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# Experimental study on flexural strength of precast deck with ribbed loop joints

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## ABSTRACT

Regarding precast deck, connection details between precast decks are very important because flexural performance of the structures is greatly affected by them. so connection details to secure constructability and safety, profitability are very important. In this study, new connection detail on the precast deck connections is proposed and the test results comparison from various parametric experiments would be performed to verify the applicability of the proposed technique.

## 1. INTRODUCTION

Fig. 1 Rapid construction of precast concrete bridge decks

For precast bridge deck joints, usability problems such as cracks and leakage between precast deck panels are important. Among existing precast deck connection methods, continuation method of precast deck joint using internal tendons is useful in

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performance and durability of the structure, but is unfavorable in terms of costs and workability. Precast deck with reinforced loop is economical but difficult to construct rapidly because of cast-in-place of joints and have a risk of cracks and leakage. Therefore, the development of connection technology of precast bridge deck for rapid construction and low costs is needed.

## 2. Proposal

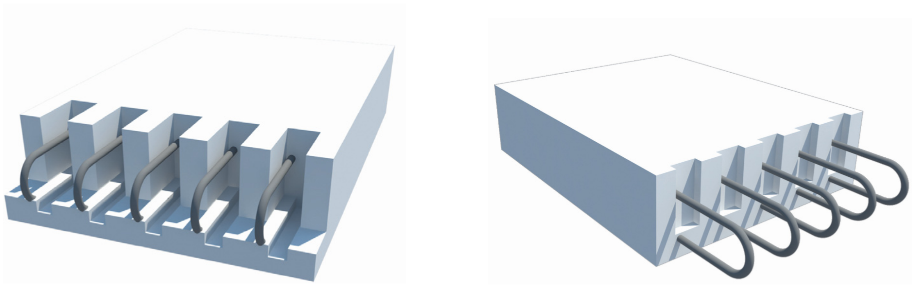

Fig. 2 Connection details of precast deck module with ribbed loop joints

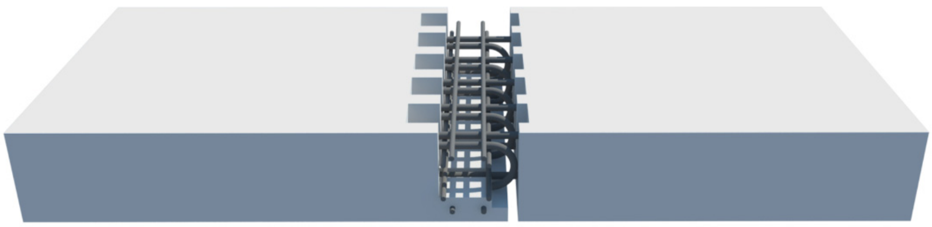

Fig. 3 Proposal of precast deck system with ribbed loop joints

As previously mentioned, continuation method of a precast deck joint using internal tendons is unfavorable in terms of economic efficiency and workability because of the addition of the tendon-related processes. An existing precast deck with loop joints has difficulties in rapid construction because of addition of cast-in-place and curing time of joints. Therefore, a study on connection techniques between precast deck panels to improve economic feasibility and constructability has been conducted. As a result, this study proposes precast bridge deck system with ribbed connections which is more improved in terms of costs and constructability than existing bridge deck joints, and the flexural performance of the proposed section is verified through various parameter tests.

Fig. 2 shows the connection details of two precast deck modules with ribbed section shape using loop reinforcements. The precast deck system satisfies the minimum lap lengths with loop joints according to related specifications and international standards. Furthermore, construction time is reduced by applying an extended bottom concrete section at the joints which eliminates formwork. To enforce the bonding strength between the connection borders in the system, precast deck panels with ribbed section shape are assembled. Since ribbed section increase adhesion area of the joint interface, the flexural strength of the ribbed section is expected to be larger than the general straight section of the precast deck.

Two precast deck modules are connected together by pouring non-shrink mortar of high strength between the two modules, as shown in Fig. 3.

## 3. EXPERIMENTAL STUDY

### *3.1 Overview*

For flexural performance comparison of the proposed ribbed precast deck, specimens are made in accordance with the following various parameters: connection type (general RC deck without joints, loop joint), joint cross-sectional shape (straight, ribbed). The configuration of the specimens is summarized in Table 1.
The design strength of the precast concrete specimen is 40MPa, the yield strength of the deformed bar is 400MPa, and the design strength of the non-shrink mortar which is filled in connection part of precast decks is 60MPa.

RC deck without joints (RC1) is fabricated as standard specimen, and some specimens with precast deck joints are made for comparison.

### *3.2 Flexural test*

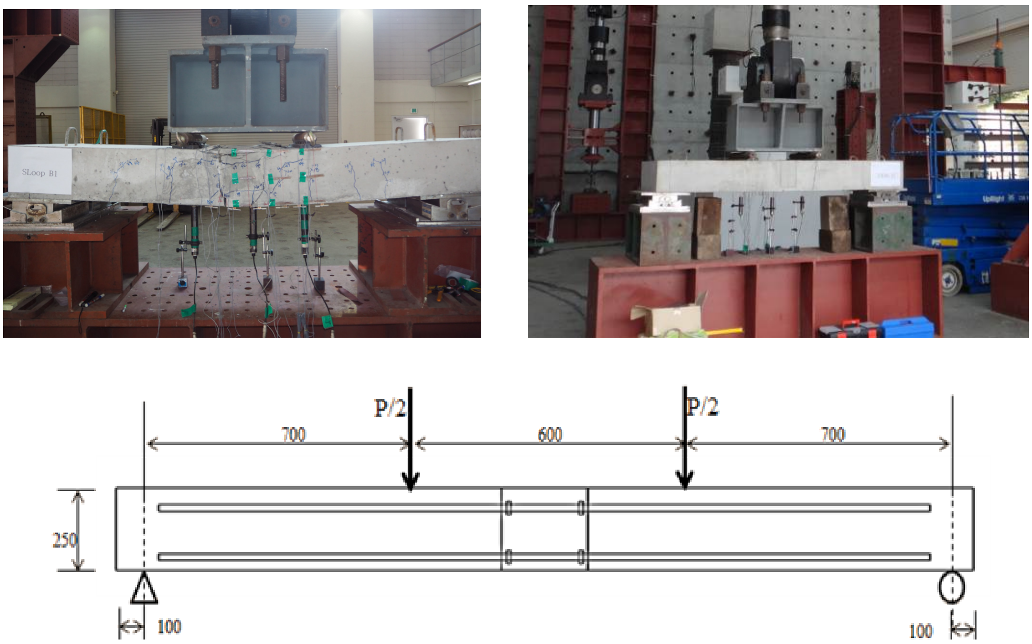


Fig. 4 Schematic of load condition for test (unit:mm)

The dimensions of the specimens are nominally identical with a width of 800mm, thickness of 250mm, and length of 2200mm. The diameter of main reinforcement is H19mm, and the reinforcement spacing is 150mm. Connection details of each specimen are different, but the appearance and specifications are the same. The specimen is simply supported at both ends, and a 500kN load capacity actuator is used to create a four-point loading system to produce pure bending. The loading setup and configuration of the specimens are shown in Fig. 4. As the load is applied at the center of the specimens, the deflection and maximum load are measured.

### *3.3 Test results*

Table 1. Experimental results

| **Specimen** | **Connection type** | **Joint width (mm)** | **Joint section shape** | **Max. load(kN)** | **Fracture mode** |
|---|---|---|---|---|---|
| RC1 | RC Deck without joints | - | - | 470 | ductile |
| LOOP300 | Loop joint | 300 | straight | 400 | |
| SLoop b1, b2 (proposed) | Loop joint | 300 | ribbed | 470 | |

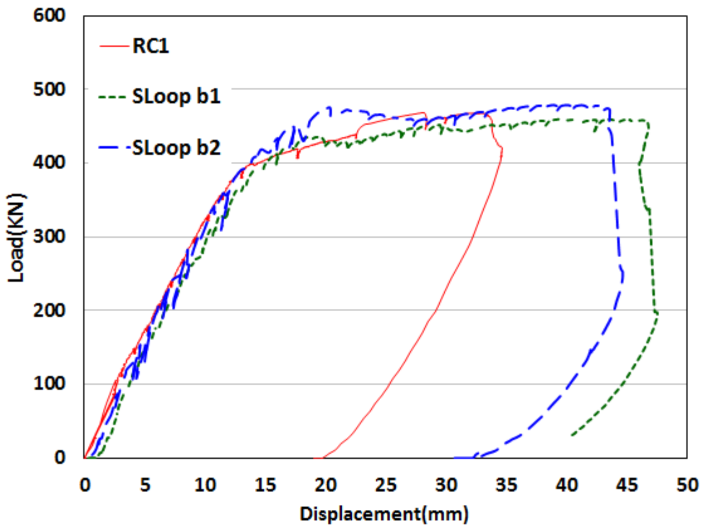


Fig. 5 Load- deflection curve (midpoint of specimen)

The maximum load and fracture patterns of each specimen according to loading is summarized in Table 1. Table 1 shows that the maximum load of the proposed specimen(SLoop b1, b2) with the ribbed-shaped section is larger than the maximum load of the specimen with the straight section (LOOP300). Load-deflection curve at midpoint of specimen for the specimens are shown in Figure 5. Since the flexural strength and ductility of the ribbed-shaped section specimen (SLoop b1, b2) are almost same as the reference specimen (RC1) as shown in Fig. 5.

## 4. CONCLUSIONS

Precast bridge deck system of ribbed-shaped section with loop joints (Sloop b1, b2) without internal longitudinal tendons that can be rapidly constructed by non-shrink mortar is proposed. Flexural performance tests has been carried out to observe extreme behavior such as maximum load and ductility of the proposed specimens, and the behavior of the proposed specimens and standard RC deck without joints is compared. From the test results, the proposed precast deck system show almost the same flexural strength performance and plastic behavior as the standard RC deck without joints.

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