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EXPERIMENTAL USE OF HIGH STRENGTH REINFORCING STEEL

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EXPERIMENTAL USE OF HIGH STRENGTH REINFORCING STEEL

by

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Introduction

This research was undertaken to gain experience with high strength reinforcing steel used in design and construction. A full scale experimental overpass structure was built to evaluate the performance of the steel. The tests were made in 1963 on a cross-road structure over Interstate Highway 35 near Hillsboro, Texas. A-432 reinforcing steel having a minimum yield strength of 60,000 psi was used in the four span continuous haunched concrete girder unit.

Objectives

The objectives of this research study were to evaluate the performance of the experimental structure with respect to adequate safety against static and fatigue failure and with respect to satisfactory deflections and crack formation.

Evaluation Procedure

The evaluation procedures were as follows:

1. Electrical Strain Gages were bonded to the bridge as it was built and deflection gages were mounted on the completed structure.

2. Test runs were made with a three axle truck which was equipped with instrumentation for measuring dynamic axle loads.

3. Air hose detection devices were mounted perpendicular to the roadway to record truck location. This information was recorded in analog form on an oscillograph and then converted to digital output and punched onto cards.

4. Cracks, as they appeared, were marked and numbered so that primary, secondary, and teritiary cracks could be distinguished.

5. Comparisons were made between observed and calculated stresses and deflections.

Results

The following results were found from the studies:

1. Maximum stresses occurred when the test truck passed over the impact ramps.

2. The skew effect and increased concrete strength and modulus of elasticity contribute to a reduction of deflections.

3. Measured impact was in general agreement with values computed by A.A.S.H.O. design criteria.

4. Speed had very little effect on peak deflection.

5. No unusual vibration characteristics were found.

6. The damping characteristics of the experimental structure were good.

7. Deflections observed approximately two years after construction were less than the calculated values used in setting construction camber.

8. The use of three different bar sizes did not show a consistent trend as to their ability to control cracking. This is contrary to the performance demonstrated in laboratory tests which indicated that smaller bars are superior in controlling crack widths.

9. Observations of the control structure with regular reinforcing steel revealed crack formation similar to that on the test structure.

Conclusions

The following conclusions were drawn from this research:

1. Measured live load stresses under overload conditions indicate satisfactory working load performance.

2. Dead and live load deflections were smaller than design predictions.

3. Measured impact percentages were generally less than A.A.S.H.O. design specification requirements.

4. Damping and vibration characteristics were satisfactory.

5. Observed crack patterns and widths indicate satisfactory performance.

6. Nothing in the observed behavior of this structure indicates unsatisfactory performance.

7. The cost experience on this project indicates a considerable cost advantage in the use of high strength steel in this type of structure.