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5. Ohnaruto Bridge

Owner:	*Honshu-Shikoku Bridge Authority*
Engineer:	*Honshu-Shikoku Bridge Authority*
Contractor:	*Honshu-Shikoku Bridge Authority*
Dimensions:	
cable span:	*93 m + 330 m + 876 m + 330 m*
clearance:	*41 m above sea level*
tower height:	*144 m above sea level*
cable diameter:	*84 cm*
width of stiffening truss:	*34 m*
Quantities of materials:	
anchorage (1A):	*96000 m^3 concrete*
anchorage (5A):	*120000 m^3 concrete*
tower:	*4200 ton steel (per 1 pier)*
cable:	*12000 ton steel*
truss:	*31000 ton steel (in completion of highway)* *36000 ton steel (in completion of railway)*
Construction Period:	*9 years*
Service date:	*1985*

Introduction

The Ohnaruto Bridge is the one of the bridges in the Honshu-Shikoku Bridge Project whose objective is to construct three different routes, connecting the main Japanese island of Honshu and the island of Shikoku.

The Ohnaruto Bridge across the 1.3 km Naruto Strait between Shikoku and Awajishima Island is a long-span suspension bridge extending a total of 1629 m. The type of the Ohnaruto Bridge is a 3-span 2-hinged stiffening truss suspension bridge. The span also includes space reserved for installation of the Shinkansen railroad track bed.

Since the Ohnaruto Bridge is located in the Seto Inland Sea National Park, much consideration was given to maintaining harmony with the natural environment in terms of foundation arrangement, bridge shape and color.

Construction work on the bridge project commenced in July, 1976 and was finished in June, 1985.

Wind Resistant Design

The basic wind speed (50 m/sec) which is a recurrent expectation over 150 years in terms of a mean speed during 10 minutes at 10 meters above the surface of the earth or the sea was determined statistically on the basis of available meteorological data at the bridge site. Wind speed varies vertically and horizontally, so the design wind speed is derived from basic wind speed with consideration of elevation of bridge members and length of the bridge. For example, the design wind speed for the stiffening truss is 73 m/sec.

Structural dimensions of the stiffening truss are determined after they are confirmed to guarantee the aerodynamic stability against the design wind speed by the means of a wind tunnel test.

View of the Ohnaruto Bridge

Earthquake Resistant Design

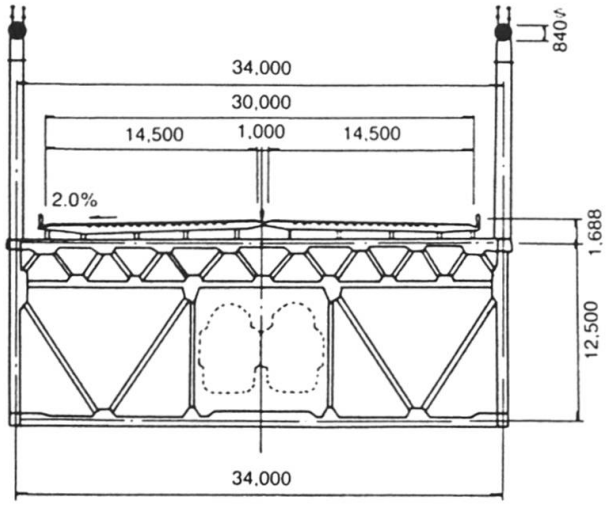
The earthquake to be considered in designing the bridge is as high as 8 in magnitude which is expected statistically to occur once or twice in 100 years off the Pacific coast at a distance of 150 km from the site.

The earthquake-resistant design criteria for this project require the modified seismic coefficient method or the dynamic analysis by the response spectra to check the stress or the deformation of a foundation assuming that the horizontal acceleration on the bearing bedrock is 180 gal (0,18 g).

Fatigue Design

Main members of the Ohnaruto Bridge are made of high-tensile strength steel in order to reduce dead load. Consequently, fatigue design is one of important problems.

Thus, the Authority has carried out large scale fatigue tests to refine fatigue design. Through these studies new S-N curves were proposed for various joints of high-tensile strength steel.



Stiffening Truss Cross-section

Substructure

The anchorage is a gravitational foundation sustaining a horizontal force of about 2500 ton.f through the cable anchor frames buried in the concrete. The anchorages were placed on the bedrock after reclaiming the shore line and excavating reclaimed land to the bedrock.

For the tower piers, the multi-columns foundation system was applied. After the hole of the column was drilled by a drilling machine of 4.4 m diameter, steel casing of 7 or 4 m diameter was installed in each hole. The inside of the casings was dried up and filled with concrete.

Superstructure

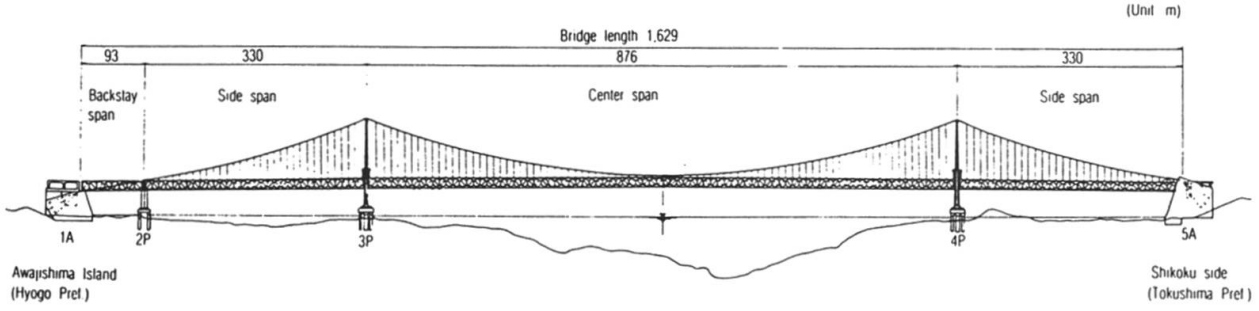
The main tower was divided into 13 blocks in the vertical direction and each of blocks has a weight of 20–90 tons. The blocks were lifted up and fabricated by a creeper-crane which had lifting capacity of 90 tons and was installed at the side of the tower.

For cable installation the prefabricated parallel wire strand method (PS method) was employed. One cable consists of 154 strands, each of which consists of 127 parallel galvanized steel wires of 5.37 mm in diameter. In the PS method, the strand of about 1720 meters in length is to be carried repeatedly from one anchorage (5A) to the other one (1A) on the cat's walk.

For stiffening truss installation the planeblock erection method was used, in which pairs of the truss side panels were fabricated as a unit. These members are transported longitudinally from the tower to the center span or the side span by traveller cranes, which are installed on the erected truss. Then they are connected to the suspenders. The connection of the truss blocks is to be done rigidly by bolting without any hinges during the erection.

After the erection of the stiffening truss, the steel roadbed was paved. The bridge was then complete.

(M. Ohashi)



Profile of Ohnaruto Bridge