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Evaluation of the Slab Effect of Coupled Wall on Structures of Wall Type Apartment Building

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ABSTRACT

This study investigated the effects that can occur when designing a wall-type structure apartment considering the slab. Among various shape of wall, a study was conducted on the coupled wall, which occurs in general and the slab effect occurs. Recently, due to the recent regulations on Housing Construction Standard, slab effect has been increased because of the minimum thickness of slab in the apartment has been changed to 210mm. Structural analysis is generally performed using a technique called diaphragm for seismic design. Since the slab was relatively thin before the increase in the thickness of the slab, there was no problem in designing using the diaphragm. However, as the thickness of the slab is limited by the law, the stiffness of the structure will increase, and the effect cannot be reflected when the diaphragm is used. This study has been constructed to figure out the slab effect on structural performance of coupled wall.

1. INTRODUCTION

Recently, the frequency of earthquakes in Korea is increasing, and the largest earthquake since the observation of earthquakes in Korea in 1978 was the Gyeongju earthquake with a magnitude of 5.8 (September 12, 2016) and the Pohang earthquake with a magnitude of 5.4 (November 15, 2017) occurred. Therefore, in Korea, non-linear analysis and seismic design for wall type apartment buildings are being performed using

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the performance-based seismic design method. Currently, in structural analysis for seismic design, a modeling technique that uses a diaphragm to constrain the story is used for the reasons of not only easy modeling but also rapid analysis. However, unlike the slab thickness of 120mm to 180mm in the past, according to the current Housing Construction Standard Regulations, the thickness of the floor slab between floors within an apartment building is stipulated to be 210mm or more regardless of the structural strength requirements. In this study, compared to the diaphragm, the effect that occurs when the slab is considered and designed will be investigated. This is the shape of the wall where the slab effect occurs, and it identifies and analyzes the slab effect for the coupled wall that is commonly seen in apartment plan.

2. LINEAR ELASTIC ANALYSIS

Before proceeding with the study, it should be possible to identify the location where the slab effect occurs in a typical wall-mounted apartment building. The location where the slab effect occurs was found through linear elastic analysis. The slab effect is evaluated by selecting an appropriate wall shape among the locations where the slab effect proven through analysis occurs.

2.1 Lateral Load Resistance System

When performing a linear elastic analysis by modeling a slab as a shell element, a area in which stress is concentrated in the slab occurs. The slab effect occurs as the stress is concentrated in the slab. This is because of the slab, the lateral load-resistance system behaves differently from the diaphragm model. In the case of the diaphragm model, the wall acts as the main lateral load resistance system and the wall behaves like a cantilever. However, by modeling the slab, the slab will act as a kind of beam, which will increase the stiffness and strength of the structure compared to the diaphragm model.

2.2 Slab Effect in Apartment

Linear elastic analysis is performed on general wall-type apartment building, and the area where stress is concentrated is confirmed. The area where the stress is concentrated can be seen as the location where the slab effect occurs. This study conducted a study on coupled wall, which can be seen as the most common among various wall shapes in which the slab effect occurs.

3. TEST

3.1 Test Plan

The specimen is composed of two story, and a specimen having a wall-slab structure was manufactured. This was manufactured as in Fig.1 to find out the slab effect that occurs when a lateral load is applied to the specimen. The loading condition was induced to simulate the seismic load by lateral loading.

Fig. 1 Construction of Specimen

3.2 Test Result

In the case of the diaphragm, it is impossible to implement it as a specimen, so a load-displacement relationship graph was obtained through nonlinear finite element analysis. Through Fig. 2, it can be confirmed that the wall-slab specimens have greater strength and stiffness than diaphragm. In addition, the increase in stiffness and strength due to the thickness of the slab increased significantly. Through this, it was proved that the slab effect works effectively. Also, it can be seen that the strength and stiffness increased by the slab thickness are very large.

As a result of the analysis, the strength of the diaphragm was 242kN, and the experimental result was 318kN and 377kN, respectively.

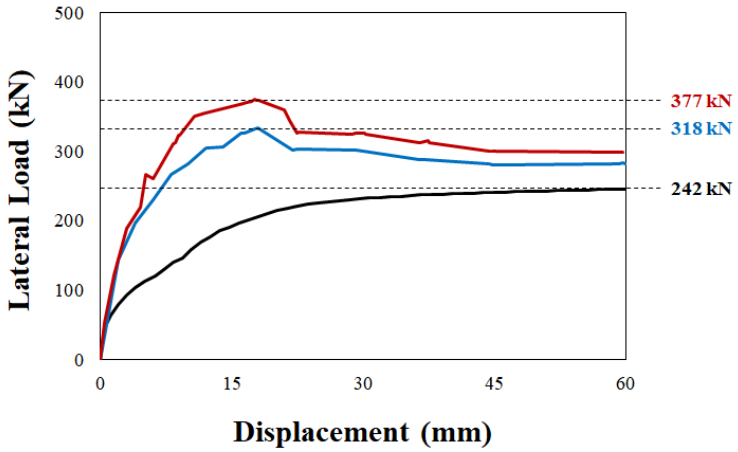

Fig. 2 Load-Displacement Relationship of Diaphragm and Slab Model

3. CONCLUSIONS

Considering the slab, the strength and stiffness are greatly increased compared to the diaphragm model. Also, as the thickness increases, the strength and stiffness change significantly. From this, it can be seen that the influence of the slab on the structure is significant.

REFERENCES

E.Brunesi., S.Peloso., R.Pinho, and R.Nascimbene. (2018), "Cyclic testing of a full-scale two-story reinforced precast concrete wall-slab-wall structure," Bulletin of Earthquake Engineering, 16, 5309-5339

Khandaker M. Anwar Hossain. (2003), “Non-Linear Performance of Slabs in Coupled Shear Wall Structures” Advances on Structural Engineering, Vol 6, Issue 4, 2003.