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Finite Element Analysis of Steel Fibre Reinforced Concrete (Sfrc) Under Monotonic Stresses in Tension

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ABSTRACT : Steel fibres are found to influence the behaviour of concrete with respect to their peak response characteristics, crack arrest mechanism, and post crack behaviour of concrete. The strain at ultimate would be improved significantly, and the load-displacement behaviour shows ductile behaviour. The present study aims to investigate and validate the predictions of a simple, yet practical finite element model concerning the responses of steel fibre reinforced concrete cylindrical specimens (150 mm diameter, 150 mm height) under static loading in indirect tension. The behaviour in tension will be studied under double punch test (DPT). Double punch test (DPT) has shown reliable assessment of tensile behaviour where the failure would be along weaker planes, rather predetermined failure plane in the case of splitting tensile test. Also, the coefficient of variation is considerably less in the case of double punch test. Compression load will be applied using steel punches (38.1 mm diameter, 25.4 mm depth), placed at the top and bottom of cylinder concentrically and the stress-strain behaviour will be arrived using finite element analysis. The parameters involved in nonlinear static finite element (FE) analysis govern the correlation of the FE results with experimental observations. Fibre parameters comprising fibre length L, aspect ratio L/d with L being the length and d the diameter, fibre content V_f, its shape, strength and orientation would result in the possible scatter of the test results. A close examination of the experimental findings with FE results would validate the reliability of the numerical investigation.

I. INTRODUCTION :

A large number of finite-element (FE) models have been developed to describe the nonlinear behaviour of structural elements, both under static and dynamic loading. The formulation of such models in analytical terms is based on the combined use of:

1. Relevant experimental data
2. Continuum mechanics theories (i.e., nonlinear elasticity, plasticity, visco-plasticity and damage mechanics).

The latter formulation usually incorporates a number of parameters, the evaluation of which is essential for achieving close correlation between the numerically predicted nonlinear specimen behaviour and its experimentally-established counterpart.

A finite element model is generally considered capable of yielding realistic predictions concerning the nonlinear response of concrete structures when the deviation of the predicted values from their experimentally measured counterparts (of particular structural characteristics) does not exceed a value of the order of 20%. Such structural characteristics usually include the relation between applied load and corresponding displacements, reactions or first-order deformation derivatives.

To date, a large number of experiments have been conducted in order to determine the effect of steel fibres on structural concrete material behaviour. The vast majority of tests have been carried out on concrete prisms and cylinders subjected to uniaxial compression, direct or indirect tension and flexure.

Based on the available test data, the introduction of steel-fibres into the concrete mix predominantly results in an enhancement of post-cracking behaviour, allowing concrete to exhibit more ductile characteristics compared to the essentially fully brittle behaviour exhibited by plain concrete specimens. The fact that this enhancement is mainly observed in tension suggests that the fibres within the concrete mix act primarily in tension, resisting the formation and extension of cracking, whereas in compression one could conservatively assume that their effect could be ignored.

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II. METHODOLOGY

- Tensile studies will be carried based on finite element analysis, on concrete cylinder model of 150 mm diameter and 150 mm height, using steek punches, 38.1 mm diameter and 25.4 mm height, placed at the top and bottom of the cylinder.
- The stress-strain characteristics will be arrived using displacement-controlled approach in the finite element tool.
- The stress-strain values at the desired load intervals as desired based on experimental findings will be obtained in the FE tool and compared with the experimental observations.

III. MODELING AND ANALYSIS

The model was done with sepcification as shown in th figure.

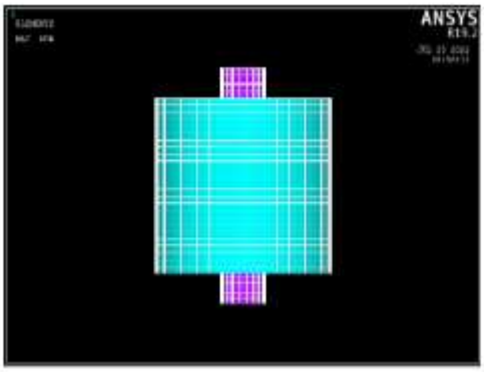

Figure III.a. ANSYS model of cylinder with top and bottom punches

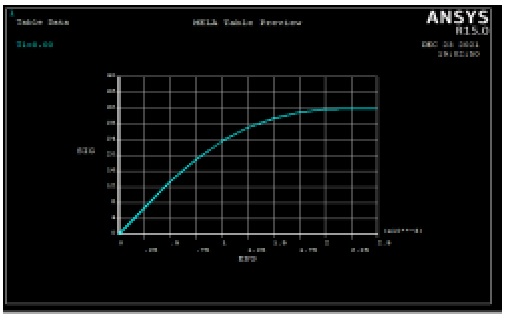

Figure III.b. Stress v/s strain graph

The model with hexahedral mesh in the APDL solver is shown above. The analysis was done for the different concrete specimens.

IV. RESULTS

The results are shown the following graphs.

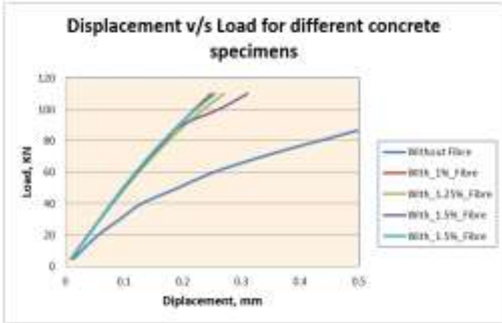

Figure IV.a. Displacement v/s load for different concrete specimens

From the above graph we can see that he concrete without fibre reinforcement shows the larger displacement values with the increase in load.

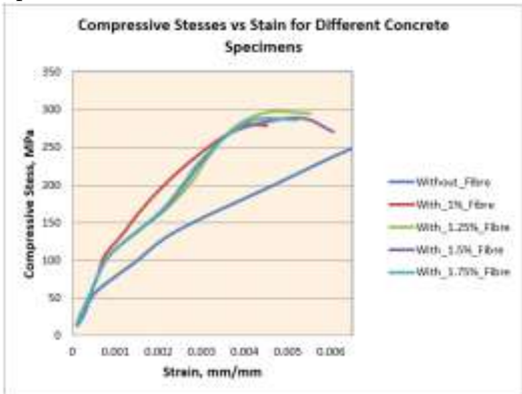

Figure IV.b. compressive stresses v/s strain for different concrete specimens

From the graph we observe that the specimens with different percentages of fibre addition shows reduced displacement values with the compressive stresses almost similar to all the SFRC

V. CONCLUSION

The main objective of this project is to study the behaviour of fibre reinforced concrete under different loading conditions and analyse the same with the ANSYS APDL Solver package. From the obtained results we can conclude the following points,

The plane concrete model without fibre shows large displacement values and higher compressive stress which in turn leading to tensile cracks in the axial directions finally leads to a specimen failure with the increase in any further load. With the addition of steel fibres, the displacement values reduced considerably with lower compressive stress values. The specimens also withstand the higher loads with lesser cracks.

From the abovess graphs we can observe that concrete specimen with 1.25% steel fibre shows better results compare to other SFRC specimens.

The APDL solver is a strong FEA tool which we can analyse any structural problem seamlessly with proper boundary conditions.

REFERENCES

[1]. Abbas, A. A., Syed Mohsin, S. M., & Cotsovos, D. M. (2016). “A simplified finite element model for assessing steel fibre reinforced concrete structural performance”. Computers and Structures, 173, 31–49. https://doi.org/10.1016/j.compstruc.2016.05.017

[2]. Abdollahi, A. (1996). “Investigation of objectivity in the application of the FEM to RC structures” - II. Computers and Structures, 58(6), 1183–1211. https://doi.org/10.1016/0045-7949(95)00215-4

[3]. Bansal, N., Kwatra, N., & Kanwar, V. S. (2013). Finite Element Modeling of Reinforced Concrete Corners Under Opening Bending Moment. Journal of The Institution of Engineers (India): Series A, 94(1), 23–33. https://doi.org/10.1007/s40030-013-0039-6

[4]. Baskar, K., Shanmugam, N. E., & Thevendran, V. (2002). Finite-Element Analysis of Steel–Concrete Composite Plate Girder. Journal of Structural Engineering, 128(9), 1158–1168. https://doi.org/10.1061/(asce)0733-9445(2002)128:9(1158)