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Autor: Machida, Fujio

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Manufacture and Erection of Prestressed Concrete Truss Bridge

Exécution et montage d'un pont à treillis en béton précontraint

Herstellung und Montage einer vorgespannten Spannbeton-Fachwerk-Brücke

FUJIO MACHIDA

Superintendent

Shimonoseki Construction Division, JNR

Shimonoseki-shi, Japan

It is an increasing tendency that P. C. bridge spans will be made longer and longer. The conventional P. C. bridge structure has an economical disadvantage, for it must support itself its heavier weight with the span elongated. Adoption of the truss structure, therefore, has been well considered. Precast-concrete is more desired than concrete usually casted in place.

JNR successfully erected in 1973 the Iwahana Bridge on the New Sanyo Line, the first P. C. truss bridge in Japan (See Photo 1). In building the bridge, precast-concrete members produced in the factory were carefully assembled with adhesive agent on the staging (See Photo 2).

One of the most remarkable features is that truss bridges can be erected safely and without difficulty even over the deep valley or during the rainy season. With the completion of the Iwahana Bridge, JNR started studying on how to use the cantilever erection method in the construction of P. C. truss bridges -- a next step to the staging erection method.

The cantilever erection method brings about the following problems:

1. Members should be firmly fixed, the joint gap between members and their directions should be accurately adjusted, when temporarily overhanged.



Photo 1. The Iwahana Bridge, the first P. C. truss bridge in Japan

2. Mortar of high quality should be developed -- the mortar of high strength at early ages enough to put pre-stress into members at initial stages.

In order to solve these problems, JNR has developed a new assembling method, the so-called "AB-Plate Method." (See Fig. 1)

Used under this method are A-plate and B-plate. Joint gap between members and their directions are adjusted with the A-plate attached directly to the members. The B-plate is a splice plate, fixed through the A-plate.

By this method members can be temporarily assembled prior to the erection of the P. C. truss bridge, as in the case of the steel truss bridge. Once adjusted in position with the A-plate and B-plate, there is hardly required of each member to be re-adjusted.



Photo 2. The Iwahana Bridge, erected on the staging

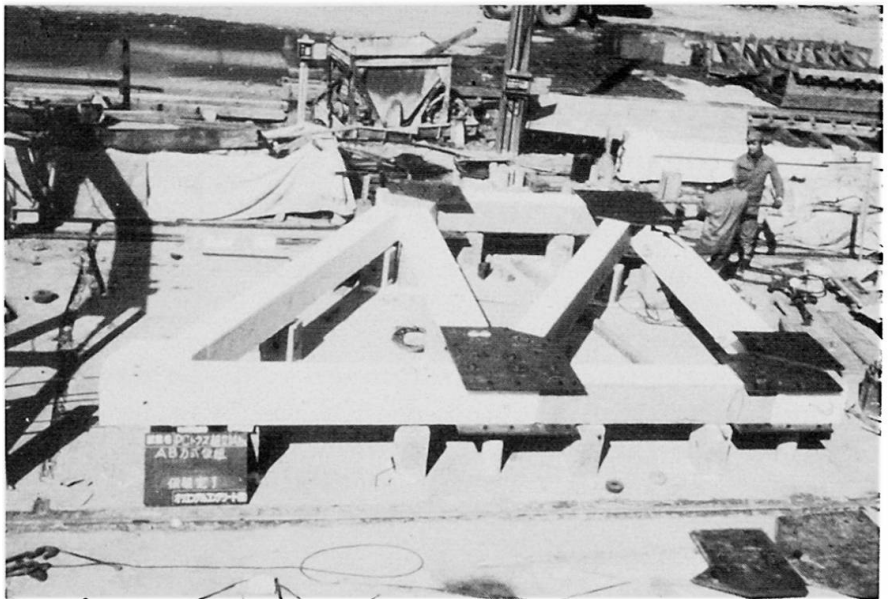
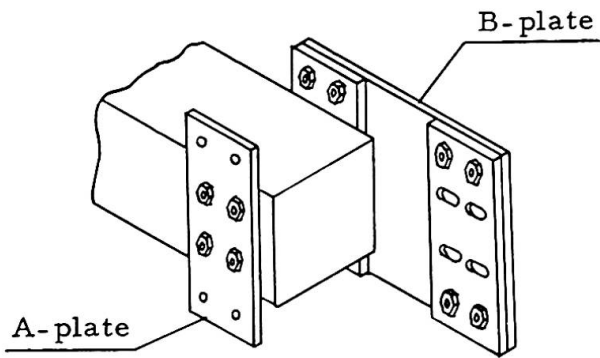
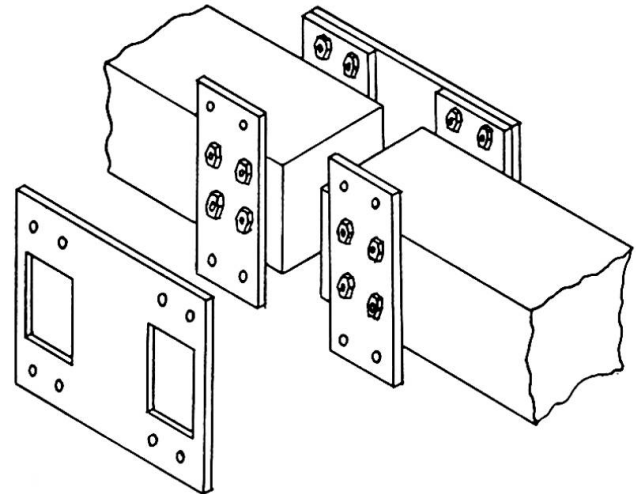


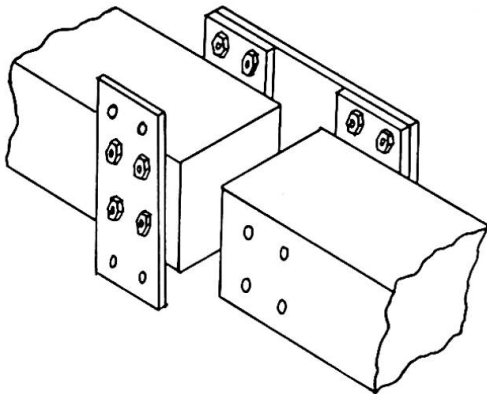
Photo 3. Truss Panel after Temporary Assembly



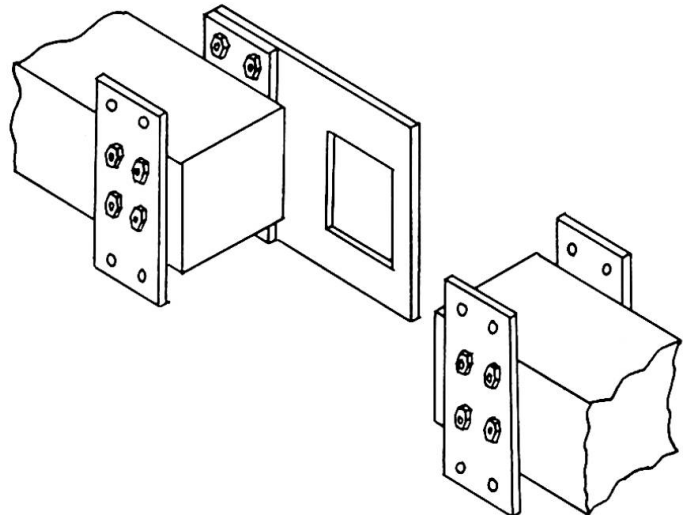
1. The one A-plate and the other A-plate joined to the one side B-plate beforehand are attached to one member.



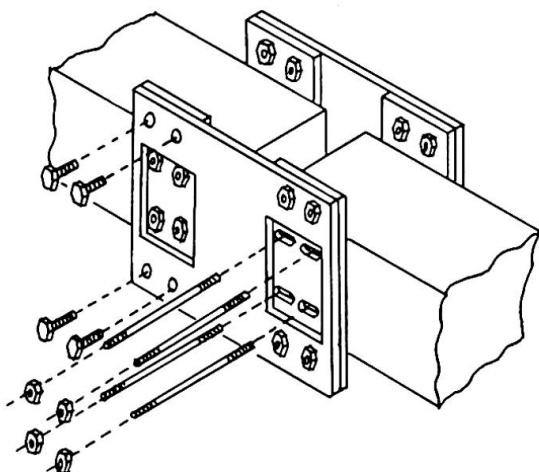
4. After the relative positions of both members are adjusted in this way, the B-plate on one side is detached.



2. The joint gap between two members and directions of them are adjusted.



5. The bolts which join the B-plate to the A-plate are taken off on one side. At this time, all the A-plates and one B-plate should not be detached. All the truss members are taken to pieces in this way, carried to the job site and then set up.



3. The remaining B-plate and A-plate are attached to the other member.

Fig. 1 Temporary Assembly Order of the AB-Plate Method

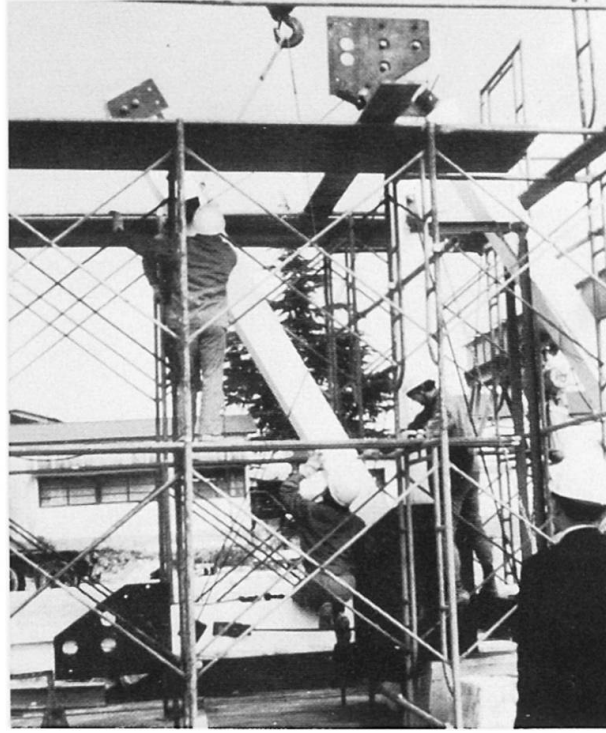


Photo 4. Assembling Test

Tests on assembling error and time were conducted by this method with the Howe type truss, 2.5 meters long and 4.25 meters high (See Photos 3 and 4). The result is as follows:

Assembling Error

This is given as the difference between 1) and 2), as shown in Table 1 -- 8 mm of the upper panel, almost 0 mm of the lower panel, and 8 mm of the truss height.

Assembling Time

This test was repeated twice, the first taking 137 minutes and the second, 105, with the time lost for adjusting the length of wire rope, as shown in Table 2. Experiences of work would reduce the 105 - 137 minutes to 90 - 105, and 30 - 35 minutes to assemble one triangle of panel.

The good results the AB-Plate Method produced both in the assembling error and time will make assured that it is not necessary for all the truss panels to be assembled temporarily in advance, but only 2 or 3 at a time. The position of members displaced during the course of erecting the bridge can also be corrected with ease and whenever necessary.

JNR is making strenuous efforts to improve this method and has a plan for putting it to practical use in the construction of the Yakkan-gawa Bridge on the Nippo Line in Kyushu.

Table 1 Assembling Error

(in mm)

| | U | | L | | H | |
|-----------------------------|----------------|----------|----------------|----------|----------------|----------|
| | Measured Value | Δ | Measured Value | Δ | Measured Value | Δ |
| Designed Length | 2 500 | / | 2 500 | / | 4 250 | / |
| 1) After Temporary Assembly | 2 490 | - 10 | 2 495 | - 5 | 4 252 | 2 |
| 2) After Practical Erection | 2 498 | - 2 | 2 495 | - 5 | 4 260 | 10 |

U : Upper Panel Length

L : Lower Panel Length

H : Height

Δ : Remainder

Table 2 Assembling Time

(in minutes)

| Order | Members to be erected | 1st time | 2nd time | Remarks |
|-------|------------------------|----------|----------|---|
| 1 | Lower chord member | 30 | 30 | Time for setting up the stay is included. |
| 2 | Diagonal member | 55 | 10 | At the 1st time, it took a long time for adjusting the length of the hanging wire rope. At the 2nd time, the lever block was attached to the wire rope, so, it took shorter time. |
| 3 | Lower panel point | 10 | 13 | / |
| 4 | Vertical member | 10 | 11 | / |
| 5 | Upper panel point | 17 | 13 | / |
| 6 | Upper chord member | 15 | 28 | At the 2nd time, the space where the upper chord member should be inserted was too short. As a result it took long time to adjust the joint gap. |
| Total | | 137 | 105 | / |

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SUMMARY

JNR successfully erected the Iwahana Bridge in 1973 by the method of staging, the first through type prestressed concrete truss bridge in Japan. It is more advantageous in many points for a prestressed concrete truss bridge to be erected by the cantilever method with precast concrete members assembled, and the wider use of this method is expected. In order to assemble precast concrete members more efficiently and with less trouble, a new method has been developed - the so-called "AB-plate-method".

RESUME

Les Chemins de Fer Nationaux du Japon ont construit avec succès, en 1973, le pont de Iwahana, premier pont à treillis en béton précontraint au Japon, par la méthode sur échafaudage. Il est plus avantageux en bien des cas de construire un pont à treillis en béton précontraint par la méthode du porte-à-faux avec des éléments de béton préfabriqués; on espère en élargir le champ d'application. Une nouvelle méthode appelée "méthode AB-plate" a été développée pour assembler les éléments de béton préfabriqués plus efficacement et avec moins de problèmes.

ZUSAMMENFASSUNG

Die Japanische Staatsbahn erbaute im Jahre 1973 die Iwahana Brücke, die erste durchlaufende Spannbeton-Fachwerk-Brücke in Japan, mit Hilfe eines Montagegerüsts. Unserer Meinung nach ist der Freivorbau unter Verwendung von vorgefertigten Betonelementen in vielen Fällen vorteilhafter. Aus diesem Grund entwickelten wir eine neue Baumethode, die sogenannte "AB-plate"-Methode, um mit vorgefertigten Betonelementen wirkungsvoller zu bauen.