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6. Meiko-Nishi Bridge, Nagoya

Owner: *Nihon Doro Kodan, Tokyo*

Engineer: *Nihon Doro Kodan*

Contractor: *Ishikawa-Harima Heavy Ind. Co. Ltd.*
Nippon Kokan K.K.
Takigami Steel Construction Co. Ltd.
Nippon Sharyo Ltd.

Dimension:
bridge length: *758 m*
bridge width: *12.5 m*
maximum grade: *3.0%*

Quantities of materials:
tower
height: *122 m*
steel weight: *2956 t*
box girder
depth: *2.8 m*
steel weight: *5577 t*
main cable
strand formation: *5 mm × 163∼379*
total cable length: *13562 m*
steel weight: *518 t*
total steel weight of superstructure: *10023 t*
total concrete volume of superstructure: *48779 m*^{3}
total reinforcing steel weight: *4520 t*

Construction Period: *4 years*

Service date: *1985*

Introduction

The Meiko-Nishi Bridge is the first of three newly projected bridges which are to form a connecting link over the Nagoya Port. The bridges will become a part of the national highway Route 302 (Nagoya Loop-2) and the Ise Bay Highway. This bridge is designed to carry an initial configuration of two traffic lanes. In future, a second bridge will be constructed in parallel with it.

This bridge is a steel cable-stayed bridge with three spans of (175 + 405 + 175 m). The box-girder type with an orthotropic deck is a trapezoidal 3-cell box-section of depth of 2.8 m. Towers are A-frames fixed to piers. The longitudinal cable configuration is the fan type of twelve stay cables.

Meiko-Nishi Bridge, Nagoya

View of the bridge

Design

The superstructure has two distinctive features. One is a simplified cable anchorage to the box girder. The cables are anchored to the steel pipes passing through the outside webs of the box girder which has four webs (two inside and two outside). The stress distribution at the cable anchorage was confirmed by a sectional model test and finite element analysis.

The other is an elastic stopper system using cables (named the Meiko Cable Damper System) connecting the tower and the girder. The purpose of the system is to reduce the longitudinal thermal and seismic forces imposed on the towers from the girder, and to function as stopper for the girder against the seismic force.

For wind and earthquake effects the bridge was designed by the following method. Static wind design forces were based on a wind speed of 55 m/sec for the girder, and 60 m/sec for cables and towers. For aerodynamic consideration, a wind tunnel test was conducted to decise the most stable cross-section of the box girder.

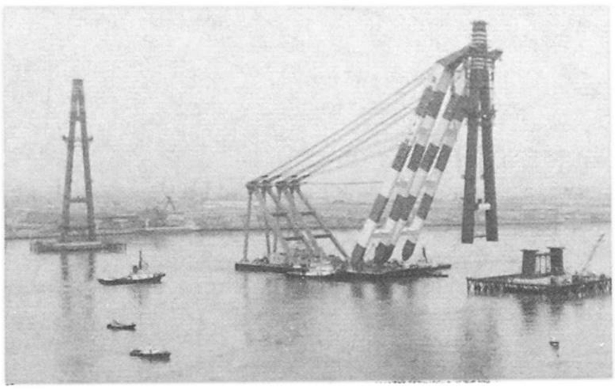
Seismic inertia forces are calculated as the product of the weight of the structure and the seismic coefficient. The maximum design seismic coefficient for this bridge was 0.3. The dimensions of the girder and the towers were also confirmed by dynamic analysis, using some seismic waves with a maximum acceleration of 150 gal.

Erection

Erection of the 122 m-high towers, each of which weighs 1460 ton, was accomplished in three stages. First, a pair of 3.5 m leg sections were carried to the piers, and were then bolted in place. The second blocks of height of 9.9 m were erected by the same procedure. Finally, A-frame towers, of height 108.6 m and weight 1350 ton, were hoisted into place by a 3000-ton floating crane.

For the side spans of girder, eight pre-assembled large blocks, with a weight of about 550 ton, were lifted on to the temporary piers and the cross beams of the towers by an 800-ton floating crane. For the center span twenty-five small blocks were erected using the cantilever erection method employing derrick cranes.

The aerodynamic stability during erection was considered in two stages, i.e. for free-standing of the towers and cantilever erection of the girder. For the towers, a damping device, which consisted of a 3-ton counterweight with a viscously damped spring, called a Tuned Mass Damper, was set on the top of the towers. For the girder, the stability was confirmed by 3-dimensional computer simulation analysis, for which the aerodynamic characteristics of the cross section evaluated by wind tunnel test were used. *(H. Kawahito)*



Erection of a tower