

Influence of Crack occurring in Half Precast Slab on Structural Performance of Composite PC Slab

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ABSTRACT: The specimen caused the crack before pouring the topping concrete in the half PC slab and the PC composite slab without the cracks were produced to investigate the structural performance of PC composite slab with crack, and it was conformed that the structural performance of the composite PC slab with crack almost corresponded to the composite PC slab without crack.

Keywords: crack control design, RC wall, crack width, number of cracks

1. INTRODUCTION

Recently, as the concern for the development of a construction method for an environmental protection and for tall building is increasing, the use of the precast concrete(PC) slab that has the solution of environmental problems and the advantage such as reduction of construction period is being demanded.

Accordingly, a lot of PC slab members and a method of construction were developed, and many studies[1][2][3][4] on the structural performance of PC composite slab were carried out.

In half PC slab, there is shortcoming that the crack can occur easily while constructing, and these cracks can have a bad influence upon the structural performance of PC composite slab. However, there is little studies on the influence of these cracks on the structural performance of composite PC slab.

In this study, the specimen caused the crack before pouring topping concrete in the half PC slab and the PC composite slab without the cracks were produced to investigate the structural performance of PC composite slab with crack.

2. TEST OUTLINE

The mix proportion of the half PC slab concrete shows in Table 1, and it of the topping concrete shows in Table 2. Table 3 shows the concrete properties of the half PC slab and the topping concrete properties. The size of specimen is 700mm in width, 2000mm in length, and 185mm in thickness of the topping concrete as shown in Fig. 1. The lattice of ϕ 6, the truss top bar of ϕ 13, and the longitudinal reinforcement of D10 were used in the half PC slab. Table 4 shows the properties of these reinforcements.

Total two specimens (CS specimen, NCS specimen) were produced. The loading frame with the jack and the prestressing bar as shown Fig. 2 was used to cause cracks in the half PC slab before pouring the topping concrete, and the topping concrete was poured in the half PC slab after tightening nuts(see Fig. 2.) to maintain the cracking load after removing the jack. In another specimen(NCS), the topping concrete was poured in the half PC slab without cracks under two-point support. These specimens were moist cured for 8 days after pouring the topping concrete. Wire strain gauges were installed on the reinforcing steel and concrete to measure strain, and contact strain gauge was used to measure the crack width. The specimens were subjected to four-point flexural load as shown in Fig. 3. The specimens were instrumented with LVDT to measure the deflection at the midspan and both load points. During testing, cracks were marked and crack width and spacing were measured within the constant moment zone.

Table I : Mix proportion of concrete
(half PC slab)

W/C (%)	s/a (%)	Proportion by unit weight(kg/m ³)				Slump (cm)	Air (%)
		Water	Cement	Sand	Gravel		
40	45.2	155	388	817	1001	15	4.0

Table II : Mix proportion of concrete
(topping concrete)

W/C (%)	s/a (%)	Proportion by unit weight(kg/m ³)				Slump (cm)	Air (%)
		Water	Cement	Sand	Gravel		
50	48.7	180	360	840	909	19	5.2

Table III: Properties of concrete

Days	Compressive strength(MPa)	Spilt strength(MPa)	Young's modulus (GPa)
13(halfPC)	45.4	3.6	27.2
21(half PC slab)	51.2	3.9	29.3
28(half PC slab)	53.4	3.8	30.1
49(half PC slab)	54.9	3.7	31.1
8(topping concrete)	45.4	3.6	27.2

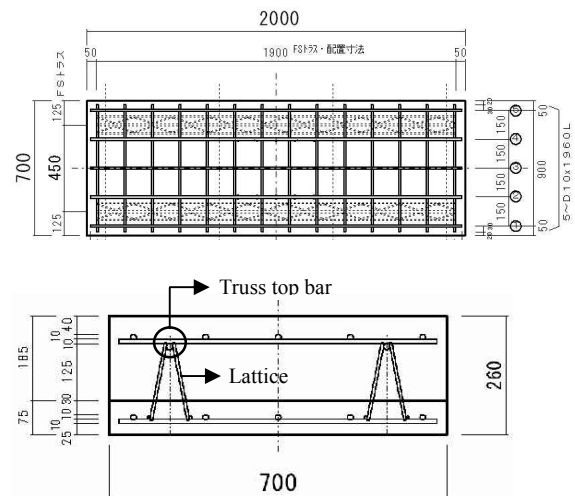


Figure 1: Details of specimen

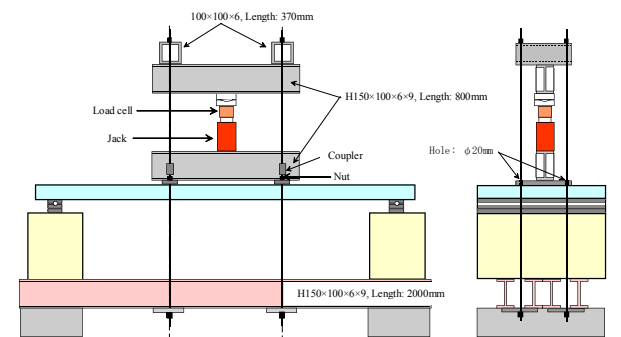


Figure 2: Loading frame before pouring topping concrete

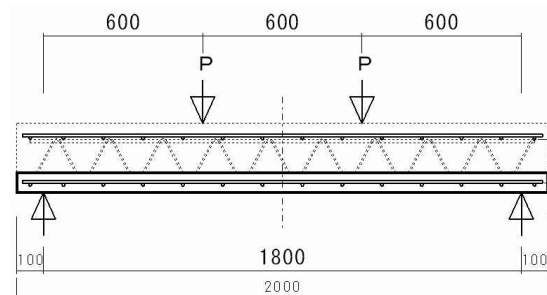


Figure 3: Loading method

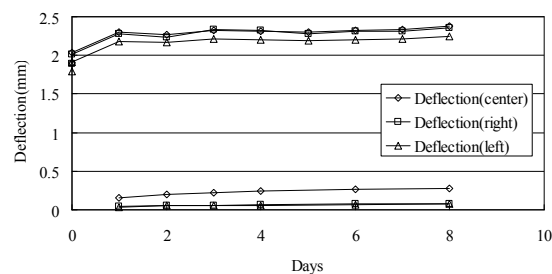
3. TEST RESULTS

3.1 Behavior of deflection and crack width of specimen before loading test

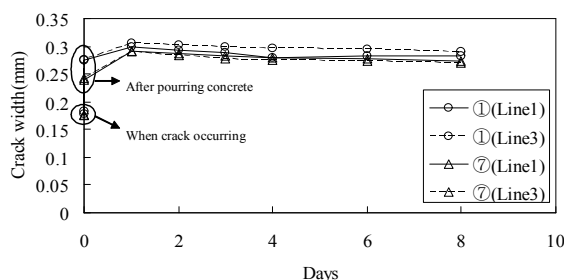
Fig.4 shows the behavior of deflection and crack width until 8-day of CS(slab

width crack) specimen after pouring the topping concrete.

Cracks occurred near ① and ⑦ (see Fig.6) by the loading frame shown in Fig. 2, and the cracking load was 15kN. The deflection and the crack width of the specimen when cracks occurred were about 1.8mm and 0.17mm, and these after pouring the topping concrete increased a little by 2mm and 0.25mm. However, the deflection and the crack width until 8-day were 2.3mm and 0.28mm, and although cracks occurred in the half PC slab before pouring the topping concrete, the change of these was very small. It is assumed that this is due to an increase of stiffness by the topping concrete. The deflection of CS specimen before loading test was about 2.3mm, and that of NCS specimen was about 0.3mm.



(a) Deflection



(b) Crack width

Figure 4: Behavior of deflection and crack width

3.2 Load-deflection of composite PC slab

Fig.5 shows the load-deflection relationship of CS and NCS. The first crack occurred at 109kN in NCS, and the new crack occurred at 114kN in CS. The yielding of longitudinal reinforcement of NCS and CS was observed at 133kN and 130kN, and

that of truss top bar of NCS and CS was observed at 160kN and 158kN. The load-deflection curve of NCS and CS was almost corresponding, and it was confirmed that the cracks occurring in the half PC slab before pouring the topping concrete influenced the deflection of the composite PC slab, but the cracks did not influence the strength of that.

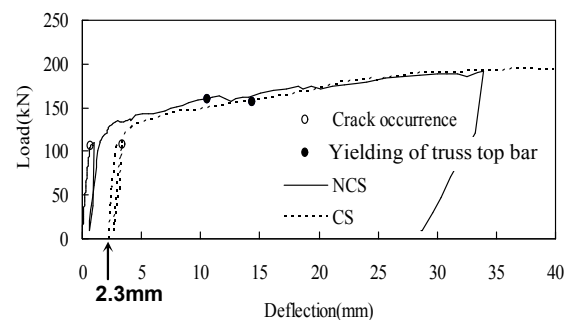
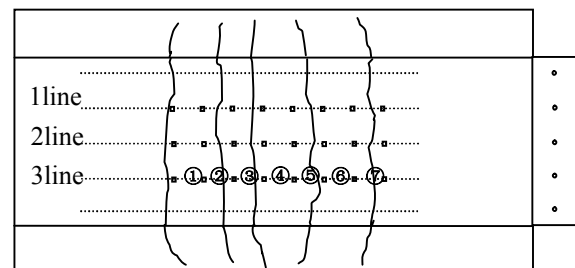


Figure 5: load-deflection curve

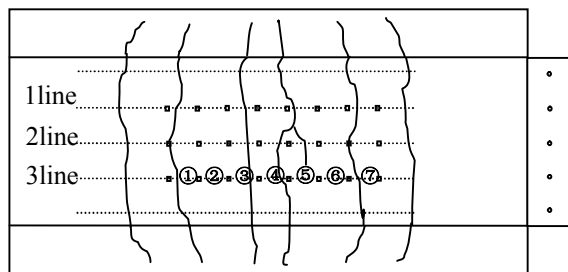
3.3 Crack patterns

The crack patterns at the stabilized crack stage shows in Fig.6. The crack width occurring near ① and ⑦ of CS before pouring the topping concrete did not increase with the loading, the new crack occurred near ③ and ④ at 105kN, and the crack width of ① and ⑦ began to increase at the second cyclic loading.

The average crack spacing of CS and NCS was about 200mm and 150mm, and the average crack width of CS except crack width of ① and ⑦ was 0.35mm, and that of NCS was about 0.30mm. The average crack spacing and crack width of CS almost corresponded to NCS.



(a) NCS specimen

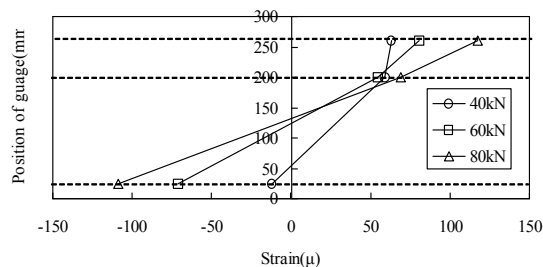


(b) CS specimen

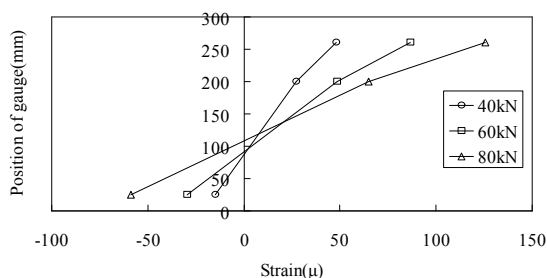
Figure 6: Crack patterns

3.4 Strain distribution of composite PC slab section

Fig. 7 shows the strain distribution of composite PC slab section. The strain below means the strain of longitudinal reinforcement, that in the middle means the strain of truss top bar, and that above means the strain of concrete surface. It was confirmed that Navier's assumption was approved.



(a) NCS specimen



(b) CS specimen

Figure 7: Strain distribution

4. CONCLUSION

The specimen caused the crack before pouring the topping concrete in the half PC slab and the PC composite slab without the

cracks were produced to investigate the structural performance of PC composite slab with crack, and it was confirmed that the structural performance of the composite PC slab with crack almost corresponded to the composite PC slab without crack.

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