Evaluation of Prestressed Reinforced Concrete Slab Punching Shear Using Finite Element Method

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Abstract

Punching shear is critical for two-way reinforced concrete flat slab. The unbalanced moment at the column-slab joint is transferred via slab moment and shear forces. ACI 318 provides an equation to evaluate the punching shear under the design load, without considering the effect from differential foundation settlement, which may govern he slab design. This paper studies a prestressed reinforced concrete slab under differential settlements using the finite element modeling (FEM) methodology. The methodology to extract data for punching shear check for the FEM is described and correlated with the corresponding code provisions. The study indicates that FE analysis results should be carefully reviewed and processed in order to perform accurate punching shear evaluation. Conclusions are made based on the case study to help engineers understand the punching shear behavior in prestressed and non-prestressed reinforced concrete slabs.

Keywords: differential settlement, finite element model, prestressed reinforced concrete slab, punching shear.

1 Introduction

Flat plate concrete floor system is a popular structural system for providing efficient clearance at a given story height in comparison to regular reinforced concrete beam-slab structures. The use of prestress/post-tension techniques can reduce the slab thickness and increase spacing between columns. ACI-318 provides standards on designing prestressed/post-tensioned concrete flat slabs [1], including flexural and shear design.

This paper focuses on checking the flat slab punching shear due to unbalanced moment at a column-flat slab connection using finite element method (FEM). The paper first explains the unbalanced moment transfer at a column-slab connection, then corresponding equations in code [1] are provided. Finally, one example of punching shear check using FEM is provided.