V－215

Pre-cast Prestressed Concrete Panels as Form-works and Structural Elements for Bridge Piers

Nagoya Institute of Technology Student Member Shahid Nasir
Nagoya Institute of Technology Member Supratic Gupta
Nagoya Institute of Technology Member Hidetaka Umehara

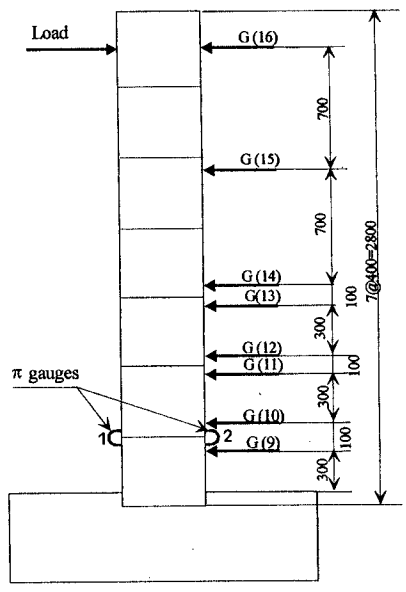
1. Introduction

Recently, an interesting concept for the construction of bridge piers is proposed to use pre-cast prestressed concrete (hereafter called PPC) panels not only as form works but will also show structural behavior. Experimental study was carried at the scale of 6/100 to validate the proposal to see the effect of using PPC panel with normal and high strength concrete. Axial load has also taken as parameter during experiments.

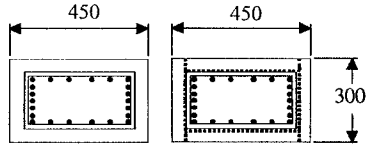
The purpose of this paper is to analyze the data obtained from the experiments and show effectiveness of the panels structurally.

2. Experimental Setup

The details of the typical column is shown in Fig. 1(a). Displacement controlled experiments was carried out on 6 different cantilever reinforced concrete columns. The details of the different parameter of all six specimen are shown in Table 1. The parameter selection for six different specimen was based on the comparative study of different cases. The following combinations has been taken for the analysis: a) high and normal strength concrete; b) with panels or without panels; c) with axial load and without axial load(not studied here due to space limitation); d) the lateral restrain for panel with or without bolts. Fig. 1(b) shows the two typical sections with and without panel to show that the sections are comparable. The PPC panel is made from high strength concrete with details as shown in Fig. 2. The bolts are used to tie the panels with concrete by the force of 0.1 N/mm^2(approximates -hand tightened). Different displacement gauges, strain gauges, π–gauges were used to get in depth understanding of the failure phenomenon.



(a) Column Specimen



Section with RCC Section with PPC
(b) Cross Section

Fig. 1: Experimental setup

3. Parametric study and Analysis of Data

This is a new technique where PPC panels are used as forms for the concrete casting in the construction of columns and later play structural role also. To play structural role, the bond between the concrete core and PPC panel should exist. π–gauges were used at the panel junction to note the crack opening there. The load-displacement data or various specimen were analyzed to see the role of the PPC panel. Crack patterns were very helpful in analyzing the data.

Fig. 3-5 shows the comparison of the displacement of gauge 13,15 and the applied displacement at the top to check the effect of use of panels as well as bolts as restrain. Fig. 3 and Fig. 4 shows that the displacement at different height matched well for the high and normal strength concrete respectively. Fig. 5 shows that that the displacement at different height of the specimen without bolt matched well with the one with bolts, implying that lateral restrain was not really necessary as there was good bond between the PPC panel and casted concrete.

Fig. 6 shows the comparison of π-gauge reading to study crack width for the normal strength concrete. Similar patterns are observed in all the three cases. This implies that the section at the panel joint also had good bond and it had no prominent effect on the failure phenomenon though the joint between the panels should act as weak plane. The π-gauge data of the high strength concrete panel was not studied as the crack in the column without panel did not pass through the gauge as can be seen in Fig. 7a.

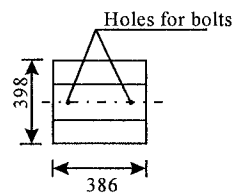


Fig.2: PPC Panel

Table 1 Specimen details

Specimen No.	Concrete f_c'(N/mm^2)	PPC Panel f_c'=50 N/mm^2	Axial Load (N/mm^2)	Bolts
1	Normal(24)	-	1.85	-
2	High Str.(50)	-	1.85	-
3	Normal(24)	PPC Panel	1.85	No bolts
4	Normal(24)	PPC Panel	0.00	Bolts
5	Normal(24)	PPC Panel	1.85	Bolts
6	High Str.(50)	PPC Panel	1.85	Bolts

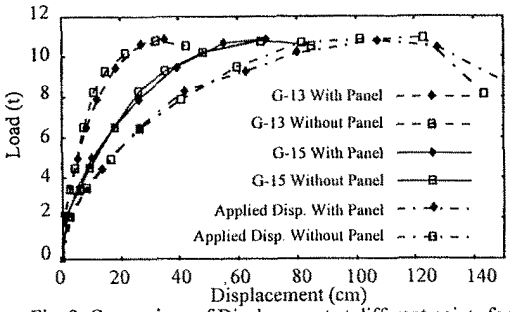


Fig. 3: Comparison of Displacement at different points for High Strength Concrete Column With and Without Panel

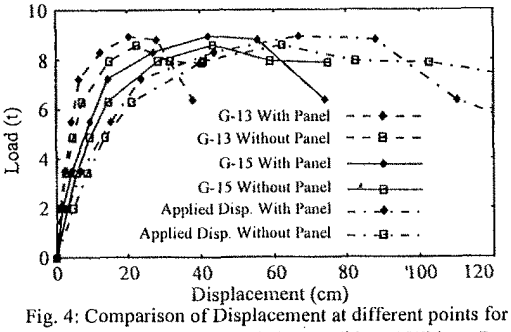


Fig. 4: Comparison of Displacement at different points for Normal Strength Concrete Column With and Without Panel

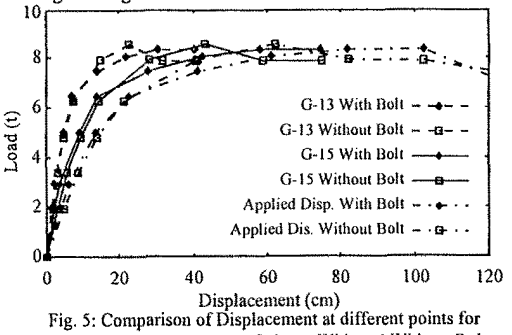


Fig. 5: Comparison of Displacement at different points for Normal Strength Concrete Column With and Without Bolts

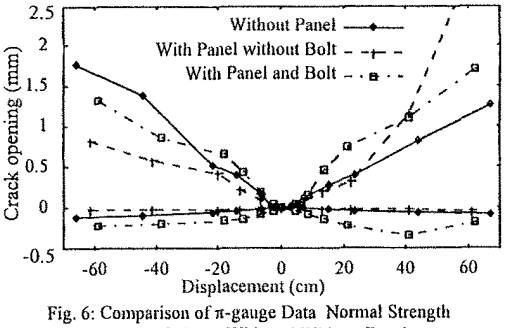
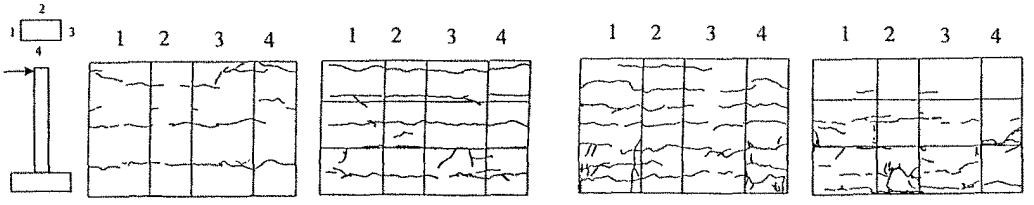


Fig. 6: Comparison of π-gauge Data Normal Strength Concrete Column With and Without Panel



without panel with Panel without panel with Panel

a) High Strength Concrete Column b) Normal Strength Concrete column

Fig. 7: Comparison of Crack Patterns

Fig.7 shows the crack pattern of different cases at the lower region of the column. Tension cracks appeared through the panel in continuation of cracks in the core concrete region in most of the cases implying the existence of the bond even though the concreting was difficult because of its small section and spacing of the main bar.

4. Conclusion

From the comparison of the displacement at different heights of the column with and without panel, with and without bolts and from the comparison of the π-gauge data and study of the crack pattern we can conclude the following:

a) Displacement at different heights matched well for *high* and *normal* strength concrete with and without *panels* implying that panels were playing effective structural role.

b) Displacement at different heights matched well for normal strength concrete with panels with and without *bolts* implying that there were no need of the bolts as there was good bond between the PPC panel and casted concrete.

c) π-gauge date reading showed comparable data implying that the weak section at the joint of the panels had no effect on load-deflection behavior of the specimen.

d) Since cracks appeared across the PPC panel in continuation of the casted core concrete, we can say that good bond existed between the two.

Acknowledgment

Authors are thankful to Chubu Cement Kenkyu Kai that has organized the experiments and provide all useful data for this study.

Key word: Pre-cast Panel Cyclic load Bond Bridge pier

Nagoya 466, Showa-Ku, Gokiso-cho Tel (052) 735-5502 Fax (052) 735-5503