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Mathematical study and analysis on impact resistance of turn steel fiber reinforced concrete

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Abstract – The steel fiber reinforced concrete (SFRC), higher values of tensile and compressive strength can be obtained with greater fracture toughness and energy absorption capacity. The impact resistance capacity of SFRC will vary with addition of steel fibers in concrete. In this mathematical analysis study of impact resistance of turn steel scrap fiber reinforced concrete with repeated impact loading is done using ANSYS software. The scraps from lathe shops. impact resistance concrete, is applied in slab(600mm *600mm *600 mm) of 0.25 %, 0.5 %, 0.75 % & 1 % as turn steel fibers by the weight of the cement is compared with opc cement concrete slab. The Impact is given by the hammer of 10 kg weight and height of 1 m. Number of blows of the steel hammer is required for first crack and the failure of slab was noted. Results obtained from this study showed that reinforced concrete with 0.75 % turn steel fiber shows maximum impact energy and assimilation capacity as compared with conventional concrete.

1. INTRODUCTION

Concrete Is a construction material used over the world. It is a composite material composed of course and fine aggregates. Concrete possess very large compressive strength and comparatively low tensile strength. And the unreinforced concrete structure is subjected to tension, it initially forms elasticity. Hence, fiber materials are added to concrete and to magnify its mechanical properties to otherwise brittle concrete. HYST bars are used for the cross-section in the concrete structures. And the steel bars are occurred to corrosion. The Water enters to the concrete through the cracks, the bars are corrode.

Fiber reinforced concrete (FRC) is a concrete mix, and it contains small discrete fibers that are consistently distributed and randomly oriented. Fiber material can be steel, carbon, polypropylene, glass, nylon, and polyester. The fiber is added to the concrete mix, and its measured by the percentage of the total volume of the concrete and fibers, termed typically ranges 0.1 to 3 %.

The mechanics of fiber reinforcement is being developed and researched as it strengthens mortar or concrete, It can be treated as a composite material. And improved the concrete properties and also improved the properties of interface between fiber and matrix. The bond is dependent on the aspect ratio of fiber. The steel fibers have high strength and Young's modulus.

2. SCOPE

Significance of impact loading is more in the of research works field and military applications. And lot of research is being occurred in the impact analysis of concrete structures like beams and slabs. Most of them are single or repeated drop weight test of hammer on slabs.

- To get a exhaustive understanding of the structural performance of concrete slabs under impact loading.
- Conduct mathematical analysis of the field experiment. Where steel hammer is repeatedly dropped to a concrete slab.

3. EXPERIMENTAL INVESTIGATION

In order to determine the compressive strength at 28 days using 150x 150 x 150 mm concrete cubes in accordance with IS 516-1959.

3.1 Intermediary and test

The turn steel scrap fiber reinforced concrete mix were prepared by hand mixing with IS 516-1959. Fill the concrete and mould by each layer of about 5 cm thick. Each layer should be given 25 times tamping using tamping rod and top surface is leveled using trowel. After 24hrs of moist air curing, specimens were placed in water tank for water curing of 28 days. And Remove the specimen from curing tank after the specified time of curing and allow It for dry. Place the specimen on the machine such that align the specimen as centre of the machine on the base plate. Specimens of 150 x 150x150 mm concrete cubes were tested in a Compressive Testing Machine of capacity 2000 KN.

Fig.1 Compressive strength test set up

Table .1 Compressive strength test result

Mix	Cube1 (KN)	Cube2 (KN)	Cube3 (KN)	Compressive Strength(N/mm2)
Conventional Concrete	750	700	_	32.22
TSSFRC0.25%	720	800	780	33.50
TSSFRC0.5%	800	820	810	34.73
TSSFRC0.75%	760	820	800	35.00
TSSFRC 1%	720	760	780	34.22

3.2 Split tensile strength

In order to determine the split tensile strength at the 28 days, using concrete cylinders of 300 mm height and 150 mm diameter in accordance with IS 5816-1999.

3.3 Intermediary and test

A direct method of ensuring the tensile strength of concrete id difficult. On the compression testing machine the split tensile strength test was carried out.

Fill the concrete in cylindrical moulds with equal layers of 10 cm thick and tamping should be done for each layer of concrete. Keep the moulds for 24 hrs in room temperature and after demoulding allow the specimen for 28 days water curing. After 28 days, the test specimen was placed at the centering with the packing strip carefully and positioning along the bottom and top of the plane of loading at the specimen. The load was applied by without shock and increased continuously at a theoretical rate until the failure. And the maximum applied load was recorded.

Table.2 Result of Tensile strength test

Mix Id	Cube1 (KN)	Cube2 (KN)	Cube3 (KN)	Split tensile strength (N/mm2)
Conventional Concrete	240	255	230	3.24
TSSFRC0.25%	235	270	250	3.30
TSSFRC0.5%	300	260	280	3.95
TSSFRC0.75%	290	270	310	4.14
TSSFRC1%	270	250	250	3.54

3.4 Modulus of elasticity

Elasticity is known as the strain appears and the strain disappears immediately on the applications, and the removal of stress. Modulus of elasticity of the concrete is to be determined by subjecting the cylinder specimen to unique axial measuring and compression deformations. Deformation by gauge length gives the strain and also give the stress by the load applied at the cross-area of the section.

Fig. 4.5 Modulus of elasticity test set up

Table.3 Modulus of elasticity test result

Specimen	Modulus of elasticity (MPa)
Conventional Concrete	22534
TSSFRC 0.25%	22536
TSSFRC 0.5%	27150
TSSFRC 0.75%	28294
TSSFRC 1%	29101

4. METHODOLOGY

- Design the grade of M30 concrete mix.
- Determination the compressive strength, split-tensile strength and Young's modulus of elasticity of M30 grade concrete with the addition of 0 %, 0.25 %, 0.5 %, 0.75 % and 1 % turn steel scrap fibers by percentage weight of cement.
- Mathematical analysis of following concrete slabs under impact loading using ANSYS software.

5. SOFTWARE VALIDATION

Validation of the mathematical analysis of repeated impact test on concrete structure is done with the test results from experimental works done.

For the analysis, ANSYS 16.2 workbench is used. Single drop test was done in Explicit dynamics. Fixed supported geopolymer concrete slab was modelled and proper mild reinforcement are given as structural steel. Slab was meshed with size of 20 mm. The impactor was modelled as steel sphere of radius 62 mm so as to have a weight of 7.7 kg. Height of fall of steel ball is given as 700 mm. Steel ball is considered as a rigid body. Engineering datas are taken from the journal.

6. RESULTS

6.1 First crack

The micro cracks are inherent in cement mortar matrix even before application of impact load; and as the micro crack widen, propagate and progressively joined together under such impact load, they are detected by some means, visual or otherwise, and termed as first crack.

6.2 Ultimate failure

The number of beats are required for the ultimate or final failure of slab was increased by 433.33%, by addition of 0.75 % turn steel fibers by weight of the cement. It can be attributed to the improvements in tensile strength and ductile characteristic of concrete.

6.3 Impact energy absorption

The Impact energy is absorbed by the slab was increased by 433.33 % by addition of 0.75 % turn steel fiber by the weight of cement. The increase in the impact energy is absorbed by the turn steel fiber reinforced concrete clearly indicates the suitability of fiber reinforced concrete in construction of strategic important structures.

7. CONCLUSIONS

The continuously drop weight impact test on turn steel scrap fiber reinforced concrete slabs were done and the following conclusions could be derived from the results.

- By the addition of steel turn fibers into the concrete increased the compressive strength. There was a maximum increase of 6.67 % in compressive strength when 0.5 % turn steel fibers by the weight of cement was added.
- The addition of turn steel fibers into the concrete the split tensile strength of concrete is increased. There was a maximum increase of 21.64 % in tensile strength. This can be adjective to the crack control properties of the steel fiber.
- Young's modulus of elasticity increases with increase in turn steel fiber content.

8. REFERENCES

- **A.J.Sangi** and **I.M.May** (2009) High Mass Low Velocity Impacts on Reinforced. Concrete Slabs, *7th European LS-DYNA Conference.*
- **F.Tahmasebinia** (2008) Finite Element Simulation of RC Concrete Structures Under Impact Accidents, *Journal of Structural Survey*, 26, 445-454.
- **G.I.Sezer, S.Yacizi** and **A.Sezer** (2015) Dependence of Impact Resistance of the Steel Fiber RC Concrete on Aggregate Origin, *Special Issue of the International on Computational and Experimental Science and Engineering*, 128, 37-39.
- **H.Sudarsana, Vaishali** and **N.V.Ramana** (2009) The Two Way Slabs Under Impact Loading, *International Journal of Impact Engineering, Response of SIFCON (ELSEVIER)*, 37, 452-458.
- **Jihad Swan** and **Mohmed Abdel-Rohman** (1986) Impact Effect on RC Slabs: Experimenta Approach, *Journal of Structural Engineers ASCE*, 9, 0733-9445
- **K.Sai Abhinav, N.Srinivasa Rao** (2016) Investigation on Impact Resistance of the Steel Fibre Reinforced Concrete, *International Journal of Science and Resesrach,* 5,810-813.
- **K.C.G.Ong, M.Basheer Khan** and **P.Paramasivam** (1999) Resistance of Fibre Concrete Slabs to Low Velocity Projectile Impact, *ELSEVIER*, 21, 391-401
- **M.M.Hossain, M.R.Karim, M.A.Islam** and **M.S.Zain** (2014) Crack Cronology of the Reinforced Concrete Beam Under Impact Loading 1990-9233.