Nitchu Bridge, Fukushima (Japan)

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Owner: *Ministry of Agriculture, Foresty and Fishery*

Engineer: *Naigai Engineering Co., Ltd.*

Contractor: *Taisei Corporation and Kajima Corporation*

Work Duration: *30 months (16 months for superstructure)*

Service Date: *April 1989*

Nitchu Bridge (previously: Ohezawa-Ichigo Bridge) was erected across the Nitchu Dam Reservoir as compensation work for the dam construction. Nitchu Dam is a rock-fill dam with a height of 101 m and a total storage capacity of 24,600,000 m^3.

Nitchu Bridge is a symmetric type 2-span (101.0 m/span) continuous PC cable-stayed bridge. The structural characteristics are such that the girder/span ratio is small, approximately 1/1000 (when converted to a 3-span continuous type). The bridge length is 204 m and the height of the pylon/bridge pier is 133 m. It is one of the leading PC cable-stayed bridges in Japan, because a unique cantilevering method (SLT Method) was adopted for the erection of the main girder. Regarding the selection of the bridge type, considerations were given to the topography, geology, river conditions, ease of maintenance etc., in addition to normal conditions such as economy, workability and safety. As a result, a 2-span continuous PC cable-stayed bridge was finally selected, since it represents a combination of outstanding structural characteristics and aesthetic appearance.

The main girder of the bridge is rigid at the center position ot the bridge pier, and movable at abutment positions situated at both ends. There is a 0.5% downgrade from the center pier toward the abutments. The layout of the stay cables is of a semi-harpsicord type with multiple parallel cables on two sides. A spread type foundation on the bedrock was adopted for both piers and abutment foundations.

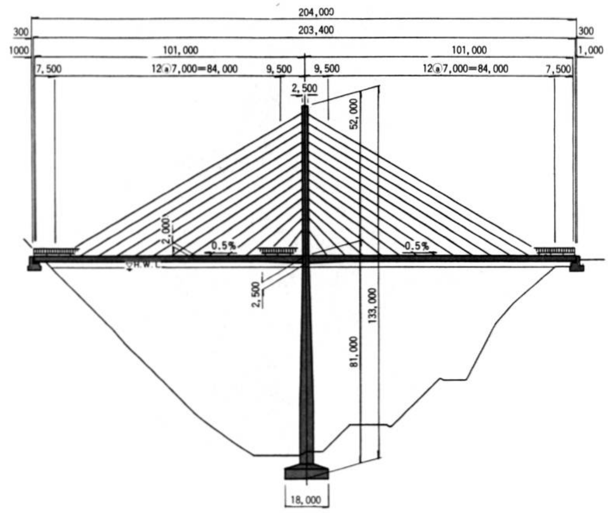

Fig. 1 Elevation of the bridge

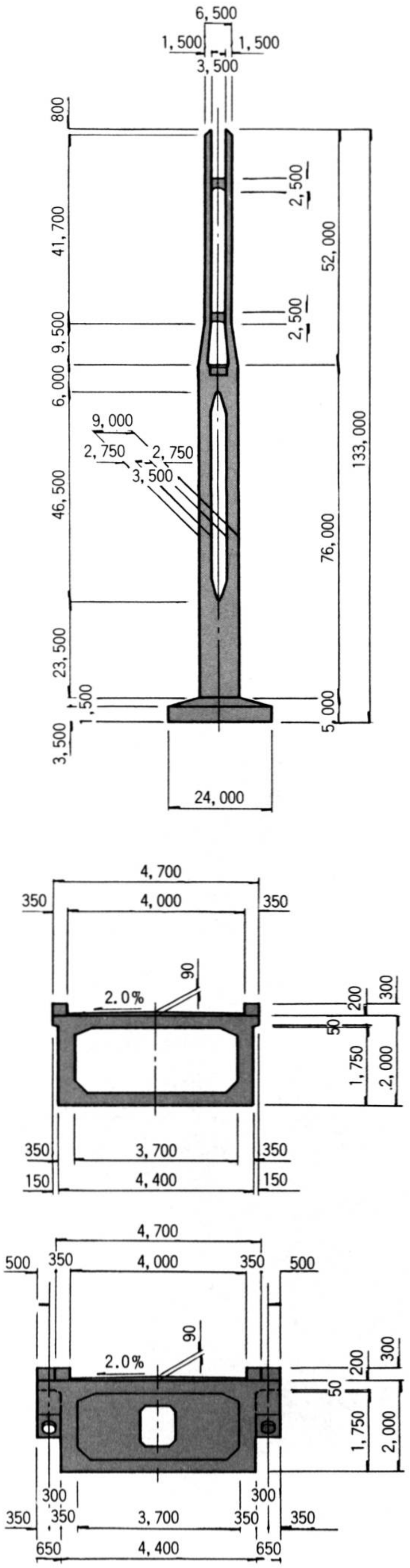

Fig. 2 Pylon/bridge pier and cross-sections of the main girder

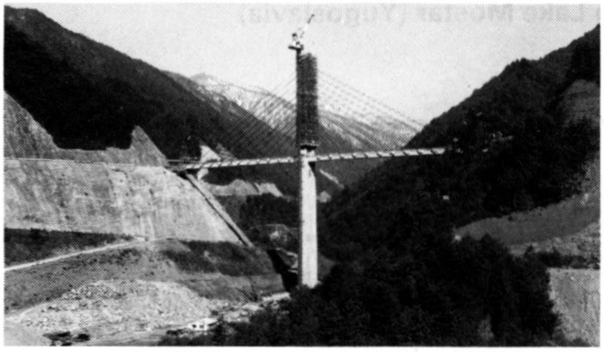

Fig. 3 General view of the bridge during construction

At the positions where the stay cables are anchored, cross-beams are located in the main girder and edge supports are provided on the outside of the single-cell box girder. For the 2-column pylon, which is a rigid structure on the bridge pier, struts (cross-beams) were installed between the columns at two locations to increase its rigidity. The stay cables were alternately anchored to the pylon in eccentric position, stage by stage, both upward and downward, for the purpose of offsetting "the torsional moment caused by the offcentering of the anchoring positions of the stay cables from the center of the pylon".

For the stay cables needed, the VSL stay cable system was adopted as it is superior both in fatigue characteristics and workability. The stay cables consist of 7 to 11 strands Ø 15 mm (0,6") and are placed in a black colored polyethylene tube (PE) which is injected with cement grout after stressing for the purpose of corrosion protection.

The anchoring parts of the stay cables are designed to enable re-tensioning and cable replacement. The fabrication of the stay cables was carried out in a factory.

The SLT (Suspended Long Traveller) Method allows structural concrete to be poured, while temporarily supporting the tips of the support girders with stay cables. This is a method which skilfully makes the most of the structural characterstics of cable-stayed bridges, making it possible to reduce construction time and PC-steel materials. By adopting this particular method, one 7.0 m long block could be constructed at a time, reducing the duration of cantilever work by approximately ⅔ as compared to conventional methods.

The construction management carried out simulations for each step of cantilever installation. The resulting analysis allowed standard values for construction management to be calculated. Further analysis was conducted to calculate response values for other factors that influence construction and these were examined for the correctional quantities given below:

- Influence of load variation (by weight, tensile force of stay cables, etc.) while under construction
- Influence of rigidity
- Influence of temperature variation
- Influence of creep and drying shrinkage, while under construction.

Correction quantities were determined by examining the variation of the tensile force in the stay cables at each stage of construction, based on the response analysis, as mentioned above. Consideration was given not only to construction situations, but also to stress and flexibility conditions after erection has been completed. Information and processing was carried out by microcomputers installed at the construction site.

(M. Sadamitsu)

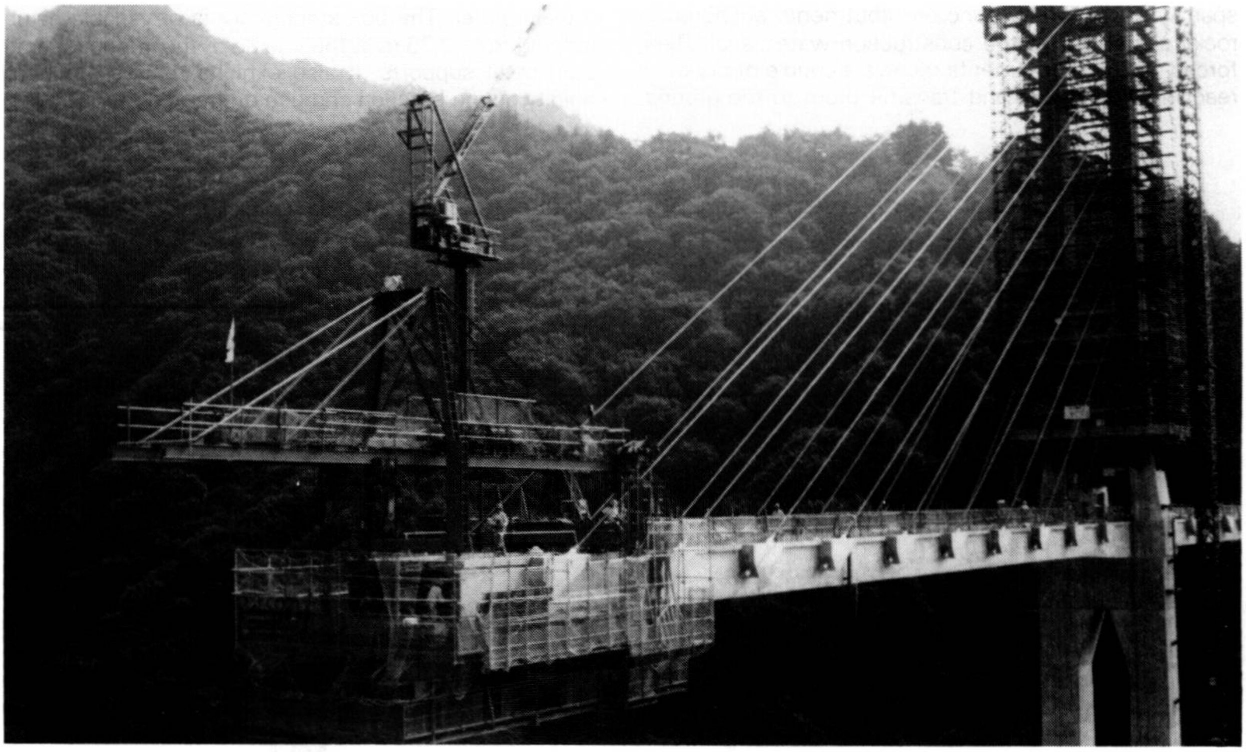

Fig. 4 View of the Suspended Long Traveller (SLT)