%	27.55	32.21
5	CONTROL+SILICA FUME	34.95	38.64
6	LATEX5%+8%SILICA FUME	36.22	42.33
7	LATEX10%+8%SILICA FUME	37.15	37.66
8	LATEX15%+8%SILICA FUME	26.24	37.66

Fig 1 Experimental setup for compressive strength

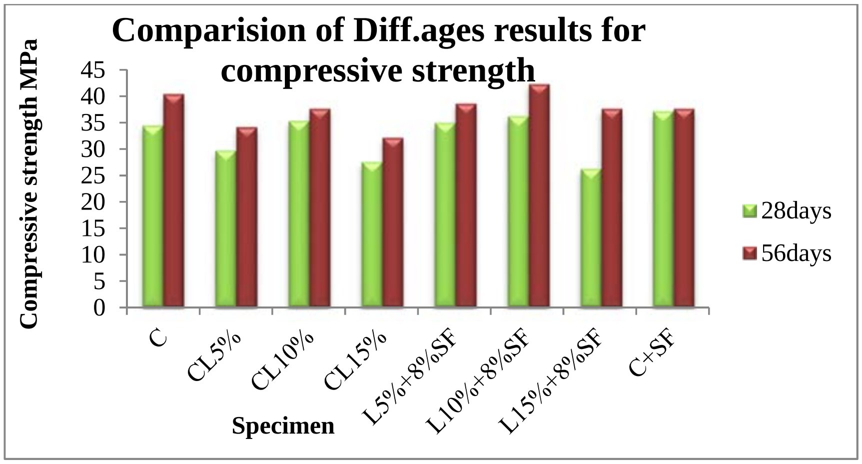

Chart-1: Improvement of compressive strength

5.2 MODULUS OF ELASTICITY:

For each mix cylinders of size 150mm diameter and 300mm long were cast to determine the modulus of elasticity of concrete.

Fig: 2 Experimental setup for E – for concrete testing

The cylinder were placed inside the young's modulus testing apparatus called compressometer, providing equal clearance to top and bottom of specimen. Each cylinder was tested in 200T capacity Compression Testing Machine (CTM). Loads were applied by means of 0.5T and the reading are noted in the deflectometer. The results were tabulated. Tests were conducted as per IS 516-1959.

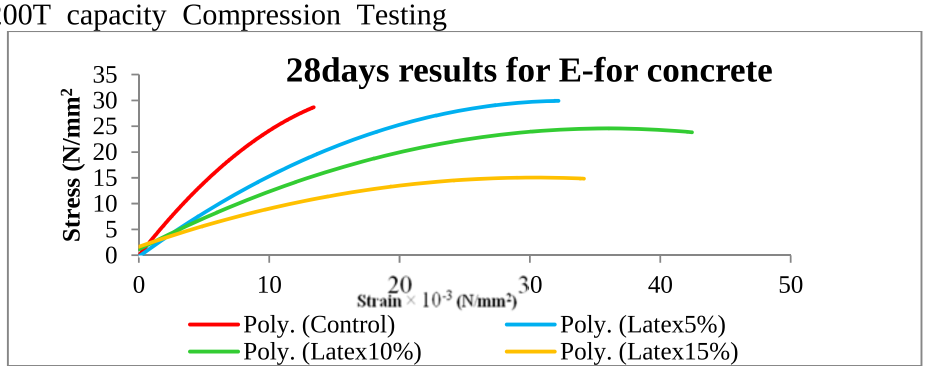

Chart-2: Stress-strain curve for concrete mix with Latex

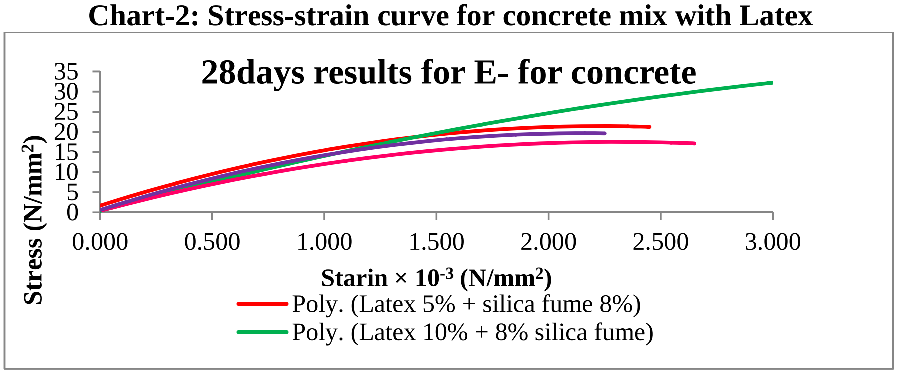

Chart-3: Stress-strain curve for concrete mix with Latex and silica fume

5.3. ELASTIC MODULUS OF CONCRETE (E –for concrete) @ 28days test

Table: 3 Elastic modulus of concrete @ 28days

S.no	Specimens	E-for concrete for 28days
1	C	2.93×10^4 MPa
2	CL5	1.64×10^4 MPa
3	CL10	1.78×10^4 MPa
4	CL15	1.57×10^4 MPa
5	CL5+8SF	1.77×10^4 MPa
6	CL10+8SF	1.80×10^4 MPa
7	CL15+8SF	1.54×10^4 MPa
8	C+8SF	1.83×10^4 MPa

5.4 FLEXURAL STRENGTH OF CONCRETE (USING SIMPLE BEAM WITH TWO-POINT LOADING):

The test specimen shall confirm to all requirements of tests method C 42 or practices C 31 or C 192 applicable to beam and prism specimens and shall have a test span within 2% of being three times its depth as tested. The sides of the specimen shall be smooth and free for scars, identification, holes, or inscribed identification marks. Centre the loading system in relation to the applied force. Bring the load applying blocks in contact with the surface of the specimen at the third points and apply a load of between 3 and 6% of the estimated ultimate load

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Fig: 3 Universal test setup for Flexural strength

Using 0.004 in (0.10mm) and 0.015 in (0.38mm) leaf type feeler gages, determine whether any gap between the specimen and the load applying or support blocks is greater or less than each of gages over a length of 1 in (25mm) or more. Grind, cap, or use leather shims on the specimen contact surface to eliminate gap in excess of 0.004 in (0.10mm) in width, leather shims shall be of uniform ¼ in (6.4mm) thickness, 1 to 2 in (25 to 50mm) width, and shall extend across the full width of specimen.

Fig: 4 Crack occurred at 1/3rd length from support for prism

Take the three measurement across each dimension (one at each edge and at the center) to the nearest 0.05 in.(1mm) to determine the average width average depth, and line of fracture location to the specimen at the section of failure,

Table: 4. Flexural strength results for 28 and 56 days

No.of mix	Specimens	Flexural strength N/mm²	
		28days	56days
1	CONVENTIONAL	4.06	5.72
2	LATEX5%	4.68	6.45
3	LATEX10%	5.41	7.49
4	LATEX15%	5.20	6.14
5	CONTROL+SILICA FUME	6.97	6.45
6	LATEX5%+8%SILICA FUME	5.10	6.56
7	LATEX10%+8%SILICA FUME	5.72	5.72
8	LATEX15%+8%SILICA FUME	5.62	5.93

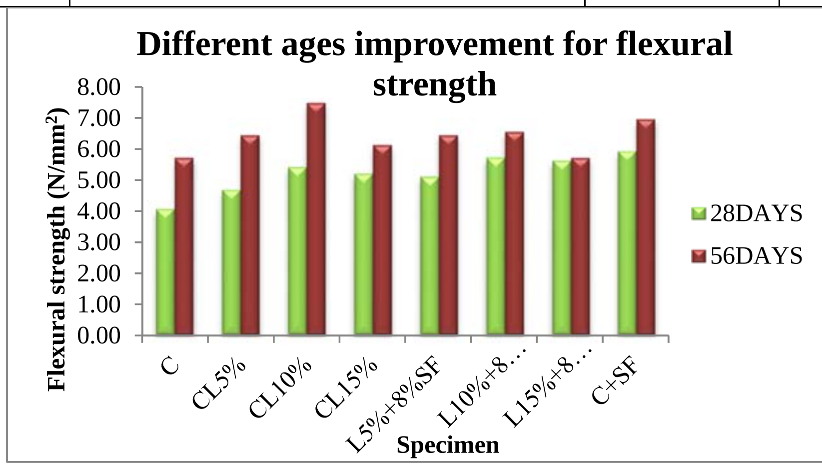

Chart-4 Improvement for Flexural strength

6. CONCLUSION

Performance evaluation latex in modified mechanical properties of silica fume based latex modified concrete was carried out by conducting is experiments for workability and mechanical related properties of latex modified silica fume based concrete were evaluated and conclusion drawn based on test result. The polymer in question acted as super plasticizers that i.e.., enable a reduction of water used for meeting concrete. The modified concrete of slump 52-75mm at satisfied cohesion and plasticity

6.1 COMPRESSIVE STRENGTH:

- ❖ Compare the control concrete the latex modified concrete source the marginal reduction in compressive strength because the latex is low modulus material
- ❖ In silica fume based latex modified concrete the percentage increase in compressive strength when compare latex modified concrete without silica fume source higher percentage increase in strength.
- ❖ When compare to the silica fume based latex modified concrete shows the higher strength than the latex modified concrete.

6.2 FLEXURAL STRENGTH:

- While testing the CL5 shown the highest strength than the control as well, as is is more better than the CL10 +8%SF shows the highest strength than the all other values
- Result shown when adding 10%Latex into the control concrete giving the better result to the concrete as compare to compressive. The flexural strength shown the good result add in of latex into the control concrete.
- The above mechanical properties the test results shows when the LMC of 10% Latex shows the higher strength in flexural strength and some reduction is varying compressive strength.

6.3 FLEXURAL BEAM RESULT:

With reference to flexural beam (0.125 × 0.25 × 3.2m) were caste above the optimized Mix ratio from the ,mechanical properties. The flexural behaviour control, LMC and silica fume based LMC concrete result of,

- All beam specimen were tested under two point load conditions.
- The load deflection and moment curvature behaviour shows the better performance in silica fume based latex modified concrete compare to control latex modified concrete
- Comparing the crack width than silica fume based latex modified concrete shows the better result than the control latex modified concrete.

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