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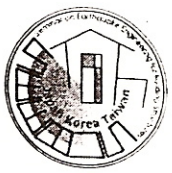

AN EFFICIENT MODEL FOR SEISMIC ANALYSIS OF FLAT SLAB STRUCTURES WITH THE EFFECTS OF STIFFNESS DEGRADATION

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SUMMARY

Flat slab system has been adopted in many buildings constructed recently because of the advantage of reduced floor heights to meet the economical and architectural demands. Structural engineers commonly use the equivalent frame method(EFM) with equivalent beams proposed by Jacob S. Grossman in practical engineering for the analysis of flat slab structures. However, in many cases, when it is difficult to use the EFM, it is necessary to use a refined finite element model for an accurate analysis. But it would take significant amount of computational time and memory if the entire building structure were subdivided into a finer mesh. An efficient analytical method is proposed in this study to obtain accurate results in significantly reduced computational time. The proposed method employs super elements developed using the matrix condensation technique and fictitious beams are used in the development of super elements to enforce the compatibility at the interfaces of super elements. The stiffness degradation of flat slab system considered in the EFM was taken into account by reducing the elastic modulus of floor slabs in this study. Static and dynamic analyses of example structures were performed and the efficiency and accuracy of the proposed method were verified by comparing the results with those of the refined finite element model and the EFM.

Keywords: *flat slab structure; stiffness of slab; stiffness degradation; matrix condensation; super element; fictitious stiff beam.*

INTRODUCTION

Flat slab system in which columns directly support floor slabs without beams is adopted for many building structures recently constructed. Since flat slab system has no beams, flat slab system exhibit several advantages such as providing lower building height, good lighting and ventilation, easy arrangement of pipes and wires under slabs, more clear space, architectural flexibility and easier formwork which consequently make construction time shorter. However, flat slab system has some difficulties in making long span structures and large openings in slabs because of the limitations in plan configuration such as aspect ratio of slabs, ratio of column spacing in both directions etc. Especially stiffness degradation is noticeable under lateral loads and it may be necessary to place some appropriate bearing walls in regard to structural plan because of large story drift. Flat slab system was primarily developed for a resistance to gravity loads and many researches on a resistance capacity for lateral loads have been undertaken (Moehle 1990, Mulcahy 1983).

Structural engineers commonly use the equivalent frame method (EFM) in practical engineering for the analysis of flat slab structures (Grossman 1997, Vanderbilt 1981). In the equivalent frame method, flat slab system is modeled by equivalent frame and elastic analysis is performed. The floor slabs in column strip are severely deformed with columns when plat slab structure is under lateral loads. However, the slabs between column strips are hardly deformed. Thus, the effective width that can resist a bending is used for the width of the equivalent

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