I – Problem Statement Title (04-EQ011)

Evaluation of the Long Term Performance of Epoxy Bonded Mechanical Couplers

II – Research Problem Statement

Question: Are the mechanical properties of epoxy-bonded mechanical couplers for reinforcing steel compromised after the epoxy has aged with time?

At the present time it is uncertain the degree of loss of tensile strength and cyclical fatigue due to the degradation of the epoxies used in the bonding process of reinforcing steel and mechanical couplers. Epoxy bonding has become increasingly popular in the construction industry, but its long term effect has not been studied. Most of the highway structures that Caltrans designs and builds require that butt splices used in reinforcing steel meet a testing criteria called the ultimate splice testing criteria. This is a requirement to verify that a particular butt splice is able to perform adequately in a catastrophic situation, such as an earthquake.

III – Objective

Build models and develop procedures to evaluate the amount of degradation of the epoxy bond used in the fabrication of mechanical butt splices that must meet the ultimate splice criteria required in many of Caltrans' highway projects.

IV – Background

Currently, the Structural Materials Testing Branch is responsible for testing and approving new mechanical butt splices, commonly known as mechanical couplers. Some of the mechanical couplers submitted by the fabricators include mechanical couplers bonded to the reinforcing steel with epoxy. Such coupler must meet the ultimate splice testing criteria, which requires the specimens to be tested for total slip, cyclical testing, and fatigue testing. The latter is performed to simulate an earthquake situation. When the specimens meet the ultimate splice test criteria, they are listed in an approved list of mechanical couplers, available to the public in the Department's website. What is unknown is the amount of degradation over time of the epoxy and the detrimental effect in the mechanical properties of this type of mechanical coupler.

V – Statement of Urgency and Benefits

A. Support of the Department's Mission/Goals:

(Improving Mobility: Safety, Reliability and Productivity) Many of the Department's highway projects are located in high seismic zones. The reliability and safety of the bridge is dependent on the performance of the couplers in the primary column reinforcement. The factor of safety built into each project can be reduced significantly if the epoxy-bonded mechanical butt splices designated as ultimate splices fail to perform accordingly. Reinforcing steel couplers have to carry design stress levels to meet seismic

performance expectations. This research investigates the potential negative effects on the mechanical coupler due to deterioration in the epoxy bonding agent.

B. Return on Investment:

It would benefit the Department in the selection of adequate mechanical splicing products that meet performance requirements for highway structure in the event of a seismic or high impact event, such as a high-hit load. When replacement of mechanical couplers is necessary, the amount of work and time required will be minimal compared to traditional repair procedures.

VI – Related Research

- None available at the present time.

VII – Deployment Potential

The first phase of the research will consist of the identification of the different epoxies used in the fabrication of epoxy-bonded mechanical splices. Once the epoxies are identified, sample specimens will be subjected to different environmental scenarios. Some of the scenarios will include casting concrete blocks with each sample imbedded. Some of these concrete samples will be exposed to salt water, sweet water, dry weather at high temperatures, and dry weather at room temperature. Other samples will be left exposed to the elements in open environments. Some environments will include marine weather, moderate weather, and dry, hot weather. The use of an environmental chamber will assist in the evaluation of the deterioration of the epoxy at extreme high and low temperatures. The second phase will consist of the mechanical testing of each sample to determine if there is any detrimental effect on the mechanical properties of the specimens.