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Wind and collision resistance performance of PC column-foundation connection using clamped headed bolt

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ABSTRACT

The mechanical splice system using clamped headed bolt was applied to precast concrete (PC) column to provide structural safety and serviceability during construction. The system was applied to the longitudinal reinforcements at the corner of the column, and the other reinforcements were applied with splice sleeves. Once the headed bolt is fastened, resistance to external loads was provided until curing other sleeves. The specimens were evaluated against wind loads according to ASCE/SEI 7-22, and evaluated in the situation of collision during transportation of another PC member to verify the safety during construction. As a result, the resistance performance was sufficient in both situations.

1. INTRODUCTION

Recently, precast concrete (PC) method has been widely applied to minimize construction work on-site. Since structural members are manufactured in advance at the factory and assembles on-site, it has the advantage of reducing manpower and construction period. A grout-filled sleeve, which is one of the mechanical splicing methods (ACI 2007), is applied for foundation-column connection to achieve an emulative structure. Although this method can provide excellent force-resisting performance, it is required to install temporary bracing or guying until the grout inside the sleeve is cured.

In this study, the mechanical splice system using clamped headed bolt was applied to precast concrete (PC) column to provide structural safety during construction. The mechanical performance of the system was evaluated, and the wind load and impact load that may occur during construction were applied.

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2. CONCEPT OF SPLCING SYSTEM

The connecting process is shown in Fig. 1. Upper reinforcement, coupler, headed bar, fixing nuts, holding socket, and lower reinforcement are the components of system. By fastening the fixing nut to the holding socket, the headed bar is clamped, resisting the load transmitted from the column.

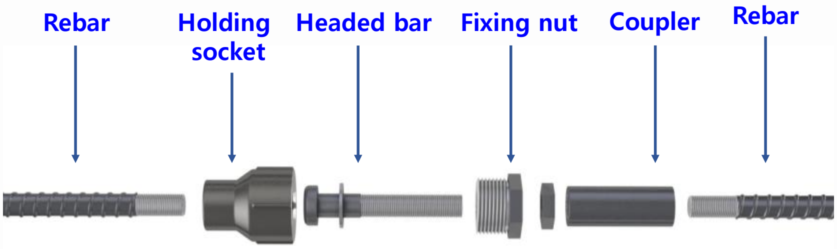

Fig. 1 Connection system

3. STRUCTURAL EXPERIMENT

The structural performance was obtained through a monotonic lateral loading test (Fig. 2). The column size was 800×800 mm and the splicing system was applied to the 4-longitudinal rebars at the corner of column. The results are summarized in Table 1.

Fig. 2 Setup for lateral loading test

Table 1 Summary of structural experiment

Peak load [kN]	Displacement [mm]	Drift ratio [%]	Nominal moment [kN-m]	Maximum moment [kN-m]
194.0	93.5	3.5	393.9	523.7

4. EVALUATION AND CONCLUSION

Installed PC column should be safe against wind load and impact load during construction. Wind load was calculated by Eq. (1) from ASCE/SEI 7-22 (2022) and was converted into moment of 26.0 kN-m. External moment from the wind load was within the elastic range of the column behavior. The comparison with the performance of specimen is shown in Fig. 3. Impact load was calculated by kinetic energy of the impactor and compared with energy dissipate capacity of column (Eq. (2)). Impact resistance performance was identified with the safety range as shown in Fig. 4, depending on the weight and impact velocity.

$$F = q_z K_d G C_f A_f \quad (1)$$

$$E_C \left(= \int_0^{\Delta} P dx \right) = E_I \left(= \frac{1}{2} m v^2 \right) \quad (2)$$

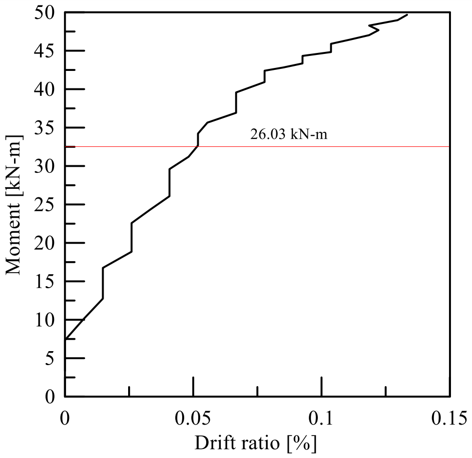

Fig. 3 External moments due to wind load and experimental results

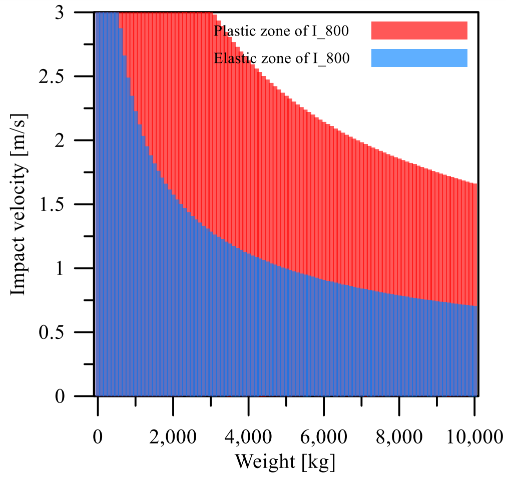

Fig. 4 Elastic and plastic range of column

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