

LONG-TERM BEHAVIOUR OF REINFORCED CONCRETE
PORTAL FRAMES UNDER CYCLIC THERMAL LOADING

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Thesis submitted to the
Indian Institute of Technology, Delhi
for the award of the degree of

DOCTOR OF PHILOSOPHY

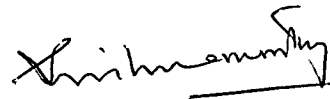
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JULY, 1983

CERTIFICATE

This is to certify that the thesis entitled, "LONG-TERM BEHAVIOUR OF REINFORCED CONCRETE PORTAL FRAMES UNDER CYCLIC THERMAL LOADING", being submitted by Mr. MRINMOY DAS to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy, is a record of bonafide research work carried out by him under my guidance and supervision.

To the best of my knowledge the thesis has reached the requisite standard. The matter presented in this thesis, in part or full, has not been submitted to any other University or Institute for the award of any degree or diploma.



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ACKNOWLEDGEMENT

I express my deep gratitude to Professor S. Krishnamoorthy Department of Civil Engineering, for his valuable guidance and kind supervision at various stages throughout this work. But for his ceaseless and inspiring encouragement this work would not have been possible.

I also wish to thank Professor B.M. Ahuja, Dr. T.K.Datta, Assistant Professor and Dr. S.N. Sinha, Assistant Professor, of Civil Engineering Department, for their help rendered during the experimental work carried out in the laboratories.

I also wish to thank Mr. C.L. Varma, S.T.O., Mr.G.K.Mehta, Foreman (S.G), Mr. Badan Singh, T.A., Mr. G.S. Trehan, T.A., Mr. Badle Ram, T.A., of Civil Engineering laboratories and Workshop and all other staff of those laboratories wherein the experimental part of the work and fabrication of the testing rigs were carried out.

I am also indebted to Mr. D.S. Sidhu and Mr. B. Bhattacharya of Civil Engineering Department for their help and encouragement throughout this work.

Thanks are also due to the staff of the Computer Centre of the Institute for rendering necessary help for running the Computer Programmes, to Mr. N.L. Arora for tracing the drawings and other office staff of the Department for their help rendered as and when required, and also to Mr.K.L. Buttan and Mr. P. Kamalasanan for typing the manuscript.

I am very much indebted to the Government of Tripura for sponsoring me under the Quality Improvement Programme and granting the required leave. I also wish to acknowledge the financial assistance received from Government of India under the same programme.

JULY, 1983

MR INMOY DAS

ABSTRACT

The research work reported herein examines the behaviour of two-hinged reinforced concrete portal frames under the combined effects of creep and shrinkage subjected to thermal cycles of heating and cooling. Subsidiary tests were performed to obtain the material behaviour for three to four months on control specimens made of same concrete as that used in the portal frames tested. The control specimens were tested at different levels of uniform temperature as well as cyclic temperature. It is shown that both the shrinkage-time-temperature and creep-time-temperature relationships can be normalised by formulating exponential form of equations considering volume/surface ratio as a function thereof which can also be used for cyclic temperature of heating and cooling.

Five portal frames were tested under cyclic temperatures for over three months; two without any mechanical load and the other three had two-point mechanical loads on the beam. The beam of the portals were heated either 'uniformly' or with temperature crossfalls. The horizontal reaction at the hinge, axial strains, curvatures, steel strains, temperatures and deflections were measured using appropriate techniques.

A computer programme based on 'rate of creep' principle has been developed for predicting the long-term behaviour of the portal frames in which possible cracking of concrete has been taken into account. The predicted results are compared with the test results. Another computer programme based on

'effective modulus' principle has also been developed and the predicted results of the two methods are compared.

The tests show that the behaviours of the frames are drastically different from those which could be predicted by elastic analysis or conventional reinforced concrete cracked section theory. Creep and shrinkage of concrete cause significant redistribution of moments which can be very much different from those predicted by thermoelastic analysis. Similarly, considerable redistribution of stresses occurs between steel and concrete and large compressive stresses in the compressive steels develop which are very large when compared with the results of conventional reinforced concrete theory.

Tests on the beams of the portals after the end of temperature cycles for their ultimate strength indicated that ultimate moment capacities of the beams were not adversely affected. Although stiffness of the beams suffered some loss, no structural damage was observed.

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