Design of Adhesive Anchors For Seismic Regions
Static Tension Tests

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ABSTRACT
Due to growing transportation demands, post-installed anchors are increasingly being used to expand and retrofit the existing bridge infrastructure. Current Caltrans design guidelines for the most common and economical adhesive anchors, known as drill-and-bond anchors, are based on 1970's and 1980's research of a limited range of reinforcing bar size (#5 to #8) shallowly bonded and subjected to tension or shear. Recent applications for drill-and-bond anchors require a design method which helps ensures ductile failure under cyclic conditions. In addition, a more flexible and transparent design method is sought for a wider range of reinforcing bar sizes.

The primary objective of this research is to establish a general design methodology to calculate the seismic tensile capacity of a single drill-and-bond rebar (#5 to #11) anchored in uncracked concrete using Set-45. Results of forty-six static tests are reported for #5, #8, and #11 reinforcing bars bonded at two primary embedment depths (8 bar diameters and 16 bar diameters). Bars failed in one of three modes: 1) bond, characterized by relative slip at the steel-adhesive and/or concrete-adhesive interface; 2) splitting, characterized by the formation of radial splitting cracks; or 3) bar fracture.

Analysis of the static test data indicates that: 1) bond strength may be determined from a uniform bond strength model based on a bond strength of 2300 psi for Set-45; 2) splitting strength may be based on the concrete splitting tensile strength, splitting plane, and a bearing angle of approximately 22 degrees between the splitting load and applied load; and 3) bar fracture may be based on the expected rebar tensile strength. The mean capacity for a single anchor may be determined from the smallest predicted load for the three failure modes. Test results to date have indicated that a ductile failure can be ensured by designing the fracture load to be the lowest failure load. Other effects on anchor strength and failure mode such as carbonation and poor grout mixing will be addressed in subsequent reports.

Both static and tension cyclic test results will be reported by February 2006. Future sponsored research is expected to address additional variables such as threaded bars, epoxy-coated bars, additional adhesive products, edge effects, group effects, shear, combined tension and shear, and cracked concrete. This will allow the design methodology to be expanded to a wide range of applications.