# Flexural bond failure of pre-stressed concrete beams

I R A Weerasekera*
*Department of Civil Engineering, University of Moratuwa, Moratuwa*

In pretensioned prestressed concrete anchorage of prestressing steel in concrete is achieved by means of steel-concrete bond. This mechanism is two fold, consisting of transfer and flexural bond. The subject area of this study focuses on the latter. At the loading stage of a beam, it is extremely important to avoid a flexural bond failure. Our knowledge on flexural bond is more limited as compared to transfer bond. However, for the overall behaviour, both these bond influences need to be emphasised.

An experimental investigation has been carried out by fabrication and testing of 13 full-scale specimens to ascertain the influence of various parameters on bond characteristics. All the beams were designed to fail in bond, even though it is difficult to achieve such a failure mode. Experiments conducted for this study show that several factors influence the ultimate failure of these beams. Among them are, concrete strength, level of pre-stress in strand tendons, strand diameter or area, confinement of the tendon dictated by clear cover or half spacing and the nature of the load and its loading position of the beam. In 4 out of 13 beams tested, the failure modes were different from bond failure. The rest were either bond-flexure or bond-shear depending. However, the primary failure mode was bond. This shows the dangers involved in practices based on major design codes adopted in Sri Lanka. A premature bond failure undermines the flexural and shear capacities of pretensioned prestressed concrete beams which is a serious cause for alarm and concern.

The experimental results show that a bond failure is manifested by very little strand slip and should be monitored throughout the testing stage. Deflection measurements have been made at several stages of the test. Results indicate the prevalence of small deflections in the event of bond-shear failure and large deflections associated with bond-flexure failures. This means that some bond failures may be brittle as opposed to a ductile failure which we often desire to have. This shows the flaws associated with various design codes of practice as these do not provide adequate safeguards against such premature bond failures.

In conclusion, adequate steps should be taken during the design stage to maintain sufficient confinement and to avoid the use of low concrete strengths in the absence of experimental data to amend relevant codes of practice adopted in Sri Lanka. Enhancing the beneficial effects of such factors may act as a preventive measure for the time being.

* ruwan@civil.mrt.ac.lk Tel: 011-2650567