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Project Title: Improving Precast System Connection Durability by Development of Nonproprietary Engineered Cementitious Material

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WHAT IS THE NEED?

Caltrans has been targeting and utilizing prefabricated components construction techniques for Accelerated Bridge Construction (ABC) over the years. ABC uses prefabricated bridge components to build bridges; it is a paradigm shift in the project planning and procurement approach, where the need to minimize mobility impacts occurs, due to onsite construction activities that are elevated to a higher priority.

Using precast concrete as the material of choice for an ABC design allows high performance and high quality structural members; minimal onsite falsework; and improved durability because of a factory-like production setting, which leads to lower maintenance and life-cycle costs. The major challenge for precast component bridge system has been finding a seismically resilient connection design for construction between each precast component.

Although Caltrans has developed several precast component connection designs and accompanying details in the past to overcome much of this issue, using more advanced material, such as self-consolidating, non-proprietary, and highly resilient concretes, would improve performance and constructability in joint regions. Since the long term consequences of applying strains into concentrated regions is not fully comprehended, using proper concrete material for the bridge connection designs would improve durability, and possibly avoid introducing regions of highly varying material properties.

Caltrans has been using Cast-in-Place (CIP) construction technique for a long time, and prefabricated bridges are relatively new to Caltrans, thus the research of connection materials for prefabricated bridge components is much needed.
WHAT ARE WE DOING?

The Principal Investigator will perform the following:

1. Develop non-proprietary, cost-effective Caltrans-Engineered Cementitious Composite (Caltrans-ECC) mix designs for ABC field-cast connections. Caltrans-ECC is a special-designed concrete, which can achieve very high concrete compression strength and tensile strength.

2. Investigate and assess the material properties, large-scale constructability and structural performance as applied to connections.

3. Recommend guidelines for design, construction, and quality control for Caltrans-ECC field-cast connections for precast concrete bridge components.

WHAT IS OUR GOAL?

The goal of this research is to:

1. Develop a self-consolidating and cost-effective concrete material for Caltrans with documented performance and construction guidelines, which can be readily used by Caltrans for precast connections.

2. Determine whether to extend this research with ongoing efforts from similar seismic-related efforts as a cost savings measure.

WHAT IS THE BENEFIT?

This project will lead to developing and quantifying non-proprietary, cost-effective mix designs for a self-consolidating cementitious material for Caltrans precast field-cast connections. Besides, the research results will provide benefits to modify and improve prefabricated element connection details, by taking advantage of the unique properties of a non-proprietary. Finally, the research will improve the connection durability and materials, which could be applied to service level connections, such as:

1. Spliced precast girder bridge connections at splice locations (using post-tensioning to connect all prefabricated bridge components. At the connection locations, the new materials will be applied without reinforcement congestions);

2. Partial-depth precast deck panel connections to the girders and CIP decks (using precast deck panel as forms to support CIP decks, and connect all these components by using the new materials); and

3. Full-depth precast deck panel connections to girders.

WHAT IS THE PROGRESS TO DATE?

The research will be executed in April, 2018.