STRUCTURAL CONCRETE SUBJECT TO TORSION BENDING AND SHEAR

By
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Thesis submitted in partial fulfilment of
of the requirements for the degree of
DOCTOR OF PHILOSOPHY
in
CIVIL ENGINEERING

INDIAN INSTITUTE OF TECHNOLOGY, DELHI
NEW DELHI
1974

CERTIFICATE

This is to certify that the thesis entitled "Structural Concrete Subject to Combined Torsion, Bending and Shear" being submitted by Sri Bipin Kishore Mital to the Indian Institute of Technology, Delhi for the award of Degree of Doctor of Philosophy in Civil Engineering, is a record of bonafide research work carried out by him. Sri Bipin Kishore Mital has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis, which to my knowledge has reached the requisite standard.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.

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ACKNOWLEDGEMENTS

The author wishes to express his deepsense of gratitude to Professor B.M. Ahuja for his kind help, guidance and constant encouragement throughout this investigation.

The author is thankful to Professor K. Seetharamulu for providing the necessary facilities to complete this project.

He is also thankful to Dr. D.V. Mallick and Dr. S. Krishnamoorthy for giving every assistance in the structural engineering laboratory.

Sincere thanks are also due to the staff of civil engineering workshop and structural engineering laboratory for their co-operation and assistance during this investigation.

The author is also thankful to Sarvsri V.Raja Rao, Anil Kumar, A.K. Nagpal and P. Suryanarayan for their assistance at one time or another in the structural engineering laboratory.

Last but not the least the author is thankful to Mr. D.R. Joshi for typing the manuscript neatly.

March 25, 1974 (Bipin Kishore Mital)

ABSTRACT

Tests are reported on 18 reinforced rectangular concrete beams of depth width ratio 1.5 under pure torsion, torsion and bending and torsion, bending and shear. Ten beams were reinforced with only longitudinal steel and remaining eight beams were reinforced with both longitudinal and transverse steel. Beside these, use has been made of approximately 300 results published by other investigators and presented all in relation to the theory proposed to predict the failure.

The behaviour of the beams and mechanism of the failure were carefully examined for various moment torque ratio. All beams having only longitudinal steel failed by crushing of concrete. The presence of the dowel force was observed perhaps for the first time through the strain measurements in beams having only longitudinal steel. The beams having both longitudinal and transverse steel failed either by crushing of concrete or by yielding of steel. An emperical equation based on observed data has been given to predict the inclination of crack on the faces of the beam. Using this equation a theory based on skewed bending concept and considering the equilibrium of all the forces has been developed to predict the ultimate strength of the beam having only longitudinal steel or having both longitudinal

and transverse steel in combined loading. The theory gives the ultimate load for both the cases when either steel yields or concrete crushes.

There is a certain amount of uncertainity when the dowel force plays a major role namely the cases when the failure is due to crushing of concrete.

When the beams have no transverse steel, the crushing of concrete seems to be inevitable. There are also instances of crushing of concrete when the transverse steel is too small. Because of the uncertainity due to variation in concrete strength and the important role played by accompanying dowel force, the predicted results in such cases of failure through crushing of concrete show a considerable scatter. Since such cases are to be avoided in practice, the theory seems reasonably satisfactory.

The I.C.L. 1900 computer was used for all computations.

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