Combine Effect of Silica-Fume, Fly-ash and Steel Fibre on Reinforced Concrete, A Review

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Abstract - Cement is the mainly use construction material in recent trend cement concrete is replace by admixtures such as, slag, fly ash, silica fume to increase the characteristics strength of high performance of concrete in order to decrease the shrinkage and creep and to increase tensile strength, fibres are added. Strength Properties studies involve compressive strength flexural strength tensile strength and abrasion. Standard cubes 15cm x 15cm x 15cm, standard cylinders 15cm dia x 30cm height and standard beam 10cm x 10cm x50cm were considered in the research. The study bring that the use of waste material like silica fume, fly ash with steel fibres develop the strength properties of concrete, which is otherwise unsafe to the environment and thus may be used as a fractionally replacement of cement.

Key words - Silca-Fume,Fly-Ash,Steel Fibres, concrete strength Plasticizer,etc.

Objectives - To study the viability of silica fume, fly ash, steel fibre On the strength of concrete.

Introduction

Concrete is the commonly use construction material which has numerous desirable properties like, stiffness high compressive strength and durability under normal usual environmental factors. Concrete is a breakable and mixed material that is strong in compression and weak in tension. We know that concrete mixed with other material was applied for resistance purpose. Without any fiber in the concrete there was development of the cracks due to plastic shrinkage, drying shrinkage and changes in volume of concrete. The structural properties of fiber reinforced concrete are well known. Plain concrete, being brittle in nature, has lower tensile strength and lower resistance to crack propagation. The fibres improves significantly many other engineering properties of concrete such as flexural strength, shear strength, fracture toughness, post-cracking ductility, resistance to fatigue, impact, thermal variations, wear and spalling. The American concrete institute (ACI) defines silica fume as a ‘‘very fine noncrystalline silica produced in electric arc furnaces as a by-product of production of elemental silicon or alloys containing silicon’’. Silica fume is also known as micro silica, condensed silica fume, volatized silica or silica dust. It is usually a grey colored powder, somewhat similar to Portland cement or some fly ashes. It can exhibit both pozzolanic and cementitious properties. Plain concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to the concrete would act as crack arrester and would substantially improve its Compressive and flexural strength properties. This type of concrete is known as fiber reinforced concrete.

Materials Used

Silica-fume:- silica fume as a ‘‘very fine noncrystalline silica produced in electric arc furnaces as a by product of production of elemental silicon or alloys containing silicon’’. Silica fume is also known as micro silica, condensed silica fume, volatized silica or silica dust. It is usually a grey colored powder, somewhat similar to Portland cement or some fly ashes. It can exhibit both pozzolanic and cementitious properties. Silica fume has been recognized as a pozzolanic admixture that is effective in enhancing the mechanical properties to a great extent. Addition of silica fume to concrete improves the durability of concrete and also in protecting the embedded steel from corrosion.

Steel Fiber:-in Concrete: Plain concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to the concrete would act as crack arrester and would substantially improve its Compressive and flexural strength properties. This type of concrete is known as fiber reinforced concrete.

Fly-Ash:- The fly ash is one of the waste materials of thermal power stations According to survey, fly ash is lightweight material and self depleting substance in comparison to raw soil. Additionally fly ash comprises of non-plastic silt size particles of moderately low permeability than sand. Fly ash has been effectively utilized as Concrete Production, in Cement Clinkers, Substitute Material in Brick and Mineral Filler in Bituminous Concrete etc. It is also mixed with clayey soil to construct different civil engineering works like sub grade, foundation base and embankments. The utilization of fly ash as additive in soil stabilization is advantageous because it is moderately economy, compare with cement and lime. Utilization of fly ash advances feasible construction through lessening of vitality utilizes and decreases of greenhouse gases.

Review of Literature

V.S Dasari(2015), adding 1% steel fibre 0% silca fume and 1% chemical admixture the compressive strength after 7days & 28days is 36.72N/mm^2 & 53.52N/mm^2 while it gets decreased by 15% by adding 0.5% silca fume but by adding steel fibre 1% silca fume 10% and chemical admixture 1.5% the strength increases by 10%.The best results are shown at the ratio of Steel fibre 1% silca fume 15% and chemical admixture 1.5%.

Rahul(2016), In this study the mixtures of silica flume ratio of 5%, 7.5% and 10% was used in the concrete mix and cement is replaced by silica flume. Polypropylene fiber 0.5% constant was used for silica fume concrete mixes. A coarse aggregate ratio of 2.66 and fine aggregate ratio 1.5 and water ratio 0.38% with super plasticizer of 0.06% was used in this study. Each series consists beam, cylinders and cubes as per IS code standard. The tests are performed to find out the flexural strength, split tensile strength and compressive strength and abrasion test of 7 days 14days and 28 days. By adding 5% silica fume with constant polypropylene and water-cement ratio the compressive strength increases by 15% after 7days 14 days & 28days. The partial replacement of 10% silica flume with cement can giving most extreme conceivable compressive strength with polypropylene fiber.

Prashant Y.Pawade(2012), The effect of silica fume comparison with control concrete for the replacement of 4%, 8% and12% cement by silica fume showed 6.26%, 15.84%, and 11.45% increases in compressive strength at 28 days of curing. And 6.73%, 15.68%and 12.73% increase in compressive strength at 90 days of curing. This shows the significant increase in compressive strength. For 28 days of curing, Silica fume of 4% 8% and 12% with steel fiber of 0.5 % shows 8.17%, 17.68% and 15.09%, fiber 1.0 % shows 10.8%,18.56% and 16.2%. And fiber 1.5 % shows 13.72%, 19.78% and 17.96%.

The flexural strength increase by replacement of 4%, 8% and 12% cement by silica fume showed 4.18%, 9.83% and 9.2% at 28 days of curing and 5.18%, 9.16% and 8.76%increase in flexural strength at 90 days of curing. Effect of silica fume with steel fibers days of curing, Silica fume of 4% 8% and 12% with steel fiber of 0.5 % shows 5.86%11.29%and 10.4%, fiber 1.0 % shows 8.16%, 13.6%and 12.76%. And fiber 1.5 % shows 9.21%, 15.27%and 14.27%.For 90 days of curing, Silica fume of 4% 8% and 12% with steel fiber of 0.5 % shows 5.98%, 9.36%and 9.16%, 1.0 % shows 8.37%, 10.16% and 9.96%.And 1.5 % shows 9.16%, 12.15%and 11.35%.

Heba A. Mohamed(2011), In this paper three types of concrete mixes are prepared categorised as type-I,II and type-III.Type-I is combination of plain concrete(PC) and fly-ash(FA),Type-II is the combination of plain concrete and silica-fume(SF) while type-III is combination of plain concrete, silica fume and fly-ash. The percentage of type-1 sample is 10% FA and 90%PC,15%FA and 85%PC,20%FA and80%PC so on upto 50%FA and 50%PC.Same percentage pattern are added in type-II and type-III samples. It has been noted that in type I (with FA) the higher the percentage of FA the higher the values of compressive strength until 30% of FA, after that the increase in the percentage of FA lead to decrease in values of concrete compressive strength. However, in type II with SF the highest value of concrete compressive strength is obtained from 15% of SF. It can be noticed that specimens of type II with 15% of SF as a replacement cement content gives higher values of concrete compressive strength than specimens of type I with 30% of FA by about 12% and 10% for 550 kg/m3 and 450 kg/m 3 cement content respectively. Compressive strength is obtained from 15% of SF. It can be noticed that specimens of type II with 15% of SF as a replacement cement content gives higher values of concrete compressive strength than specimens of type I with 30% of FA by about 12% and 10% for 550kg/m3 and 450kg/m3 cement content respectively. Of concrete compressive strength in this case higher than the values in case of 15% FA and 15% SF by about 19% and 18% for 550 kg/m3 and 450 kg/m3 cement content respectively. While, the increase can be estimated by about 24% and 22% respectively in case of 20% FA and 20% SF.

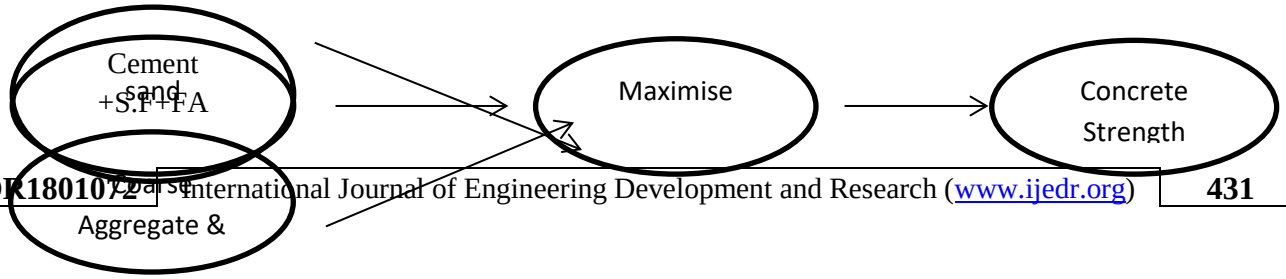
Abhinav Shyam(2017),concluded that optimum percentage of Silica Fume varies from 5% to 15%. Up to these Percentage Replacement improvement in the strength of concrete has been observed in terms of Compressive Strength, Flexural Strength and Tensile Strength on partial replacement of Cement with Silica fume.

Anurag Jain(2015), The effect of silica fume is more noticeable for the 28day curing period than for the 7-day period. On the other hand, the effect of curing period was not as significant for the control mix. Longer curing allows the Pozzolanic activity to develop, leading to the significant performance improvement. The variation in electric current was not consistent.

A.M. Shende(2012),Concluded that compressive strength, split tensile strength and flexural strength are on higher side for 3% fibres as compared to that produced from 0%, 1% and 2% fibres. . All the strength properties are observed to be on higher side for aspect ratio of 50 as compared to those for aspect ratio 60 and 67. It is observed that compressive strength increases from 11 to 24% with addition of steel fibres, flexural strength increases from 12 to 49% with addition of steel fibres and split tensile strength increases from 3 to 41% with addition of steel fibres.

Sharma &Seema (2012) examined the effect of partial replacement of cement with silica fume on compressive strength of concrete.M20 grade of concrete with W/C ratio as 0.5 and percentage replacement was 0%,10%,20%. The optimum compressive strength is obtained at 20% cement replacement by a Silica Fume at all age levels (i.e. 24 hours,7& 28 days). The 28 days' compressive strength at 20% replacement was found to be 32.29 MPa with a slump value of 21 mm.

Research Model



On the basis of the present review of literature the researcher developed the research model which clearly depicts that use of silica fume, Fly ash and steel fibre increases the strength of concrete than the normal concrete.

Conclusion

On the basis of existing review of literature it can be concluded that the strength increases in concrete with increases in silica fume rate upto 15% after that it gets decreased, but by adding steel fibre upto 2% the strength gets increased upto 10%-15%.On other side when fly ash is added to the plain concrete,It has been noted that the higher the percentage of F.A the higher the values of compressive strength until 30% of F.A, after that the increase in the percentage of F.A lead to decrease in values of concrete compressive strength. Overall the best results are shown at the percentage of 15%-20% of adding silca fume and fly-ash.

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