Behavior of Joint Panel of Precast Prestressed Concrete Pavement System with Different Design Details

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ABSTRACT

From the extensive review of literature on existing precast prestressed concrete pavement (PPCP) systems, an innovative PPCP system has been developed. After the analysis and design, the sample system has been built and experimented under service loads and the defects of the system has been noted. Further study has been done to improve the performance of the defects. The appeared cracks around post-tensioning pockets was a crucial problem which needed to be solved in order to satisfy the service life of the system without any doubt. In this paper, different shape and arrangement of the post-tensioning pockets in the joint panel has been designed and analysed in order to find best performance for the system.

1. Introduction

It has been more than half century that Prestressed Concrete Pavement (PCP) has been first applied. Since the first application in 1940s in Europe, many researches on many countries made the state-of-art of the PCP methods developed [1-2]. An innovative PPCP system has been developed after an extensive literature review on existing pavement systems .The proposed concept for the PPCP system consists of full-depth precast prestressed concrete panels. The panels will all be pretensioned in the transverse direction during the fabrication and post-tensioned together for a section length in the longitudinal direction after placement. The developed PPCP system, presented in Figure 1,is formed of three different types of panels which are base, joint and central anchor panels.

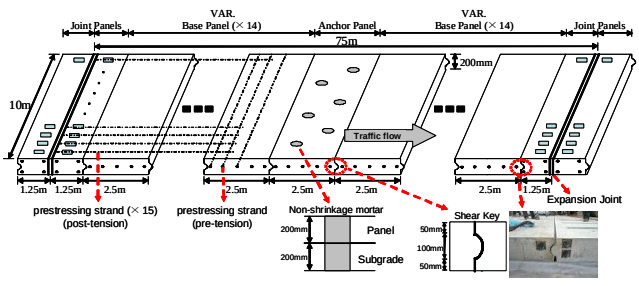

Fig1. The general layout of the PPCP System

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2. Testing of the PPCP System

In order to understand the behavior of the PPCP system, a field test has been performed and monitored the performance under traffic loads. The experimental panels have been designed 200mm thick with 2.5m width and 10m length, 1.25x2 joint panels on ends, 1 anchorage panel and 2 base panels. The behavior and the faults of the PPCP system have been recorded during the experiment. According to the investigation on the system, it has been noticed that undesirable cracks has been appeared at the edges of some post-tensioning pockets on the joint panels. Further analysis has been done on post-tensioning pockets and alternatives have been analyzed.

3. Evaluation of the alternative post-tensioning pockets

In order to get rid of undesirable cracks around post-tensioning pockets, a sequence of analysis has been performed with different pocket designs and arrangements, which has been shown at Figure 2. The full system, which has 2 base panels, 1 anchorage panel in the middle and two joint panels on the sides, has been designed and analyzed 2D by WCOMD. The representative strand force on each pocket has been applied at the pockets reciprocally on both joint panels facing each other. The joints between panels have been designed as interface element. The reason of the cracks was assumed due to size of the pocket and the short distance between stressing edge of the pocket and joint. Firstly, the size of the pocket has been reduced to 45cm (original case was 100cm) and reached better results that first crack appeared at 190kN shown at Table 1. However, if we keep the same sizes of pocket but moving the central point of it toward the edge away from the joint, it has been noted that crack strength (200kN) is not much different than the previous case. The Case 4 shows the same pocket size but moved toward joint keeping the same distance with the Case 1. The crack first appeared at 160kN which is close to the Case 1 .

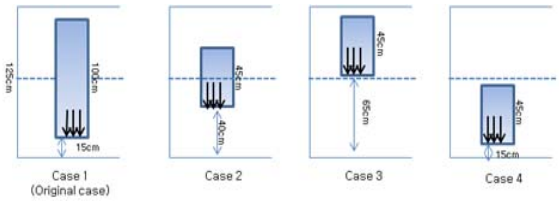

Fig2. Analyzed Pocket Designs

Table1. The results of the analysis

	First Crack (kN)	Failure Strength (kN)
Case 1	150	590
Case 2	190	840
Case 3	200	860
Case 4	150	680
Case 5	190	840

4. Conclusion

At this stage, it can be judged that the size and the location of the pockets are important; however the location is dominating while there are same sized pockets. From this point of view, the Case 5 has been designed, taking into account the availability of prestressing rams and the workability on pockets, at the same line with the Case 2 but has greater length with 70cm. This case has the same result for first crack as the Case 2. Having superior results as well as providing better workability option, the Case 5 can be selected as new post-tensioning pocket design.

Acknowledgements

The authors gratefully the support from the Center for Concrete Corea, Korea, Leader Industrial Co., LTD, and a project on standardization of performance based construction specifications of the Korean Concrete Institute.

Reference

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