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EFFECT OF SCRAP STEEL FIBRE AND CRUMB RUBBER ON THE STRENGTH OF CONCRETE

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Abstract - *As construction in India and other developing countries increases, the consumption of energy and resources is also increasing in an alarming way. Most of the developing nations have reduced the usage of virgin material like aggregates in construction, due to economical and environmental reasons, so they focused on the environment, safeguarding of natural resources, and recycling of wastes materials. In this investigaton the effect of combination of crumb rubber and scrap steel fibre is to be investigated on the performance of concrete. Crumb rubber was incorporated into normal concrete(NC) steel fibre concrete with 2% volume fraction of waste steel fibre mixes partially replacing fine aggregate at five different ratios i.e. 0%, 3%, 6%, 9%, 12%. The standard compressive strength , splitting tensile strength and workability test should be conducted to the corresponding properties of concrete. The objective of the study was to study the effect of combination of steel fibre and crumb rubber on the properties of concrete on different percentages of rubber tyre aggregates and steel fibre to M35 mix.*

Key Words: **Crumb rubber, Scrap steel fibre, Rubberized concrete, Compressive strength, Split tensile strength, workability**

1. INTRODUCTION

India has completed a noteworthy jump on building up the frameworks, for example, structures development, express parkways, control ventures and modern structures, dams, and so forth to meet the prerequisites of globalization. For the development of structural building works, solid assume primary job and an expansive quantum of cement is being used. Both coarse total and fine total is a noteworthy establish utilized for making ordinary cement, has turned out to be exceedingly costly and furthermore rare. In the background, there is expansive interest for elective materials from squanders. Squander tires administration is a genuine worldwide concern. A huge number of waste tires are created and dumped or consumed each year, regularly in an uncontrolled way, causing a noteworthy ecological and medical issue.

1.1 Waste tyre rubber

Dumping of waste tyre rubber on land represent a noteworthy natural issue of expanding importance. Over the years, disposal of waste tires has turned out to be one of the difficult issues for the earth. Imaginative answers for take care of the tire transfer issue have for some time been being developed.. One of the successful strategies for use of these materials is their utilization in concrete. Crumb rubber is thought to be a potential material for use in concrete technology. It is considered as an alternative to the natural aggregates, used as filler in concrete matrix. Owing to lower strength, rubberized concrete is recommended for non loading bearing structures and structural members. Use tyre rubber also reduce the pollution and it does not affect the environment.

1.2 Scrap steel fibre

When we use steel reinforcement the tensile strength of concrete increases. Research followed by technological developments have enlightened us with ways to add fiber to strengthen concrete. In this investigation lathe waste material that is locally available. The steel scrap material which is obtained from the lathe can be used as steel fiber for the innovative construction industry and in pavement consruction.

2. MATERIAL USED

2.1 CEMENT: OPC 43 grade cement has been used in this study.

2.2 COARSE AGGREGATE: Coarse aggregate of 20mm and 10 mm were used. The specific gravity of aggregate is 2.45.

2.3 FINE AGGREGATE: Locally available sand has been used in this study. It confirms to zone II with a specific gravity of 2.59.

2.4 CRUMB RUBBER: The rubber in powdered form has been used in this study with a specific gravity of 1.15.

2.5 SCRAP STEEL FIBRE: Lathe waste material has been used as steel fibre. The aspect ratio was not always constant. The diameter varies from 0.3 to o.75mm.

3. METHODOLOGY

3.1 GENERAL

This investigation includes design of concrete mix of medium strength concrete. In this study design mix used is M35. The guidelines given in various codes like SP: 23-1982, IS:10262-1982 AND IS:456-2000 have been adopted for mix design of

concrete. In this study fine aggregate is replaced with crumb rubber with different percentages of rubber and compute the strength and then steel fiber is used with 2% fraction with different percentage of rubber and then strength of this concrete is used. Basically we use two mixes: RC (rubberized concrete) and SFRRC (steel fibre reinforced rubberized concrete).

3.2 BATCHING, CASTING AND CURING

All the dry materials are put in the mixer. Then mixer is rotated and cement is added to it. At last water is added to it and mixing is continued till a uniform mixture is produced. Then, concrete specimens of standard cube mould of size 150 x 150 mm were casted in different batches having different replacement of crumb rubber. similarly, cyclindrical mould were casted in different batches. After casting, curing process is done at normal temperature.

3.3 MIX PROPORTION

Concrete mix of strength of M35 has been designed and modified with 2% scrap steel fiber and varying percentages of crumb rubber (0%, 3%, 6%, 9% and 12%) by weight of fine aggregate. There were two basic mixes; rubberized concrete mixes(RC) and steel fiber reinforced rubberized mixes(SFRRC). The control mix in this study is designated as NC.

4. RESULT ANALYSIS

4.1 GENERAL

This chapter deals with the results of various mechanical properties rubberized concrete and steel fiber reinforced rubberized concrete and the result are compared with the results of conventional concrete. In this present study, the workability test, the compressive strength test, split tensile strength were tested.

4.2 WORKABILITY TEST

The slump test is carried out for all the different concrete mixes to know the workability of concrete. The value of slump decreases with the increase in rubber content. It can be noted that with increase in rubber content upto 3% the slump value increases but further increase in rubber content the slump value decreases. Steel fibre rubberized concrete mix shows higher slump value than the rubberized concrete.

Table – 1: values for slump for different mixes

MIX DESIGNATION	SLUMP(mm)
NC	95
RC3	95
RC6	82
RC9	75
RC12	62
SFRRC3	110
SFRRC6	100
SFRRC9	92
SFRRC12	88

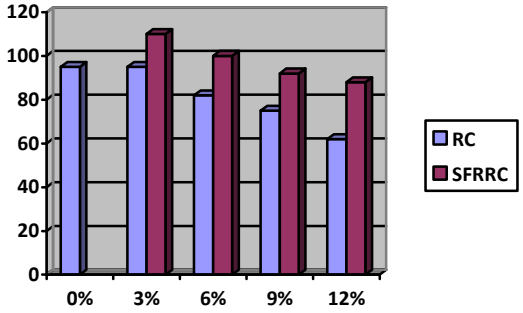

Figure -1: values of slump

4.3. COMPRESSIVE STRENGTH TEST

The result obtained for cube compressive strength for different mixes at 7 days and 28 days. In this experiment, the compressive strength showed a decreasing curve when the percentage of crumb rubber is increased. The 28 compressive strength of normal concrete obtained is 44.50MPa. When the percentage of crumb rubber varied from 3-12 the strength reduced by 5-35%. When scrap steel fiber is added to the mix there is very low reduction in compressive strength. When the crumb rubber percentage varied from 3-12 in steel fiber mixes, the strength reduced only by2-15%. In general, steel fiber rubberized concrete mixes shows higher compressive strength than rubberized concrete mixes.

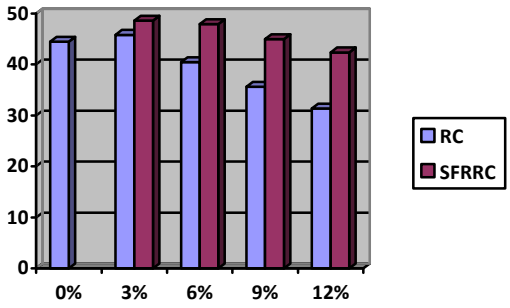

Figure – 2: 28 days compressive strength

4.4. SPLIT TENSILE STREMGTH TEST

The split tensile test of normal concrete at 28 days obtained is3.45. With the replacement of crumb rubber the strength is reduced by 28%. With the addition of scrap steel fibers this shows an increase in the strength. Steel fiber rubberized reinforced concrete mixes shows better result than rubberized concrete mixes.

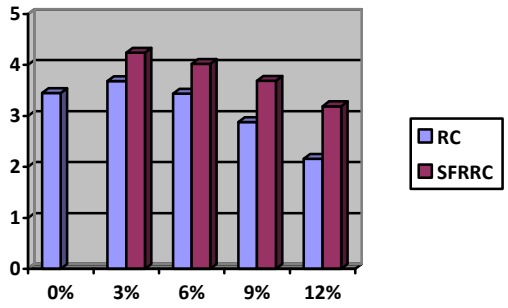

Figure- 3: 28 days split tensile strength

5. CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSIONS

The following conclusion can be drawn from this study:

1. The compressive strength, split tensile strength decrease with the increase in the rubber content. This can be reduced by adding the steel fibers to it. Steel fibers shows higher compressive strength.

2. In rubberized concrete , when the rubber content varied from 3-12% the compressive strength reduced by 5-35%. But in the case of steel fiber concrete mixes when the crumb rubber varied from 3-12%, the compressive reduced to 2-15%.

3. In rubberized concrete , the compressive strength with 3%replacement shows higher compressive strength than normal concrete.

4. In compressive strength SFRRC3, SFRRC6 and SFRRC 9 shows higher compressive strength than normal concrete.

5. In split tensile test, with the increase in rubber content there is decrease in split tensile test, but SFRRC3 AND SFRRC9 shows higher spiltting tensile strength than the normal concrete.

6. Upto 3% of rubber can be added to the concrete mix to achieve the strength.

7. Only upto 2% steel fiber can be added to the mix . fibers added higher than 2% volume reduces the workability of mixes as they clump together.

8. Waste rubber of tyres is the source of pollution in the environment, we utilized this waste material in civil engineering works, it help us to keep green environment.

9. Although adding crumb rubber into the concrete reduces its characteristics strength of the concrete, but to overcome from this kind of deficiency we also added steel fibre into the concrete to enhance the characteristics strength of concrete.

10. Such practice conserves natural resources and reduces the space required for the landfill disposal of these waste material.

5.2 FUTURE SCOPE

1.This study can be extended by increasing the percentage of rubber aggregate in the given design mix.

2. This study can also be done by using different grades like M40,M45 etc. for different types of percentage or by using the same given percentage.

3. More test can be performed for this study like flexure strength test, abrasion resistance , impact resistance test.

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