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Article / Book Information

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種別(和文)	要約
Type(English)	Outline

Thesis Outline

Title: Seismic Performance, Soil-Structure Interaction and Effect of Seismic Sequences on Post-Tensioned Hybrid Precast Concrete Walls

The doctoral thesis entitled "Seismic Performance, Soil-Structure Interaction and Effect of Seismic Sequences on Post-Tensioned Hybrid Precast Concrete Walls" has the objectives to: (i) investigate the feasibility of using post-tensioned hybrid (PH) precast concrete walls as partial infill walls in reinforced concrete (RC) frame buildings, (ii) propose a compact regression equation to estimate constant-strength inelastic displacement ratio for evaluating existing PH precast concrete walls and generating floor response spectra (FRS) for self-centering (SC) structural systems, (iii) propose a simple regression equation to estimate constant-ductility inelastic displacement ratio for use in seismic design of PH precast concrete walls, (iv) explore the nonlinear soil-structure interaction (SSI) effects on seismic performance of PH precast concrete walls and discuss beneficial/detrimental effects and appropriate shallow foundation, and (v) investigate the effect of aftershocks on collapse capacity of PH precast concrete walls and develop aftershock fragility curves of mainshock-damaged walls. The outline and contents of the thesis are summarized as follows:

Chapter 1 - Introduction: Characteristics and literature review of post-tensioned hybrid precast concrete walls, its necessity, and importance on implementing in RC buildings, aspects lacking attention on its further development, and research objectives are explained.

Chapter 2 - Modeling and validation of numerical models: Different numerical models for modeling PH precast concrete wall and their validation, a numerical model to simulate the SSI effect, and a simple flag-shaped hysteretic model are discussed.

Chapter 3 - Seismic performance and collapse safety assessment of post-tensioned hybrid precast concrete infill wall-frames: The feasibility of using PH precast concrete wall as partial infill walls is investigated for a 4-story RC frame designed with frame shear ratio β_F = 0, 0.25, and 0.5, where results are compared with RC infill wall-frames in terms of seismic demands under design earthquake (DE) and risk-targeted maximum considered earthquake (MCE_R) level and collapse safety of the frames. The applicability of post-tensioned hybrid precast concrete partial infill wall (PIW) frames for seismic regions is verified by checking the acceptance criteria from FEMA P695.

Chapter 4 - Constant-strength inelastic displacement ratio C_R for self-centering structural systems: A compact regression equation to estimate inelastic displacement ratio of flag-shaped hysteretic systems is proposed in code-compliant initial vibration period T form and normalized T/T_g form (where T_g is the predominant period of ground motion) under far-fault ground motions. The equations for C_R are used to estimate the inelastic displacement demand of PH precast concrete walls and FRS for SC structural systems. The estimates of the inelastic displacement demand and the FRS showed good accuracy when compared with nonlinear response history analysis (NLRHA) results.

Chapter 5 - Constant-ductility inelastic displacement ratio C_μ for self-centering structural systems: An equation to estimate the inelastic displacement ratio for the design of self-centering flag-shaped hysteretic structural systems under far-fault ground motions is proposed, which could be incorporated in the direct displacement-based design method of PH precast concrete walls. The comparison of the inelastic displacement demand depending on the ground motion characteristics (near-fault and far-fault) is also discussed.

Chapter 6 - Effect of nonlinear soil-structure interaction on post-tensioned hybrid precast concrete walls: A wide range of nonlinear SSI effects on PH precast concrete walls is investigated. The capacity reduction factor (*CRF*) defined as the ratio of yield moment of wall to ultimate moment capacity of shallow foundation is used to investigate the seismic performance of PH precast concrete walls. The relationship between *CRF* and static vertical factor of safety against bearing FS_v is also discussed. The beneficial and detrimental roles of nonlinear SSI considering shallow foundation with recommended *CRF* values from this study on code-designed 2- and 4-story PH precast concrete walls are explored.

Chapter 7 - Effect of seismic sequence on collapse performance of post-tensioned hybrid precast concrete walls: The effect of aftershocks on collapse capacity of PH precast concrete walls designed with different post-tensioning (PT) pre-stress ratios, energy dissipating (ED) steel moment ratios, and response reduction factors are investigated. Several post-mainshock damage states based on damage level on PT tendons and ED bars are considered, and aftershock fragility curves are generated for mainshock-damaged PH precast concrete walls.

Chapter 8 - Conclusions and recommendations: Conclusions of the present study are summarized, and some recommendations for future research are outlined.