THE FATIGUE OF PRESTRESSED CONCRETE BEAMS UNDER REVERSED CYCLIC LOADING

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SYNOPSIS

This thesis reports investigations into the stiffness of and energy loss in two series of prestressed concrete beams subjected to reversing sinusoidal cyclic end rotations of equal magnitude and direction. These rotations produced equal moments at the ends of the beams and zero moment at the centre which led to uniform shear along the length of the member.

Special care was taken in the manufacture of the two series of beams to ensure essential uniformity of the properties of the beams one to another. The end rotations and the resulting moments where measured by suitable transducers and traces of the moment versus rotation relationship were recorded on an X-Y recorder at intervals during each test run. The amplitude of rotation was progressively changed during each test to ensure a steady value of the end moments. From these recordings the changes in end stiffness and energy absorption were observed and recorded against the number of cycles of moment applied. Concrete strains near the ends of the beams were recorded during the tests.

The end moments were expressed as a percentage of the "ultimate" moment which would be required to fail the beams in one reverse cycle of loading. The moment rotation properties of the beams were observed to change as the number of cycles

of loading were increased, this change being more rapid for higher percentages of "ultimate" moment.

The energy dissipation was found to increase with an increase in the frequency of the cyclic loading. It was considered that the greater part of the energy dissipation arose from the material damping within the concrete. At higher percentages of ultimate moment, the number of cycles sustained before failure was found to increase when ties were inserted around the reinforcing wires.

The results from the tests were analysed and an attempt made to relate the properties by the beams to the properties of the component materials of the prestressed members.

A theoretical model was postulated with certain simplifications of the relationships of the material properties and a computer program designed to simulate qualitatively, the behaviour of the beams tested. A non-linear hysteretic stress-strain relationship was assumed for the concrete in this analysis which gave similar stress-strain traces to these found in the experimental analysis.