Field Observation on Aerodynamic Response of Meiko West Bridge

Yuji SUZUKI
Japan Highway Public Corp.
Nagoya, Japan

Kazuyuki MIZUGUCHI
Japan Highway Public Corp.
Nagoya, Japan

Toshio UEDA
Hitachi Zosen Corp.
Osaka, Japan

Satoru SAKUMA
Japan Highway Public Corp.
Nagoya, Japan

Toshiaki MAEKAWA
Japan Highway Public Corp.
Nagoya, Japan

Yoshikazu KOBAYASHI
Hitachi Zosen Corp.
Osaka, Japan

Abstract

The Meiko West Bridge is composed of two cable-stayed bridges with flat box girders. The interval between parallel cable-stayed bridges is 50m as shown in Fig.1. The phase I line bridge completed in 1985 has been put in service, and the phase II line bridge was finished in 1998. Now both bridges become a part of the Ise-Bay Highway that will link the New Tomei and Meishin Expressways.

The aerodynamic stability of these bridges in tandem arrangement was investigated by the wind tunnel tests using the 3-dimensional aeroelastic models with the scale of 1/100 in Hitachi Zosen's wind tunnel facility. From the results, it is concluded that the vortex-induced oscillation occurs in a smooth flow, but it vanishes in a turbulent flow. In order to certify those phenomena, the field observation was carried out from the early erection stage to the final erection stage at which the both side girders were connected at the center of the main span.

The characteristics of the wind on the site were measured by the ultrasonic anemometer and the girder responses were picked up by the servo-type accelerometer.

Many precious data including monsoon in winter and three times typhoons in 1997 were recorded by the automatic measuring systems.

The wind direction was predominantly northwest on the land side and southeast on the seaside, and so it inclined diagonally to the axis of the bridge girder respectively.

The response data are similar to the one derived from the wind tunnel tests in a boundary layer turbulent flow with 10% or 15% intensity of turbulence, and so it is estimated that the aerodynamic safety of these bridges is enough.

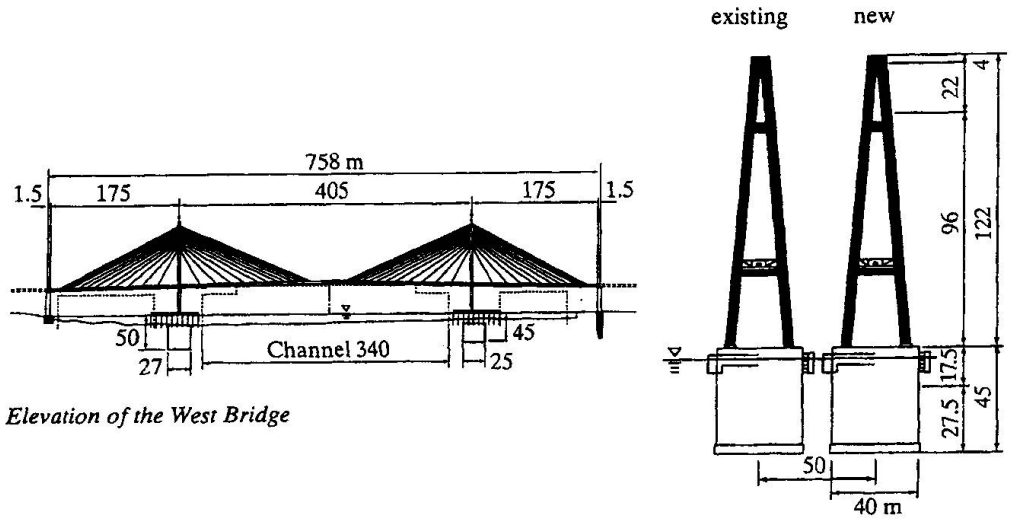
It is well known that the rain-wind-induced vibration was discovered under construction of the phase I line bridge of the Meiko West Bridge in Japan. By this time all stay cables of this bridge have been connected mutually by the wire ropes. Therefore it will be necessary for any controlling device to be installed if the same phenomenon occurs on the phase II line bridge. To obtain the materials for the design judgement, the field observation of the stay-cable's motion was carried out simultaneously.

Ten times rain-wind-induced vibration's data and many vortex-induced oscillation's data were obtained.

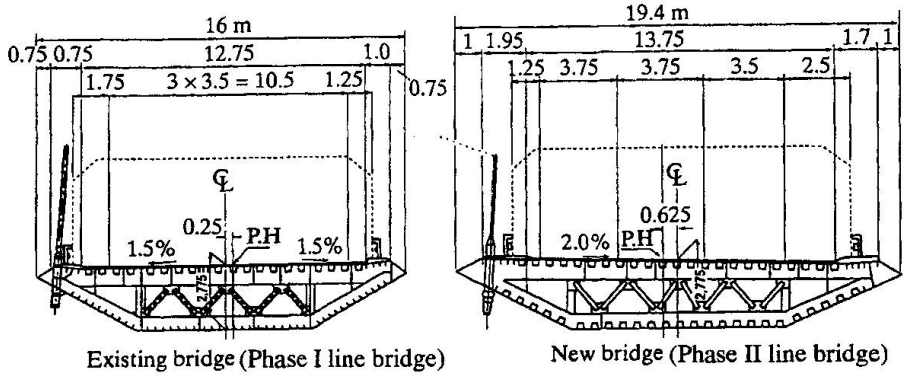
The hard rubbers for suppression of bending at the end of cables and the rubber covers for sealing the cable-anchorage pipes are set on the phase I line bridge's stay-cable

after completed , but there is no such attachments on the phase II line bridges cables under construction. Therefore, the aspect of the rain-wind-induced oscillations of two bridges are different each other. That is, the oscillation in the phase I line bridge's cables is composed of many vibration modes, i.e. from 1st to 20th mode, and on the other hand the oscillation of the phase II line bridge's cables includes only a few low-frequency modes.

The maximum total value derived from the addition of each mode's displacement is about 30cm on the phase I line bridge and about 10cm on the phase II line bridge, respectively. Those results show that there is no problem in the fatigue strength of the stay-cables. But, from the view point of serviciability, the controlling devices with high viscous damping rubbers were installed on both bridges taking the aesthetic design into consideration.



Elevation of the West Bridge



Cross section of the girders for the West Bridge

Fig.1 Outline of Meiko West Bridge