Shear Resistance of Cast-In-Place Post-Tensioned Girders

A research to develop an accurate approach, including details to determine the safe shear resistance of Cast-In-Place post-tensioned box girders.

WHAT IS THE NEED?

The American Association of State Highway Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications is the national bridge construction standard which adopts a conservative approach. California Amendments to the AASHTO LRFD Bridge Design Specifications (abbreviated to CA Amendments below) however, is relatively more progressive and cost effective in building bridges. Caltrans has been following the CA Amendments for bridge constructions, but currently does not have any adequate experimental or analytical data to support the CA Amendments, concerning shear resistance of girders with post-tensioning ducts. Shear resistance (also known as shear strength and shear capacity) refers to the strength of a component against external force, such as an earthquake, until the component fails in shear.

Furthermore, a recent research (Moore et al. 2014) has examined the behavior of post-tensioned girders with one duct only, whereas Caltrans’ Cast-In-Place post-tensioned box girders often have two or more ducts that become bundled away from the anchorages. Therefore, it is necessary to conduct a research to examine box girders with multiple ducts, and determine the safe shear resistance.

WHAT ARE WE DOING?

The Principal Investigator will:

1. Perform large scale experimental testing to understand shear failure of box girders, as it depends on post-tensioning duct arrangement and conditions.
2. Conduct Parametric Analyses based on the load test results using Finite Element Modeling. The Parametric Analyses will cover variations in the loading patterns, positioning of the post-tensioning steel within the girder, and other critical factors that may affect the shear capacity of the girders.

WHAT IS OUR GOAL?

The goal of this research is to:

1. Provide adequate experimental, analytical support and rationale to the CA Amendment provisions for the typical Cast-In-Place box girder construction.

2. Recommend appropriate detailing, such as duct diameter and spacing, and safe shear resistance in Cast-In-Place post-tensioned box girders.

The research team will provide a final report to present the key findings of this research. Additionally, the report will highlight any potential changes to Caltrans Standards and Guidance materials.

WHAT IS THE BENEFIT?

Caltrans does not have any adequate experimental or analytical data to support the CA Amendments deviating from the national standards, the AASHTO LRFD Bridge Design Specifications. This research will provide a basis to support the CA Amendments, concerning the shear design in Cast-In-Place post-tensioned box girders.

Furthermore, in order to not adversely affect the shear resistance of post-tensioned bridge girders, the research findings will lead to best practices recommendation by documenting girders details, in terms of maximum duct diameter and spacing of bundled ducts, which will ultimately save cost in the construction of Cast-In-Place box girder bridges.

WHAT IS THE PROGRESS TO DATE?

The research will start in May, 2018.

IMAGE

Box girder in construction