DRISI

Caltrans Division of Research, Innovation and System Information

Research Notes

Geotechnical/ Structures

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Impact of Inspection Tube Placement on Structural Performance of CIDH (Cast-In-Drilled Hole) Piles

Evaluate the influence of spacing of vertical reinforcement on the structural performance of CIDH piles, and develop mix designs and calibrate evaluation methods to improve the quality of concrete placement in CIDH piles in the presence of inspection tubes.

Project Title:
Seismic Design Details for Improved Bridge performance

Task Number: 2173

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WHAT IS THE NEED?

In the presence of ground water, the slurry displacement method is used for CIDH piles to ensure the stability of the drilled holes during construction. As concrete is placed under water without compaction, defects or cavities may occur around reinforcement, affecting the structural integrity of the pile. Hence, the construction of CIDH piles larger than 2-ft. in diameter under wet conditions requires installation of inspection (PVC) tubes for non-destructive detection of potential anomalies in concrete. Current Caltrans practice is to have the clear spacing between the longitudinal reinforcing bars immediately adjacent to a tube be at least 8.5 in. so that the clear spacing between a tube and an adjacent rebar will be at least 3 in. There are two main concerns with this requirement. One is the increased spacing of the vertical reinforcement, which is beyond the 8-in. maximum center-to-center spacing permitted by the design specifications and may affect the structural performance of a pile. The other is the quality of concrete placement with limited clear spacing.

WHAT ARE WE DOING?

This research includes both experimental and numerical studies to investigate the influence of the spacing of the vertical reinforcement on the structural performance of a pile, and a study to examine the influence of concrete constituent materials and proportions on the flowability and quality of concrete mixes, with an aim to identify mix designs that will ensure good quality concrete placement in CIDH piles and methods to evaluate concrete mixes. This research consists of six tasks. Task 1 is to develop a finite element model that can be used to study the influence of the spacing of the vertical reinforcement on structural performance. Task 2 is to study the influence of the spacing of the vertical reinforcement on the uniaxial compression behavior of circular-sectioned RC members. Task 3 is to conduct lateral loading tests on two 10-ft. tall RC piles that have different longitudinal

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reinforcement spacing. Task 4 is to conduct a numerical parametric study using nonlinear finite element models on laterally loaded piles with different reinforcing details and dimensions to develop a design recommendation on the spacing of the vertical reinforcement. Task 5 is to assess the influence of different constituent materials and proportions on flowability, and to assess the applicability of different test procedures and identify the most reliable method to quantify flowability. Task 6 is to conduct a calibration and field evaluation of the most promising flowability test method identified in Task 5.

WHAT IS OUR GOAL?

This study is to address the aforementioned concerns. It will ascertain that the vertical reinforcement in a pile can have a center-to-center spacing exceeding 8 in. without having a detrimental effect on the structural performance of the pile; it will provide a better understanding of the influence of concrete constituent materials and proportions on the flowability and quality of concrete mixes, developing mix designs can that can minimize anomalies and defects in concrete placement; and identify a specific or suite of reliable test methods that can be used to determine the suitability of concrete mixes for CIDH piles that have limited clear spacing in rebar cages.

WHAT IS THE PRODUCT OF THE RESEARCH?

Revisions to the Caltrans Bridge Design Specifications on the maximum spacing limit for vertical reinforcement in circular-sectioned RC members, and revisions to the Caltrans concrete mix specifications for CIDH piles.

WHAT IS THE BENEFIT?

CIDH piles containing anomalies and defects are expensive to repair or replace. The study will provide a substantiated and rational recommendation on the maximum permissible spacing of the vertical reinforcement in circular-sectioned RC members subjected to axial and flexural loading. If the study shows that the spacing can be increased beyond 8 in., the quality of concrete placement in CIDH piles can be improved with increased rebar spacing. Furthermore, the study will provide recommendations on concrete mix designs that have the desired workability and properties for CIDH piles and will avoid anomalies and defects in concrete placements. Reliable in-situ evaluation methods for concrete mixes will be identified to ensure the suitability.

WHAT IS THE PROGRESS TO DATE?

Complete the work as described in the scope of work