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 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

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.

Technical data and the typical properties of Styrene Butadiene Rubber (SBR) designed for use with Portland cement play the important role latex modified concrete. The latex modified concrete has the setting time increase when the latex content is 10% increased, the flexural strength of latex increase the early age strength but lower at long-term strength of concrete. As per split tensile strength of concrete trends was similar the overall result from split tension test was smaller than those from flexural tension tests.

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.

The beneficial influence of SF in concrete is often due to a combination of various factors such as physical and pozzolanic effects. The former involves mainly a filler effect whereby fine SF particles reduce the initial porosity of the cement paste by partially occupying spaces between cement grains. Furthermore, SF particles reduce the “wall effect” around aggregate and reinforcement, thus allowing better packing of cement grains at the interface of the cement paste with aggregate or reinforcement. The addition of small dosage of SF and a proper amount of high-range water-reducing admixture can decrease the viscosity of the paste thus reducing the water demand and the risk of bleeding. Small SF spheres can displace some of the water present among flocculated cement particles and fill some of the voids between the coarser particles which otherwise can be occupied by some of the mix water. This causes some gain in workability and densification of the fresh paste.

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.

But in this study based on combined both together (Latex and Silica fume) various ratio and then verify the flexure behaviour of latex modified concrete with silica fume based concrete RC beams and study their different type of properties

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 S.H.OKba, A.S.EI-dieb and M.M.Reda (1997) - The objectives of this study is to evaluate the corrosion resistance of latex modified concrete (LMC) compared to conventional concrete using an accelerated corrosion cell. The latex specimen were prepared polymer latex used was Styrene – Butadine Rubber (SBR) from Fosroc – Egypt. The SBR is used a dosage of 15% solid latex material to cement by weight (P/C ratio) was used. Curing of LMC specimen were covered with wet burlap for 48hours after being cast, then after being de-molded the specimen were air cured at 23℃. The air curing regime proved to be the most suitable regime for LMC. The conclusion of this accelerated corrosion cell proved to be a good and simple test to access the durability of concretes especially with respected to chloride ion penetration, and steel reinforcement protection against corrosion.

2.3 I.Ray and A.P.Gupta (1995) – The report deals with the individual and combined effect of latex and super plasticiser on Portland cement mortar in the hardened state. The selected two superplastisizers (out of five) and four latex (5%,10%,15% and 20%) solid content were studied for 7-day and 28-day compressive strength, deformation, ultrasonic pulse transist time absorption. Finally conclude that Latex – mortar improves compressive strength (compared to conventional) for up to 12 to 15% of addition. Water absorption for all latex-mortar is less than for conventional mortar. Addition of super plasticiser further reduces the water absorption. Loss in compressive strength after three cycles of wetting and drying of super plasticiser latex modified specimen was less than for corresponding latex modified specimen.

2.4 Daniel Bordelean, Michel pigeon and Nenkumar Banthia (1992) – Freezing and thawing tests in the presence of a 2.5% NaCl solution were carried out on normal concretes and Styrene Butadiene Rubber (SBR) latex. The LMC were prepared with 7.5% and 15% of solid polymer- to-cement ratio. Three different water cement were used 0.30, 0.35, and 0.40. This study was undertaken the scaling resistance of latex-modified concrete made with two SBR concentration and three water-cement ratios was investigated. That a latex concentration of 15% of solid polymer (by weight of cement) is the optimum ratio, considering performance versus cost for the chosen latex product. The study was thus performed using a concentration 0f 15% of solid polymer (by weight of cement) is the optimum ratio, considering performances versus cost for the chosen latex product. The study was thus performed using a concentration of 15%, and also 7.5% to be able to evaluate the influence of the latex concentration. The use improvement is in direct relationship with the quantity of latex, but 7.5% of SBR already insures a significant improvement. And also indicated that the deicer salt scaling resistance of latex-modified concrete is related to the air-void spacing factor, but this factor, is less important for latex-modified concrete than for normal concrete.

2.5 T.S.Nagaraj & K.T Sundara raja lyengar (1987) et al investigated Super-plasticized natural rubber latex modified concrete from their reports, it can been seen that for dry rubber contents up to 2% the maximum compressive and tensile strength remain unaltered, compared to that of plain concrete, but with pronounced increase in the strain capacity. It was concluded that with natural rubber latex as an admixture the ductility of the concrete becomes enhanced with natural rubber latex as an admixture the ductility of the concrete becomes enhanced with the retention of strength level of plain concrete; 2% dry rubber content has been found to induce optimal levels of improvement in ductile behaviour without reduction in compressive strength of plain concretes.

2.6 J.M. Gao, C.X. Qian, B. Wang, K. Morino 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.

2.7 Joao adriano rossignolo 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).

EXPERIMENTAL INVESTIGATION

MATERIAL USED IN CONCRETE

- CEMENT
  Ordinary Portland Cement of 43 grades having specific gravity of 3.11
- FINE AGGREGATE:
  Natural river sand conforming to IS-383, Zone-III having specific gravity 2.62
- COARSE AGGREGATE:
  Crushed granite angular aggregate of size 10mm passing confirming to IS-383 having specific gravity 2.73.
- MINERAL ADMIXTURES :
  Silica fume (Specific gravity of 2.14)
- ADMIXTURE :
  Latex.
- WATER :
  Ordinary portable water conforming to IS 456.

MATERIAL REPLACEMENT :
Silicafume-8%volume replacement of cement

PHYSICAL PROPERTIES OF MATERIAL USED:

S.no	Descriptions		Test results	Requirements as per IS
1	Specific gravity	Cement	3.11	> 3.15
		Fine aggregate	2.62	2.6-2.7 (IS 383 – 1970)
		Silica fume	2.14	---
		Coarse aggregate	2.73	> 2.6 (IS 383 – 1970)
2	Fineness modulus	Fine aggregate	3.21	Zone-III
		Coarse aggregate	6.86	

Table; Physical properties of material used

PRELIMINARY TEST RESULT

SPECIFIC GRAVITY OF CEMENT

S. no	Empty weight of bottle w_1(g)	Weight of bottle+sample w_2(g)	Weight of bottle+sample+water w_3(g)	Weight of bottle + water w_4(g)	Specific gravity
1	67	85	179	169	1.98
2	67	84	178	169	2.18
3	67	89	182	169	2.14
					Avg = 2.14

Technical data of Latex used:

S.no	Properties	Technical data
1	Type	SBR(Styrene Butadiene latex) fosroc
2	Specific gravity	1.01
3	Colour	Milk white
4	Total solid content	50%
5	Total liquid content	50%
6	Temperature of drying	45℃

EXPERIMENTAL RESULT

EXPERIMENTAL TEST RESULT AND DISCUSSION:

Based on the IS code recommendation we have to casted the specimen and demould at 24houres from at the time of casting, then cured the specimen for code recommendation. The specimen to be used for test when the specimen completely drying condition so that keeping the specimen out the water at the day of test in early as possible as. The test results are tabulated and compare here,

Before going to testing the specimen it will be properly prepared by white washed the specimens and marked the name of the specimens.

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

Compressive strength = P/A

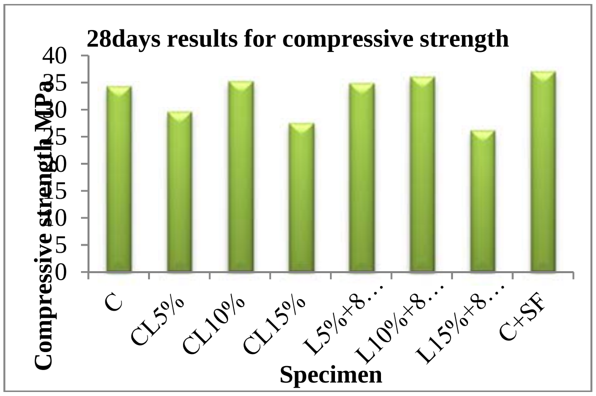
Where,

P = Ultimate load in N

A = Area of the cube in mm^2

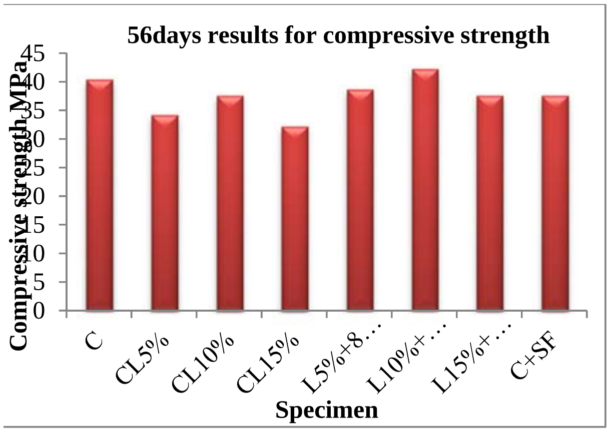
Table: Compressive strength results for 28days:

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



Compressive strength results for 56days:

No. of mix	Specimens	Compressive strength N/mm^2
1	CONVENTIONAL	40.44
2	LATEX5%	34.20
3	LATEX10%	37.66
4	LATEX15%	32.21
5	CONTROL+SILICA FUME	38.64
6	LATEX5%+8% SILICA FUME	42.33
7	LATEX10%+8% SILICA FUME	37.66
8	LATEX15%+8% SILICA FUME	37.66

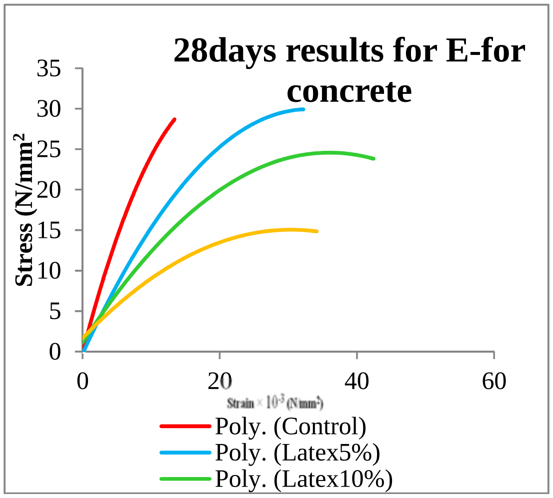


56days results for compressive strength

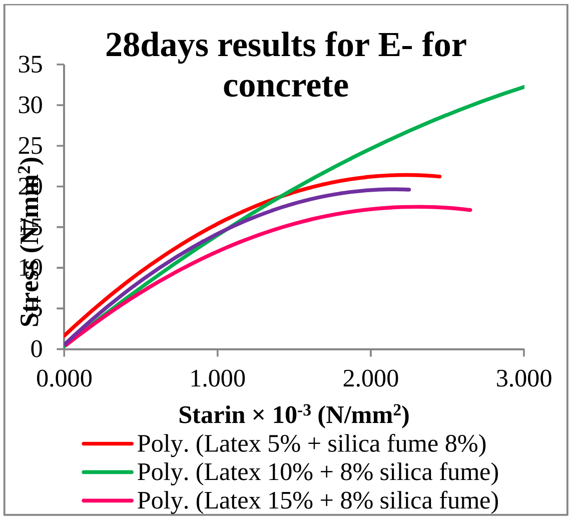
3 MODULUS OF ELASTICITY:

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

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.



Stress-strain curve for concrete mix with Latex



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

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

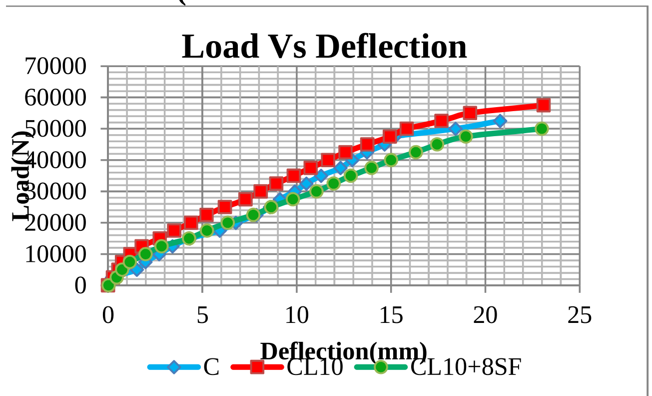
Elastic modulus of concrete @ 28days

BEAM RESULTS

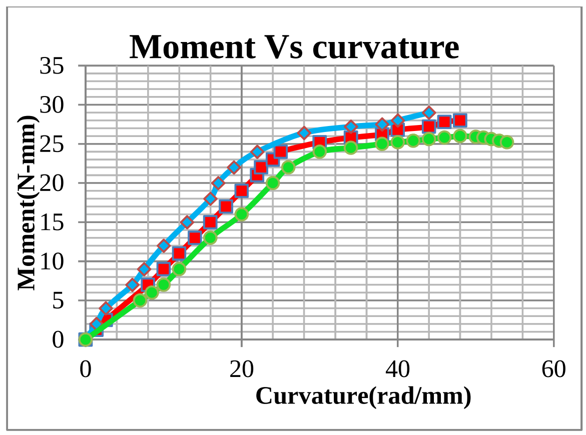
Testing procedure

The beam was kept on the loading frame and dial gauges were kept a one-third points and mid span point. The beams were tested at an interval of 2.5Kn each (load stage). The beams were loaded till the failure load is reached. Deflection and strains were measured for a load increment of 2.5KN up to failure. Static tests were conducts for determining the moment-curvature, load deflection variations with loading in addition to the evaluation of ultimate load carrying capacity of ultimate load carrying capacity of the test beams.

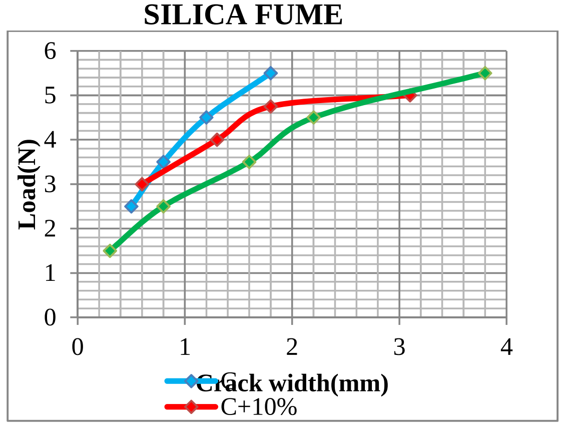
6 LOAD – DEFLECTION BEHAVIOUR OF R.C.C BEAM WITH AND WITHOUT LATEX AND SILICA FUME CONTROL(EXPERIMENTAL



MOMENT- CURVATURE BEHAVIOUR OF R.C.C BEAM WITH AND WITHOUT LATEX AND SILICA FUME (EXPERIMENTAL)



SILICA FUME



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

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.

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.

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.

SUMMARY OF CONCLUSION

Comparing the result of mechanical properties of control, latex modified concrete and silica fume based latex modified concrete have margin is reduction in compressive strength because of the low modulus of latex. Properties like flexural strength as like in improve by adding latex and silica fume based latex concrete. In comparing the beam silica fume based latex modified concrete beam shows the better behaviour than the control and latex modified concrete.

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