Super long-span bridge with 2-box and 1-box combined girder

Autor(en): **Ogawa, Kazushi / Shimodoi, Hideki / Nogami, Chiaki**

Objekttyp: **Article**

Zeitschrift: **IABSE reports = Rapports AIPC = IVBH Berichte**

Band (Jahr): **79 (1998)**

PDF erstellt am: **27.06.2024**

Persistenter Link: https://doi.org/10.5169/seals-59931

Super Long-Span Bridge with 2-Box and 1-Box Combined Girder

Kazushi OGAWA
Senior Mgr, Bridge Eng. Dept
Kawasaki Heavy Ind. Ltd
Akashi, Hyogo, Japan

Hideki SHIMODOI
Mgr, Bridge Eng. Dept
Kawasaki Heavy Ind. Ltd
Akashi, Hyogo, Japan

Chiaki NOGAMI
Eng., Bridge Eng. Dept
Kawasaki Heavy Ind. Ltd
Akashi, Hyogo, Japan

Summary

In the super-long span suspension bridge, it becomes serious how to make the bridge aerodynamically stable in economical ways. This paper investigates application of the 2-box and 1-box combined girder to the super-long span suspension bridge, in which the 1-box girder is used at the tower part and the 2-box girder at the other part. The 2-box girder opened between boxes improves aerodynamic stability and the 1-box girder prevents the deck width from increasing the space of pylon. In the study the newly developed suspension bridge with the 2-box and 1-box combined girder shows better aerodynamic characteristics on flutter than the usual suspension bridge with the 1-box girder.

1. Description of super-long span bridge with 2-box／1-box combined girder

A conceptual view of the newly developed suspension bridge having a main span of 2,500m is shown in Fig.1. Areas of the 1-box girder and the 2-box girder are indicated in Fig.2. Cross sections of 1-box girder and 2-box girder are shown in Fig.3. The space between cables is 7m, adjusted to the open width of the 2-box girder. Hangers suspend the 1-box girder obliquely and the 2-box girder vertically. The total mass of the girder and cables in the 2-box/1-box combined girder is 37.9t/m, which is only 1.1 times heavier than that in the 1-box girder. According to the dynamic analyses of the super-long span bridge with the three dimensional finite element method, the 17th mode corresponds to the 1st torsional vibration, in which torsional displacement prevails. The 1st torsional frequency is 0.155Hz.

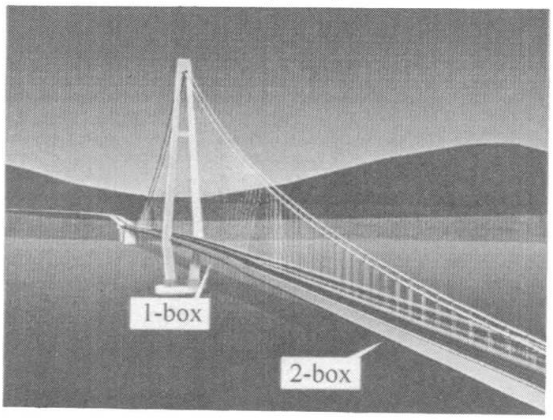

Fig. 1 Image of super-long span bridge

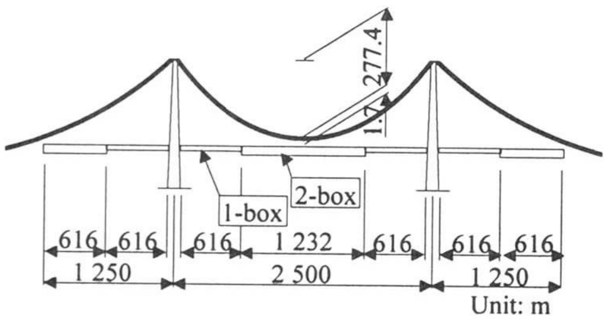

Fig. 2 Areas of 2-box girder and 1-box girder

2. Aerodynamic characteristics of super-long span bridges

Distortion of the super-long span suspension bridge in wind was analyzed with the large deformation finite element method. Fig.4 shows torsional displacement of the girder at the center of the main span due to wind forces. In the original 2-box and 1-box combined girder, unbearable large torsional displacement is induced in the high wind velocity of over 70m/s. Using the modified section in the 2-box girder to abbreviate pitching moment of the steady aerodynamic force on the girder, torsional displacement can be decreased less than that of the suspension bridge with the 1-box girder only.

The flutter phenomena on the bridge were analyzed with the multi-mode flutter analyses, considering the first 30 modes. The aerodynamic forces on the girder were induced from the wind tunnel test with the two dimensional deck model. Fig.5 shows results of flutter analyses on the super-long span suspension bridge at the wind attack angle of 0°. The flutter velocity in the 2-box/1-box combined girder, 67m/s, is higher than that in the 1-box girder, 50m/s. Applying the modified section to the 2-box girder, it can be improved to 80m/s. If torsional displacement of the girder due to wind is considered in the flutter analyses, the flutter velocity can be estimated at 90m/s. Thus combination of the 2-box girder and 1-box girder can improve flutter stability of the super-long span suspension bridge notably.

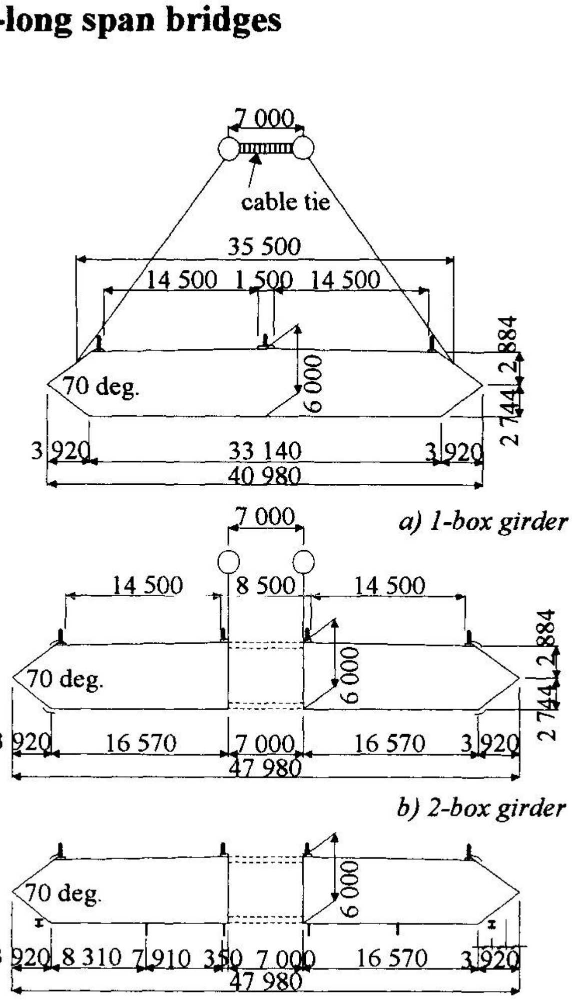

Fig. 3 Stiffening girder section

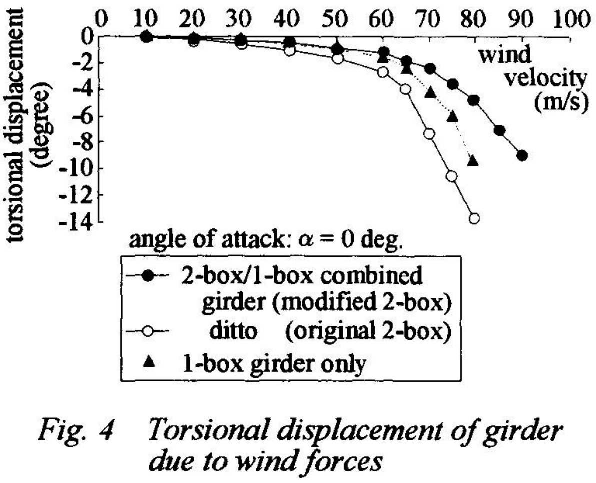

Fig. 4 Torsional displacement of girder due to wind forces

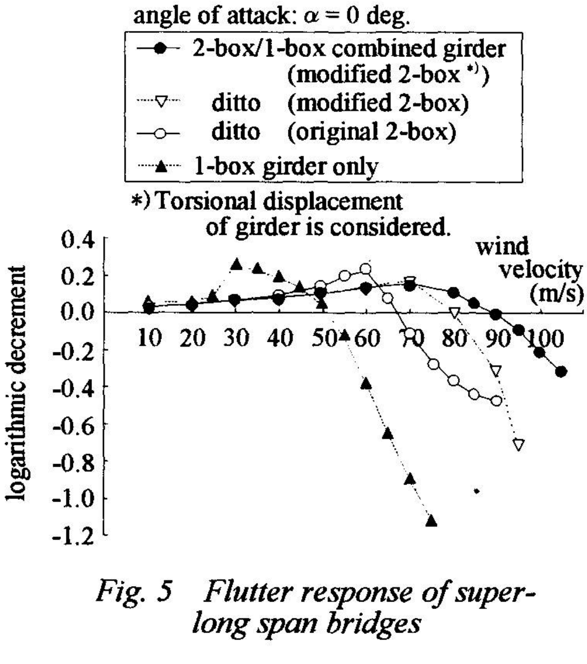

Fig. 5 Flutter response of super-long span bridges