톨러런스기반 플레이트 접합 장치를 사용한 고중량 RC보의 설치 성능

Erection Capability of Heavy Precast Frames with Metal Plates using Wet Concrete for Tolerance

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Abstract

Methods for the manufacture, erection, and assembly of heavy frame modules were proposed. Interferences among precast members were prevented by using bolted metal plates for dry precast beam-to-column joints during assembly with a clearance for tolerance implementing grouted concrete filler plates instead of metal filler plates. Clearances for tolerances were provided to avoid conflictions among components during erection phases. These gaps were, then, grouted by high-strength mortar. The constructability of new connections of a beam-to-column joint using bolted metal plates for precast structures was examined using a full-scale assembly test in which practical observations indicated that members could be aligned and placed accurately in both horizontal and vertical directions, leading to a fast and convenient assembling. Bolt holes of the endplate were properly aligned using couplers with 30 mm fastened length embedded in the columns. The assembly test demonstrated the erection safety and structural stability of the proposed joints that were without filler plates when they were subjected to heavy loads at the time of their erection. The facile and rapid assembly of precast beam-to-column connections with a 30 mm tolerance was observed. The proposed assembly method is rapid, sustainable, and resilient, replacing the conventional methods of concrete frame construction, offering a connection that can be used in constructing infrastructure, such as buildings and pipe-rack frames.

키 워 드 : 건식 조인트, 보-기둥 조인트, 조인트 톨러런스.
Keywords : dry precast joints, clearance for tolerance, beam-to-column joint.

1. Introduction

A joint is an essential item in precast concrete design because it must satisfy the required design criteria, such as strength, ductility, and deformation capacity, making the construction and maintenance processes convenient and fast. Several studies have been performed to develop improved beam-to-columns joints for precast structures by Ma et al.[1] and Nzabonimpa et al.[2]. In this study, an erection and assembly method for precast frames was proposed using a clearance for tolerance as illustrated in Figure 1 to avoid the interference between precast members during assembly.

2. Erection of frames

As shown in Figure 1, a precast column and beam are connected with a 30 mm clearance for tolerance. Figure 1(a) and (b) illustrate the 30 mm clearance for the tolerance grouted with non-shrinking high-strength (70 MPa) concrete. The erection and assembly test demonstrated that most pour forms can be eliminated by grouting the clearance space with non-shrinking high-strength concrete. The volume of grouted concrete per joint was 0.0102 m^3, and the grouting took only 20 minutes per joint. Figure 1(c) illustrates a completed connection that attained its designed concrete strength after its concrete mortar was cured in less than 10 hours. The compressive strength of non-shrinking concrete is twice the compressive strength required at the clearance. Figure 2(a) shows beam end-

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plates were connected to the columns through the coupler holes, allowing for a fully restrained moment connection. Figure 2(b) demonstrates beam endplates were bolted at the top and bottom to provide for compression-tension force couples. The fastened lengths of the connecting bolts are approximately 30 mm, as specified for the couplers manufactured for use with 20 mm diameter bolts.

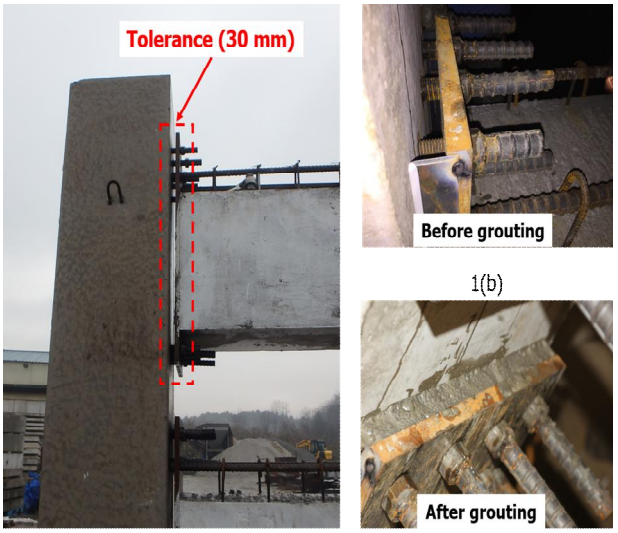

Figure 1. Detail of a clearance for tolerance

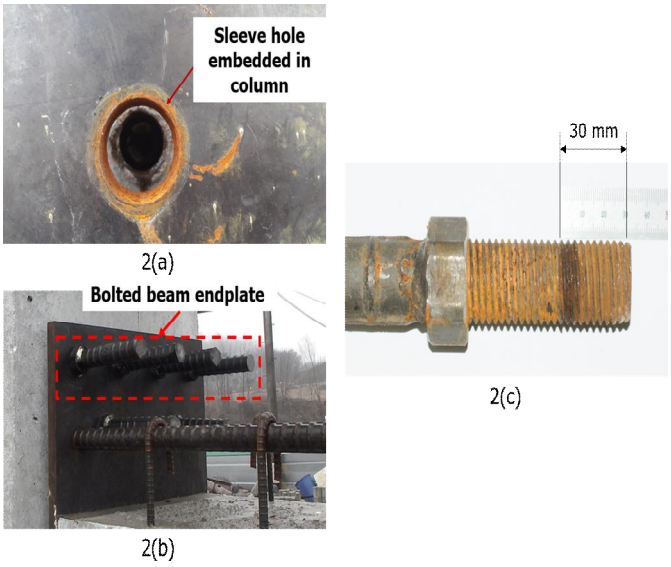

Figure 2. Assembly of beam-to-column connection[3)]

3. Conclusions

The structural safety and constructability of a frame with dry hybrid joints were demonstrated during frame assembly using bolted metal plates. The efficiency of the proposed erection method was demonstrated through a full-scale erection test of the precast frames under heavy loads. A clearance for the tolerance was provided to avoid during assembly interference among the precast members that were grouted with non-shrinking high-strength mortar.

1) Methods for the erection of heavy frames were proposed with a clearance for tolerance using grouted concrete filler plates to avoid the interference among frame members (beams and columns).
2) The proposed assembly method is rapid, sustainable, and resilient and can replace the conventional methods used in concrete frame construction, offering a type of connection that can be used in buildings and pipe-rack frames.

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