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Prediction of long-term deflection for post-tensioned slabs affected by construction load

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ABSTRACT

For long-span flat slab system, use of post-tensioned (PT) slabs has advantages over conventional reinforced concrete (RC) slabs. The PT slab has minimal cracks under construction load and is expected to show better performance in deflection. The long-term deflection can be evaluated by multiplying the short-term deflection and time-dependent coefficient related to creep and shrinkage. However, because the formula and coefficient for calculating long-term deflection specifically pertain to the RC slab, the value for PT slabs is required and its reliability must be guaranteed. In this study, the proposed value of time-dependent coefficient for PT slabs in the previous research was compared with measured deflection. The long-term deflection of PT slabs in the actual building has been monitored for six years.

1. INTRODUCTION

Regarding serviceability design criteria, long-term deflection should be controlled within allowable deflection. The long-term deflection due to creep and shrinkage can be generally evaluated by multiplying the short-term deflection and the time-dependent coefficient. Prestressing force applied in the PT slab restrains cracks under construction load and reduces short-term deflection. It is expected to show better performance in long-term deflection. As the time-dependent coefficient related to RC could be conservative for applying to PT slabs, the value for PT slabs may need to be required and verified for its reliability. Cho (2020) monitored the deflection of PT slab in the actual building for 900 days and suggested the time-dependent coefficient for PT slab. In this study, the suggested coefficient and deflection are compared with the measured deflection of PT slabs after 900 days.

2. COMPARISON BETWEEN MEASURED AND PREDICTED LONG-TERM DEFLECTION

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The deflection of the PT slab has been measured to evaluate an appropriate time-dependent coefficient. The monitored building had flat slabs wherein each column has a rectangular drop panel. It had a floor height of 3.9 m, slab thickness of 210 mm, and drop panel thickness of 190 mm. The span of each square shape slab was about 10 m. Fig.1 shows the location of deflection measuring points on the 13th and 14th floors. There are three types of slab: a slab at the corner (13F-A, 14F-A), a slab on the edge (13F-B, 14F-B), and an interior slab (13F-C, 14F-C). Since the largest deflection occurred in the slab at the corner, the time-dependent coefficient was proposed and verified based on the measured deflection of 13F-A.

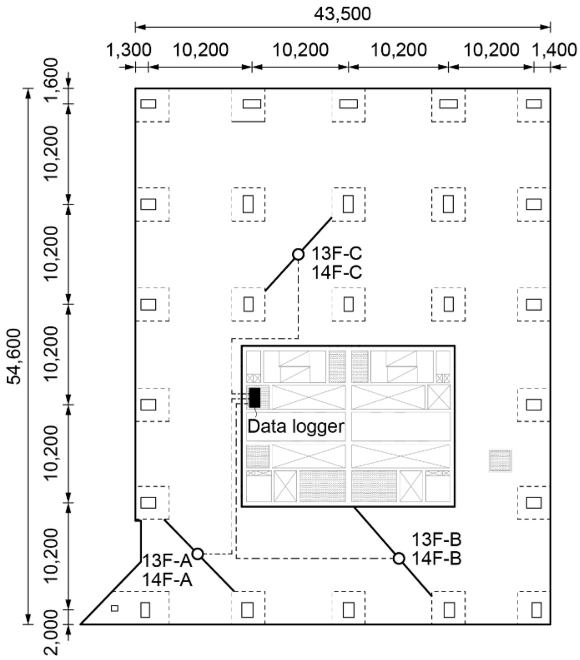

Fig. 1 Location of deflection measuring points on 13th and 14th floors [unit: mm]

Although several equations from codes evaluate the long-term deflection, the equation of KBC 2016 has only one changeable variable, time-dependent coefficient, as shown in Eq. (1) and Eq. (2). Table 1 shows the time-dependent coefficient for PT slabs suggested in the previous study. Based on the deflection monitored up to 900 days, the coefficient of 1800 days was predicted. In this study, the suggested coefficient is attempted to be verified using the measured deflection after 900 days.

$$\Delta_L = \Delta_S(1+\lambda_\Delta) \tag{1}$$

$$\lambda_\Delta = \frac{\xi}{1+50\rho'} \tag{2}$$

Where Δ_L is the long-term deflection; Δ_S is the short-term deflection; λ_Δ is the amplification factor; ξ is the time-dependent coefficient; and ρ' is the compression steel ratio.

Table 1. Time-dependent coefficient ξ_{RC} and ξ_{PT} according to Cho (2020)

Time [days]	ξ_{RC}	ξ_{PT} (suggestion)
90	1.0	0.8
180	1.2	0.95
360	1.4	1.1
1800	2.0	1.4

Fig. 2 compares the measured long-term deflection and the predicted values using the formula of Eq. (2) with the suggested parameters.

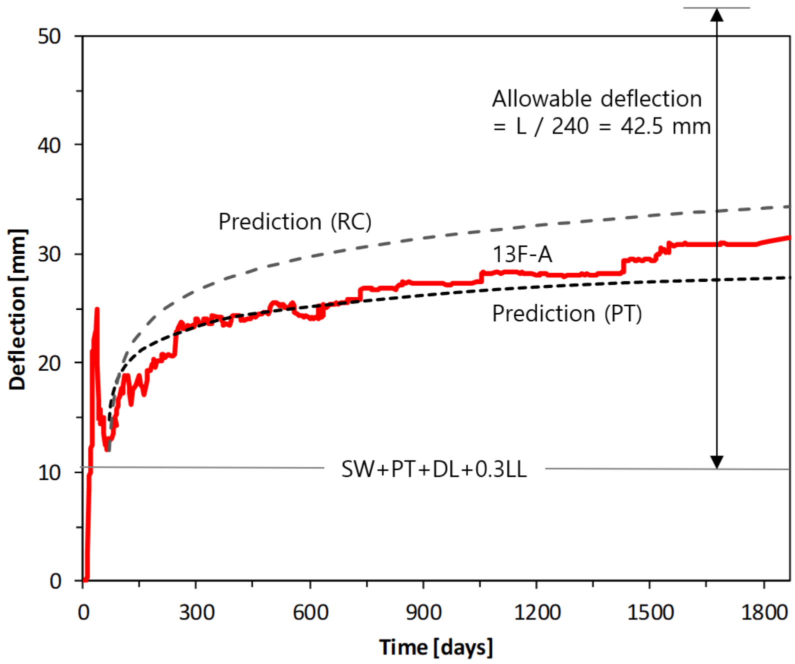

Fig. 2 Comparison between prediction and real value for long-term deflection

Although the deflection tended to converge along with the prediction of the PT slab, it increased slightly after 1400 days. After 1800 days, a deflection of 31 mm was recorded, larger than the predicted 27 mm. Even if the actual deflection was greater than the predicted one, it was expected to converge within the allowable deflection range.

3. CONCLUSIONS

Prediction of long-term deflection is essential in terms of serviceability and maintenance. The suggested time-deflection coefficient for the PT slab was evaluated using the actual deflection monitored in the building. The deflection was observed to be 15% greater than the predicted deflection, but the value gradually converged within the allowable deflection. The time-deflection coefficient after 1800 days for the PT slab needs to be supplemented using more actual data.

REFERENCES

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