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Article / Book Information

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Thesis Outline

Title: Structural Behavior of Cast-in-place Concrete-filled Steel Tube Piles

The doctoral thesis entitled "Structural Behavior of Cast-in-place Concrete-filled Steel Tube Piles" has the following primary objectives: (a) understand the structural behavior of realistic-size concrete-filled steel tube (CFST) piles under axial load ratios representative of actual design conditions, (b) identify methods to compute ultimate strength, and (c) establish numerical tools appropriate for the design and analysis of CFST piles. The outline and contents of the thesis are summarized as follows:

Chapter 1 - Introduction: discusses the background and motivation of the research, characteristics of CFST piles, and research objectives.

Chapter 2 - Literature review: presents a review of the available literature, provisions in the current CFST design standards, and previous experimental studies pertaining to the issues addressed in the thesis. The review identifies specific research gaps in the literature.

Chapter 3 - Large-diameter concrete-filled steel tubes: Flexural test database, analysis, and design considerations: evaluates the applicability of current approaches to calculate the axial-flexural capacity of CFST members to large-diameter CFST piles. A review of flexural tests on large-diameter CFST piles is presented, and a database is compiled using the reviewed test data. Recommendations are provided to improve the axial-flexural capacity predictions and accurately simulate the moment-curvature response of CFST piles.

Chapter 4 - Fiber-based models to simulate axial-flexural response of concrete-filled steel tube piles: presents simple stress-strain models and hysteretic rules to simulate the nonlinear axial-flexural response of CFST piles. Different fiber-based modeling approaches are compared, and the advantages/limitations of each approach are highlighted. The accuracy of the proposed modeling approach is verified using existing test data of CFST piles covering a wide range of material strengths, section slenderness, loading types, and boundary conditions.

Chapter 5 - Numerical modeling of noncompact and slender concrete-filled steel tubes under axial compression: provides guidelines for the detailed finite-element modeling and efficient fiber-based analysis of noncompact/slender CFSTs under axial compression. A finite element model capable of explicitly simulating the interaction between concrete and steel tube is developed in LS-DYNA. For fiber-based analysis, the accuracy of seven stress-strain model sets to simulate the behavior under axial compression is evaluated using the experimental data in the compiled database and the finite element analysis results.

Chapter 6 - Experimental and analytical study on shear behavior of concrete-filled steel tube piles: presents the results of cyclic shear tests conducted on three CFST piles. The hysteretic behavior, damage progression, and failure mode of each specimen are discussed in detail. The experimental results are used together with the existing test data to evaluate the approaches to calculate the shear strength of CFST piles. A detailed finite-element model was developed and validated with the test results. The model is used to understand the shear-resisting mechanism and relative strength contributions from steel tube and concrete.

Chapter 7 - Conclusions and recommendations: summarizes the main findings of this study with recommendations for future studies.

In addition to the material covered in the main body of the thesis, **Appendix A - Flexural performance of concrete-filled steel tube piles under varying axial load** presents an in-depth analysis of the cyclic flexural response of five large-scale CFST pile specimens under varying axial loads based on existing experimental data. This appendix discusses issues relevant to the design and performance assessment of piles, such as moment capacity, hysteretic response, damage progression, strain distribution, and strain limits. The discussion focuses on the effect of axial load ratio and internal reinforcement on the flexural response. Other appendices (**Appendix B** to **F**) present additional information/details to supplement the results presented in the main body of the thesis.