Tension Stiffening Effect in Normal, Self Compacting and High Strength Concrete

UJWAL KUMAR
(Scholar – *Civil Engineering*)
M.S. Ramaiah Institute of Technology, Bengaluru, Karnataka, INDIA

RAJAT RANJAN
(*Scholar – Civil Engineering*)
National Institute of Technology, Patna, Bihar, INDIA &
M.S. Ramaiah Institute of Technology, Bengaluru, Karnataka, INDIA

VIVEK SINGH
(*Scholar – Civil Engineering*)
M.S. Ramaiah Institute of Technology, Bengaluru, Karnataka, INDIA

SHYAM DUTT SHUKLA
(*Scholar – Civil Engineering*)
M.S. Ramaiah Institute of Technology, Bengaluru, Karnataka, INDIA

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PREFACE

Dedicated to all the Scholar's and Students of Civil Engineering.

Constructive feedback is cordially invited.

✍ *Author(s)*

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✍ *Ujwal Kumar*
✍ *Rajat Ranjan*
✍ *Vivek Singh*
✍ *Shyam Dutt Shukla*

DEDICATED

TO

OUR BELOVED PARENTS

FOR

THEIR LOVE AND SUPPORT

ABSTRACT

Tension stiffening effect is an important phenomenon to be under stood before applying it to the structural concrete. It has been observed from the literature the cracking and deformation behavior of the structural concrete depends on the tension stiffening. This investigation presents the structural response of reinforced concrete under direct tension to understand the tension stiffening effect. The variables are normal strength concrete (NSC), High strength concrete (HSC), and self-compacting concrete with different diameter reinforcing bars. This investigation covers the interaction of structural steel reinforcement and concrete in uniaxial tension. A large number of studies are available with respect to several parameters viz., different grades of concrete, diameter of bars, transverse cracks, splitting cracks, crack widths, bar-bond behavior, use of steel fibers etc. in tension stiffening.

An experimental program has been designed to mix, cast and test three different grades on concrete viz. M20, M70, M30 SCC. The different diameters of bars used are 10mm, 12mm and 16mm. All specimens were caste in wooden moulds; concrete was poured in three layers and compacted by vibration. The test was carried out after 28 days of casting. The experimental constants are the geometry of specimen (100×100×400) mm as well as the test set up.

A procedure of trials was adopted to find a suitable mix design in which I.S method of proportioning was used for M20 and M70 and a method proposed by "Nan Su et al" has been used for proportioning of SCC. The cracking pattern, first cracking load, stress-strain relation and ultimate failure behavior were experimentally studied.

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NOTATIONS

UPPER CASE LETTERS

A_{st} = Area of total tensile reinforcement, mm^2

P_{cr} = Cracking load, KN

P_u = Ultimate load, KN

P_{br} = Breaking load, KN

V = Absolute volume of concrete

S_c = Specific gravity of cement

W = Mass of water per cubic metre of concrete, kg

C = mass of cement per cubic metre of concrete, kg

p = ratio of fine aggregate to total aggregate by absolute volume

f_a, C_a = total masses of fine and coarse aggregates, per cubic metre of concrete, respectively, kg

S_{fa}, S_{ca} = specific gravities of saturated surface dry fine and coarse aggregates

LOWER CASE LETTERS

f'_{ck} = Target mean strength, MPa

f_{ck} = characteristic strength, MPa

s = Standard deviation

b = Breadth of the specimen

d = Depth of the specimen

d_b = Diameter of the reinforcing bar

GREEK LETTER

p = Reinforcement ratio

Δ_{cr} = Deformation at cracking load

Δ_u = Deformation at ultimate load

Δ_w = Deformation at working load

Δ_{br} = Deformation at breaking load

Δ_y = Ductility

ABBREVIATIONS

HSC = High strength concrete

NSC = Normal strength concrete

SCC = Self compacting concrete

MPa = Mega Pascal

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