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EVALUATION OF A PRESTRESSED PANEL, CAST-IN-PLACE CONCRETE BRIDGE

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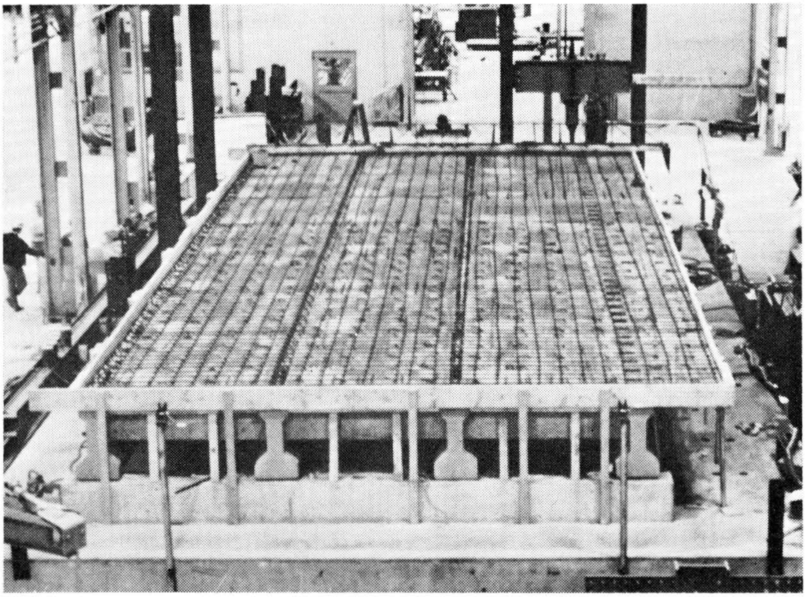

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Evaluation of a Prestressed Panel, Cast-in-Place Concrete Bridge

by

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Key Words: bridge, prestressed concrete, precast concrete panels, slab, repetitive loads, ultimate load, composition action.

A relatively new type of beam and slab bridge makes use of precast, prestressed panels as part of the slab. In this type of bridge construction, the panels are placed to span between the beams and serve as forms for the cast-in-place portion of the deck. They remain in place to become an integral part of the continuous structural slab. Composite action is obtained in the structure by bonding the prestressed elements together with the cast-in-place portion of the deck. This structure incorporates unproven structural details—bonding of concrete at the interfaces and the inclusion of panel butt joints.

The purpose of this study was to experimentally and theoretically investigate the ability of such a structure to distribute wheel loads in a satisfactory manner and to behave as a composite unit.

A single span full-scale prestressed panel bridge of this type was evaluated experimentally in the laboratory, and theoretical studies of the structure were made. The structure was subjected to cyclic applications of design load plus impact and to static failure loads.

Two million applications of simulated design axle load plus impact were accomplished at three locations on the bridge structure. The bond at the interface between the prestressed panels and the cast-in-place concrete performed without any indication of distress under these cyclic loads.

Two million cycles of design wheel load plus impact alternating on opposite sides of a panel butt joint were applied at one location on the structure without causing distress. Satisfactory performance was exhibited by the bridge slab when subjected to static failure loads. The lowest value of cracking load measured experimentally was 3.8 times the design wheel load plus impact, and the lowest measured ultimate load was 12.5 times the design wheel load plus impact.

The failure surfaces that developed in the static failure tests were typical of punching shear failures. The surfaces intersected and continued across the panel to the cast-in-place interface and were not influenced by the interface.

Theory presented by Westergaard (the basis of present design specifications) predicts local bending stresses in the slab of the structure with reasonable accuracy if in-plane stresses

resulting from spanwise bending of the entire structure are ignored. An elastic analysis of the structure, including in-plane as well as bending effects was developed for comparison with strains and displacements measured in the bridge.

The following conclusions were drawn from the results of the theoretical and experimental program.

1. The bond at the interface between the prestressed, precast panels and the cast-in-place concrete performed without indication of distress under cyclic design loads and static failure loads.

2. Wheel loads were transferred and distributed across transverse panel joints in a satisfactory manner.

3. It is feasible to design for composite action in a prestressed panel bridge of the type studied.

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